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"Food and Health" journal will publish peer-reviewed (double blind) articles covering all aspects of **food science and their health effect** in the form of original research articles (full papers and short communications), and review articles. Their team of experts provides editorial excellence, fast publication processes and high visibility for your paper.

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Manuscripts submitted to "**Food and Health**" journal will go through a double-blind peer-review process. Each submission will be reviewed by at least two external, independent peer reviewers who are experts in their fields in order to ensure an unbiased evaluation process. The editorial board will invite an external and independent editor to manage the evaluation processes of manuscripts submitted by editors or by the editorial board members of the journal. Our journal will be published quarterly in English or Turkish language.

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Editor in Chief: Prof. Nuray ERKAN
Address: Istanbul University, Faculty of Aquatic Sciences, Department of Food Safety, Ordu Cad. No: 8, 34134 Fatih/Istanbul, Türkiye
E-mail: nurerkan@istanbul.edu.tr

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Vol. 8 Issue 1 Page 1-91 (2022)

Content

RESEARCH ARTICLES

REVIEW ARTICLES

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COVID-19 pandemisinin gıda güvenliği konusunda tüketici tutum ve davranışlarında yaptığı değişikliklerin belirlenmesi: Bitlis Eren Üniversitesi örneği

Akif DÜNDAR[1], **Mustafa Şamil ARGUN**[2]

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[1] Bitlis Eren Üniversitesi Lisansüstü Eğitim Enstitüsü, Gıda Güvenliği Anabilim Dalı, Bitlis, Türkiye

[2] Selçuk Üniversitesi, Akşehir Mühendislik ve Mimarlık Fakültesi, Gıda Mühendisliği Bölümü, Akşehir, Konya, Türkiye

ORCID IDs of the authors:
A.D. 0000-0002-7622-1729
M.Ş.A. 0000-0001-8209-3164

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Correspondence:
Mustafa Şamil ARGUN
E-mail: msargun@selcuk.edu.tr

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ÖZ

COVID-19 pandemisi her alanı etkilediği gibi gıda güvenliği ile ilgili tüketici tutum ve davranışlarını da etkilemiştir. Bu çalışma, COVID-19 pandemisinin Bitlis Eren Üniversitesi akademik ve idari personellerinin gıda güvenliği konusunda kişisel yargılarında, tutum ve davranışlarında yaptığı değişikliklerin belirlenmesi amacıyla planlanmış olup tarama modelinde kesitsel bir araştırmadır. Çalışmada veri toplama aracı olarak çevrimiçi anket yöntemi kullanılmıştır. Çalışma sonucunda katılımcıların çoğunluğu COVID-19'un gıdalarla bulaşmadığını, market ve pazar gibi dışarıdan satın alınan ürünleri en az sekiz saat bekletmekle bulaşmanın engellendiğini düşünmektedir. Katılımcılarda (% 66.1) kişisel bakım ve hijyene ayrılan zamanın COVID-19 pandemisi ile beraber artış gösterdiği görülmüştür. COVID-19 pandemisi ile katılımcıların gıda güvenliğine, tarıma, kişisel hijyen ve sanitasyona verdikleri önemin arttığı bulunmuştur. Katılımcıların çoğunluğu COVID-19 pandemisi ile insanlarda gıdasız kalma korkusu oluştuğunu, gıda işletmelerinde hijyen ve sanitasyon kurallarının öneminin arttığını bildirmiştir. COVID-19 pandemisinde tarım, gıda güvenliği ile hijyen ve sanitasyon kavramlarının değer kazandığı sonucu ortaya çıkmıştır.

Anahtar Kelimeler: COVID-19, Pandemi, Gıda güvenliği, Tüketici, Tutum ve davranış

ABSTRACT

Determination of changes in consumer attitudes and behaviors on food safety caused by the COVID-19 pandemic: Bitlis Eren University example

The COVID-19 pandemic has affected every field as well as the consumer attitudes and behaviors regarding food safety. This study is a cross-sectional study in a screening model planned to determine the changes that the COVID-19 pandemic has made in the personal judgments, attitudes and behaviors of Bitlis Eren University academic and administrative staff on food safety. In the study, online survey method was used as a data collection tool. As a result of the study, the majority of the participants think that COVID-19 is not transmitted through food and that contamination is prevented by keeping the purchased products from outside such as markets and bazaar for at least eight hours. In the participants (66.1 %), it was observed that the time allocated to personal care and hygiene increased with the COVID-19 pandemic. It was found that the importance given by the participants to food safety, agriculture, personal hygiene and sanitation has increased with the COVID-19 pandemic. The majority of the participants reported that with the COVID-19 pandemic, people fear of going without food and the importance of hygiene and sanitation rules in food businesses has increased. It has emerged that the concepts of agriculture, food safety, hygiene and sanitation gained value in the COVID-19 pandemic.

Keywords: COVID-19, Pandemic, Food safety, Consumer, Attitude and behavior

Giriş

Çin'in Hubei eyaleti Wuhan şehrinde 2019 yılının Aralık ayında ortaya çıkan yeni tip korona virüsün (SARS-CoV-2) yol açtığı pnömoni Dünya Sağlık Örgütü (DSÖ) tarafından 11 Şubat 2020'de COVID-19 (Coronavirus Diesase 2019) olarak adlandırılmıştır (Akpinar, 2020). Salgına sebep olan COVID-19'un, hâlihazırda yeni bir hastalık olmasından dolayı, doğrudan bulaşma yolu ile ilgili kesin veriler mevcutsa da dolaylı bulaşma yolları hususunda bilgiler netlik kazanmamıştır (Sağdıç ve diğ., 2020). Korona virüsler (CoV), soğuk algınlığından Orta Doğu Solunum Sendromu (MERS-CoV) ve Şiddetli Akut Solunum Sendromu (SARS-CoV) gibi daha şiddetli hastalıklara kadar değişen hastalıklara neden olan geniş bir virüs ailesidir. Yeni korona virüs (nCoV), daha önce insanlarda tanımlanmamış yeni bir türdür (WHO, 2020). Korona virüsler; sığır ve domuzlarda enteritten ve tavuklarda üst solunum yolu hastalıklarından, ileri derecede ölümcül insan solunum yolu enfeksiyonlarına kadar uzanan, çok çeşitli insan ve hayvan hastalıklarına sebep olabilmektedir (Sofi ve diğ., 2020). Küresel olarak COVID-19 hastalıkları ve ölümlerindeki hızlı artış, salgın hastalığın bulaşma yolları hakkında sorulara sebep olmaktadır. En yaygın bulaşma şeklinin solunum yoluyla olduğu, daha sonra enfekte insanlarla veya kontamine yüzeylerle doğrudan temas geldiği, üçüncü olarak da havadaki küçük damlacıkların solunması olabileceği düşünülmektedir (Morawska ve diğ., 2020). SARS-CoV-2 ile enfekte bir hastanın, virüsü konuşurken, öksürürken ve hapşırırken oluşturduğu solunum damlacıkları yoluyla yaydığı ifade edilmektedir. Genel olarak, COVID-19'un iki iletim şekli olduğu ve bunların doğrudan ve dolaylı olmak üzere ikiye ayrıldığı belirtilmektedir. Doğrudan bulaşma yollarının üçe ayrıldığı ve birincisinin, cerrahi ve dişçilik işlemleri ve / veya solunumda damlacık şeklinde oluşturulan aerosoller yoluyla; ikincisinin, dışkı, tükürük, idrar, meni ve gözyaşları gibi vücut sıvıları ve salgıları vasıtasıyla; üçüncüsünün ise anneden çocuğa bulaşma yolu ile olduğu düşünülmektedir. Dolaylı bulaşma yollarının ise, (1) enfekte bir hastanın yakın çevresinde bulunan fomitler veya yüzeyler ile olduğu ya da (2) enfekte kişi üzerinde kullanılan nesneler aracılığıyla gerçekleşebileceği tahmin edilmektedir (Karia ve diğ., 2020). COVID-19'un dışkı yoluyla bulaşma olasılığının olması, özellikle sağlık hizmetlerinin ve hijyen uygulamalarının yetersiz olduğu bölgelerde tehlike oluşturabilmektedir (Mehraeen ve diğ., 2020). Cai ve diğ. (2020), Çin'in Wenzhou kentindeki bir alışveriş merkezinde virüsün (SARS-CoV-2) olası bulaşma yollarını belirlemek için, bir dizi korona virüs (SARS-CoV-2) vakasını araştırmışlar ve elde ettikleri veriler doğrultusunda, virüsün dolaylı bulaşma yollarının, muhtemelen nesnelerin virüsle kontamine olmasından ve kapalı bir alan içerisinde virüsün aerosollerle taşınmasından veya asemptomatik enfekte kişilerden yayılmasından kaynaklanabileceğini ifade etmişlerdir. SARS-CoV-2'nin gıdalar yoluyla bulaşma riskleri üzerine yapılan çalışmalarda, düşük sıcaklığın SARS-CoV-2 ve diğer korona virüslerin yüzeyler üzerindeki kalıcılığını önemli ölçüde uzatabileceğini göstermesine rağmen, donmuş ve soğutulmuş gıdalar, potansiyel vektörler olarak büyük ölçüde göz ardı edilmiştir (Chin ve Poon, 2020; Han ve diğ., 2020; Matson ve diğ., 2020). Temmuz 2020'nin başlarında Çin'de kontamine gıda kaynaklarıyla bağlantılı yeniden ortaya çıkan iki salgında ambalaj malzemeleri ve saklama ortamları da dahil olmak üzere donmuş gıdalar üzerinde SARS-CoV-2'nin saptanmasıyla gıdaların salgındaki rolü açıklanmıştır. Buna ilave olarak soğuk zincirin kontaminasyonu arttırabileceği düşünülmektedir. Çünkü laboratuvar çalışmalarında SARS-CoV-2'nin buzdolabında 4 °C'de ve -10 °C ile -80 °C arasında, et, balık ve kümes hayvanlarında donma koşullarında oldukça stabil kaldığını göstermiştir. Bu koşullar altında virüsün hayatta kalma süresi ve bulaşıcılığı konusunda yeteri kadar veri olmasa da, SARS-CoV-1 dahil olmak üzere diğer korona virüsler hakkında bol miktarda kanıt gösterilmiştir. Bu nedenle, kontamine soğuk depolanan gıdaların ülkeler ve bölgeler arasında SARS-CoV-2 bulaşması için sistematik bir risk oluşturabileceği varsayılmaktadır (Han ve diğ., 2020). Ceniti ve diğ. (2021) virüsün (SARS-CoV-2) soğutulmuş ve dondurulmuş koşullarda birçok gıdada aktif ve stabil kaldığını, özellikle dondurulmuş gıdaların Çin şehirlerinde COVID-19 hastalığının yeniden ortaya çıkmasının ana kaynaklarından biri olarak gösteriliğini söylemişlerdir.

COVID-19, gastrointestinal sistemden değil, solunum yoluyla enfekte olan bir solunum yolu hastalığı olmasına rağmen, tüketiciler yinede gıda ile bulaşabileceği konusunda endişe duymaktadırlar. Bu kaygıları ortadan kaldırmak için kişisel tedbirler gibi gıda üreticileri ve hazırlayıcılarının da ellerini düzenli olarak yıkaması, çalışanların bilgi düzeylerinin ve farkındalıklarının sürekli arttırılması, gıda işletmelerinde hijyen-sanitasyon uygulamalarının dikkatlice uygulanması, çiğ ve pişmiş gıdaların ayrılması, özellikle yaş meyve-sebze ve tüketime hazır gıdaların satın alınmalarını takiben belirli süreler bekletildikten sonra tüketilmesi gibi uygulamalar bu virüsün gıda zincirine girmesi ve buradan yayılmasını önlemek için alınması gerekli temel tedbirler olarak belirtilmektedir (Pressman ve diğ., 2020; Sağdıç ve diğ., 2020; Tayar, 2020).

Bu çalışmada COVID-19 pandemisinin Bitlis Eren Üniversitesi akademik ve idari personellerinin gıda güvenliği konusundaki tutum ve davranışlarında yaptığı değişikliklerin tespit edilmesi amaçlanmıştır.

Materyal ve Metot

Araştırmanın Türü

Bu araştırma tarama modelinde kesitsel bir araştırmadır.

Araştırmanın Yeri ve Zamanı

Bitlis Eren Üniversitesi akademik ve idari personellerine Ağustos-Eylül 2020 ayları içinde yapılmıştır.

Araştırmanın Evreni ve Örneklemi

Araştırmanın evrenini Bitlis Eren Üniversitesi akademik ve idari personelleri oluşturmaktadır (*N*=765*)*. Örneklem Tablo 1'de belirtildiği şekilde hesaplanmıştır (Dean ve diğ., 2011). Örneklem büyüklüğü, popülasyon boyutu belli evren için kullanılan formülden yararlanılarak ve sapma değeri d=0,13 alınarak %95 güven seviyesinde belirlenmiş olup çalışmamıza 59 kişi katılmıştır. Birçok araştırma için 30'dan büyük 500'den küçük örneklem büyüklükleri yeterlidir (Gürbüz ve Şahin, 2014). Katılımcılar Bitlis Eren Üniversitesi genelinde basit rastgele örnekleme yöntemiyle seçilmiştir.

Tablo 1. Araştırmanın örneklem büyüklüğünün hesaplanması (Dean ve diğ., 2011)

Table 1. Calculation of the sample size of the research (Dean et al., 2011)

Popülasyon boyutu (*N*)	765
Popülasyonda sonuç faktörünün varsayılan % sıklığı (*p*)	50% ±13
Güven sınırları (+/- %)(*d*)	13%
Tasarım etkisi (for cluster surveys-*DEFF*)	1
Çeşitli güven seviyeleri için örneklem büyüklüğü (n)*	
Güven seviyesi (%)	**Örneklem büyüklüğü (n)**
95%	53
80%	24
90%	39
97%	64
99%	88
99,9%	133
99.99%	174

***n* = [DEFF*Np(1-p)]/ [(d2/Z21-α/2*(N-1)+p*(1-p)]**

Araştırmada Kullanılan Veri Toplama Araçları

Verilerin toplanmasında araştırmacılar tarafından gerekli literatür araştırılarak oluşturulan ve katılımcıların sosyodemografik özellikleri ile COVID-19 salgınının gıda güvenliğine etkisi hususunda (A) bilgi düzeyi, (B) tutum ve davranış değişiklikleri ile (C) kişisel görüş değişikliklerinin saptanmasıyla ilgili ifadeleri içeren soru kağıdı kullanılmıştır. Çalışmamız kapsamında söz konusu anket, https://docs.google.com/forms anket sistemi üzerinden yapılmıştır. Oluşturulan anket sorularının güvenilirliği Cronbach Alfa katsayısı ile belirlenmiştir. Cronbach Alfa değeri 0.60 ile 0.79 arasında ise ölçek oldukça güvenilirdir. Anket formumuza SPSS programında Cronbach Alfa testi uygulanmış ve Cronbach Alfa değeri 0.725 olarak hesaplanmış olup anketimiz oldukça güvenilir sınıfa girmektedir.

İstatistiksel Analiz

5'li Likert tipi soruların değerlendirilmesinde katılımcıların sorulara verdikleri cevapların ortalaması hesaplanmıştır. Ortalama değer 3'ün üzeri olan sorular da çoğunluğun görüşü olumlu, altında olan sorularda ise olumsuz olarak yorumlanmıştır. Elde edilen değerlere normal dağılım testi uygulanmış ve değerlerin normal dağılmadığı tespit edilmiştir. Bu nedenle istatistik analizinde nonparametrik bir test olan Kruskal-Wallis testi uygulanmıştır.

Araştırma sonucunda elde edilen veriler "SPSS 22,0 for Windows" istatistik paket programı kullanılarak değerlendirilmiştir. Nitel ve nicel değişkenler için uygun betimsel değerler verilmiştir. Nitel değişkenler sayı (s) ve yüzde (%) olarak ifade edilmiştir. Nicel değişkenler ortalama ± standart sapma şeklinde verilmiştir (Bayram, 2011). Tüm istatistiksel değerlendirmelerde P<0.05 değeri anlamlı olarak kabul edilmiştir.

Etik İlkeler

Araştırmanın yürütülebilmesi için Sağlık Bakanlığından (https://bilimselarastirma.saglik.gov.tr) 27 Haziran 2020 tarihinde gerekli onay alınmış ve çalışmamız Bitlis Eren Üniversitesi Etik İlkeler ve Etik Kurulunun 13.07.2020 tarih ve 2020/05-VIII sayılı kararı ile uygun görülmüştür.

Bulgular ve Tartışma

Sosyo-Demografik Özellikler

Katılımcıların sosyo-demografik özelliklerinin dağılımları Tablo 2'de verilmiştir. Buna göre katılımcıların %83.1'i erkek %16.9'u bayan, %79.7'si evli %20.3'ü bekârdır. Katılımcıların %1.7'si gelir düzeyini düşük, %62.7'si orta, %35.6'sı yüksek olarak algılamaktadır. Çalışmaya katılanların %32'si idari personel, %68'i de akademik personeldir.

Katılımcıların COVID-19 - Gıda Güvenliği İlişkisine Ait Bilgi Düzeyleri

Katılımcıların COVID-19 - gıda güvenliği ilişkisine ait bilgi düzeyleri ile ilgili ifadelere verdikleri cevaplar Tablo 3'de sunulmuştur. Katılımcıların "COVID-19 gıdalar ile bulaşır" ifa-

desine verdiklerin cevapların ortalaması 2.76 olmakla çoğunluğun bu görüşe katılmadıklarını göstermektedir. "Paketli gıda yolu ile COVID-19 bulaşır" ifadesine verilen cevapların ortalaması 2.93 bulunmuş olup bu görüşü de çoğunluk olumsuz cevaplamıştır. Katılımcıların çoğunluğu; ambalaj içerisindeki ürünlerde bulaşma riski olmadığını (ort. 3.07), dışarıdan (market vb.) alınan ürünleri en az sekiz saat bekletmekle bulaşmanın engellendiğini (ort. 3.36), dışarıdan (market vb.) alınan ürünleri sirkeli su (ort. 3.08) ve ambalajlı ürünleri sabunlu su (ort. 3.17) ile yıkamanın bulaşma sorununu çözeceğini düşünmektedirler. Katılımcıların çoğunluğu; fırınlardaki ekmek, simit gibi son tüketime hazır ürünlerin güvenli olmadığını (ort. 2.86), buna karşın fırıncıların maske ve eldiven kullanmalarının virüsün bulaşmasını engellemek için yeterli olacağını (ort. 3.05) ifade etmişlerdir. Ayrıca obezitenin COVID-19 için risk oluşturduğunu (ort. 3.81), COVID-19'dan korunmak için sağlıklı beslenmenin önemli olduğunu (ort. 4.76), gıda takviyesi ve multivitaminlerin COVID-19'a karşı bağışıklık sistemini güçlendirdiğini (ort. 3.80) düşünmektedirler. Katılımcıların bu görüşünü destekler nitelikte, Grant ve diğ. (2020) yaptıkları bir çalışmalarında D vitamini desteğinin grip ve COVID-19 enfeksiyonları ve ölüm risklerini çeşitli mekanizmalarla azaltabileceğini belirtmişlerdir. Çiğ tüketilen sebze ve meyvelerin virüs taşıma riski olduğunu düşünen (ort. 3.31) katılımcılar, yemekleri yüksek ısıda pişirmek ile virüs riskini önleyebileceklerini belirtmişlerdir (ort. 3.66). Katılımcılar "paketleme ekipmanında (ambalaj, kap, torba vb.) virüs varsa gıdaya da bulaşır" ve "anti bakteriyel saklama kapları virüse karşı güvenlidir" ifadelerine sırası ile 3.44 ve 3.12 ortalama ile olumlu; "kutu içecekleri güvenlidir" ve "buzdolabında COVID-19 yaşayamaz" ifadelerine ise sırası ile 2.92 ve 2.22 ortalama ile olumsuz cevap vermişlerdir. 3.71 ortalama ile "tarladan sofraya gıda zincirinin her aşaması virüs tehdidi altındadır" görüşü de katılımcılar tarafından olumlu görülmüştür.

Desai ve Aronoff (2020) son zamanlarda yapılan araştırmaların SARS-CoV-2'nin yüzeylerde veya nesnelerde 72 saate kadar bulaşıcı kalabileceğini, ancak çoğu virüsün ilk 24 saatten sonra inaktif (bulaşıcı olmayan) hale geldiğini belirterek, paketli gıda ürünlerinin yüzeylerindeki virüsün, zamanla etkisiz hale geleceğini, ürünlerin iç içeriklerinin kontamine olma ihtimalinin düşük olduğunu ifade etmişler ve tek kullanımlık bir market poşetinin, eve gelindiğinde atılması gerektiği tavsiyesinde bulunmuşlardır. Akkemik ve Güner (2020) "COVID-19 Salgını Bir Gıda Güvenliği Tehlikesi Midir?" isimli çalışmalarında, gıda zinciri çalışanlarının ellerini düzenli olarak yıkanması, bilinç düzeylerinin arttırılması için sürekli eğitim sağlanması ve işletmelerde hijyen-sanitasyon uygulamalarının etkin bir şekilde sürdürülmesi; ayrıca çapraz kontaminasyonu önlemek için çiğ ve pişmiş gıdaları ayırmaları şeklinde önlemler uygulanmasını tavsiye etmişlerdir. Paketli gıda, yaş sebze-meyve ve hazır gıdaların satın alındıktan sonra bir süre beklemede tutulup, bekledikten sonra tüketilmesinin temel tedbirler arasında olduğunu belirtmişlerdir (Akkemik ve Güner, 2020). Djekic ve diğ. (2021), 16 ülkeden 825 farklı gıda şirketi üzerinde yaptıkları bir çalışmalarında personel farkındalığı ve hijyeninin, COVID-19 ile mücadelenin, en önemli iki özelliği olduğunu ve çalışanların ateş ölçümlerini yapmaktan dahi daha önemli bulunduğunu belirtmişlerdir. Ceylan ve diğ. (2020) yaptıkları bir çalışmada; ambalajsız veya ağzı açık gıdalar tüketmek yerine, yüksek sıcaklıkta işlenmiş, haşlanmış veya konserve edilmiş gıdaların tercih edilmesini, tüketimden önce konserve yiyeceklerin yüzeylerinin temizlemesini, hükümetlerin maske kullanımı gibi basit önlemleri önermeye veya uygulatmaya ek olarak, gıda zincirinde çalışan personeller için düzenli ve aralıklı olarak SARS-CoV-2 testleri yapılmasını zorunlu kılmalarını tavsiye etmişlerdir.

Tablo 2. Katılımcıların sosyo-demografik özellikleri

Table 2. Socio-demographic characteristics of the participants

Özellik	Sayı (s)	Yüzde (%)
Cinsiyet		
Erkek	49	83.1
Bayan	10	16.9
Yaş (ort ± ss)	37.12 ± 6.40	
Medeni Durum		
Evli	47	79,7
Bekâr	12	20,3
Gelir Düzeyi		
Düşük	1	1.7
Orta	37	62.7
Yüksek	21	35.6
Unvan		
Arş. Gör.	4	7
Öğr. Gör.	13	22
Öğretim Üyesi	23	39
İdari Personel	19	32
Salgın dönemi boyunca katılımcıların hanelerinde yaşayan kişi sayısı		
1	3	5.1
2	14	23.7
3	14	23.7
4	14	23.7
5	10	16.9
6 ve üzeri	4	6.9
Toplam	**59**	**100**

Katılımcıların çoğu aile içinde olsa bile aynı kaptan yemek yemenin (ort. 3.93), alışveriş poşetleri ve paketlerinin yemek hazırlanan tezgâhlara ve masaya konulmasının (ort. 4.19), Çin'den ithal edilen bitkisel (ort. 3.46) ve hayvansal (ort. 3.69) ürünlerin riskli olduğunu düşünmektedirler. Katılımcılar kesme tahtası ve bıçağını kullanım sonrası sabunla yıkamanın yeterli olduğunu (ort. 3.64), çamaşır suyu ile muamele etmenin gerekmediğini (ort. 2.66) belirtmişlerdir.

Tablo 1. Katılımcıların COVID-19 - gıda güvenliği ilişkisine ait bilgi düzeyleri (1: Kesinlikle katılmıyorum, 2: Katılmıyorum, 3: Fikrim yok, 4: Katılıyorum, 5: Kesinlikle katılıyorum)

Table 3. Participants' knowledge levels on the relationship between COVID-19 and food safety (1: Strongly disagree, 2: Disagree, 3: No idea, 4: Agree, 5: Strongly agree)

İfade	Sayı (s)						Yüzde (%)				
	1	2	3	4	5	Ort.	1	2	3	4	5
COVID-19 gıdalar ile bulaşır	7	22	15	8	7	2.76	11.9	37.3	25.4	13.6	11.9
Paketli gıda yolu ile COVID-19 bulaşır	7	21	9	13	9	2.93	11.9	35.6	15.3	22.0	15.3
Ambalaj içerisindeki ürünlerde bulaşma riski yoktur	9	17	8	11	14	3.07	15.3	28.8	13.6	18.6	23.7
Dışarıdan (market vb.) alınan ürünleri en az sekiz saat bekletmek bulaşmayı engeller	5	13	12	14	15	3.36	8.5	22	20.3	23.7	25.4
Dışarıdan (market vb.) alınan ürünleri sirkeli su ile yıkamak bulaşma sorununu çözer	7	15	12	16	9	3.08	11.9	25.4	20.3	27.1	15.3
Dışarıdan (market vb.) alınan ürünleri sabunlu su ile yıkamak bulaşma sorununu çözer	8	11	13	17	10	3.17	13.6	18.6	22	28.8	16.9
Fırınlardaki ekmek, simit gibi son tüketime hazır ürünler güvenlidir	5	18	21	10	5	2.86	8.5	30.5	35.6	16.9	8.5
Gıda takviyesi ve multivitaminler COVID-19'a karşı bağışık sistemini güçlendirir	4	3	12	22	18	3.80	6.8	5.1	20.3	37.3	30.5
Fazla kilo (obezite) COVID-19 için risktir	1	7	14	17	20	3.81	1.7	19.9	23.7	28.8	33.9
COVID-19'dan korunmak için sağlıklı beslenmenin önemli olduğunu düşünüyorum	0	1	0	11	47	4.76	0	1.7	0	18.6	79.7
COVID-19 pişmiş gıdalarla bulaşır	18	27	5	6	3	2.14	30.5	45.8	8.5	10.1	5.1
Çiğ tüketilen sebze ve meyvelerin virüs taşıma riski vardır	1	15	15	16	11	3.31	1.7	25.4	27.1	27.1	18.6
Yemekleri yüksek ısıda pişirmek ile virüs riskini önleyebiliriz	4	5	16	16	18	3.66	6.8	8.5	27.1	27.1	30.5
Paketleme ekipmanında (ambalaj, kap, torba vb.) virüs varsa gıdaya da bulaşır	2	10	21	12	14	3.44	3.4	16.9	35.6	20.3	23.7
Fırıncıların maske ve eldiven kullanması virüsün bulaşmasını engellemek için yeterlidir	5	13	23	10	8	3.05	8.5	22	39	16.9	13.6
Anti bakteriyel saklama kapları virüse karşı güvenlidir	6	11	21	12	9	3.12	10.2	18.6	35.6	20.3	15.3
Kutu içecekleri güvenlidir	9	13	20	8	9	2.92	15.3	22	33.9	13.6	15.3
Tarladan sofraya gıda zincirinin her aşaması virüs tehdidi altındadır	2	8	14	16	19	3.71	3.4	13.6	23.7	27.1	32.2
Aile içinde olsa bile aynı kaptan yemek virüs riskini arttırır	2	7	8	18	24	3.93	3.4	11.9	13.6	30.5	40.7

Tablo 3. (Devam)

Table 3. (Continue)

İfade	Sayı (s)						Yüzde (%)				
	1	2	3	4	5	Ort.	1	2	3	4	5
Alışveriş poşetleri ve paketlerinin yemek hazırlanan tezgâhlara ve masaya konulması virüs riskini arttırır	0	1	13	19	26	4.19	0	1.7	22.0	32.2	44.1
Kesme tahtası ve bıçağını kullanımdan sonra sabunlu su ile yıkamak yeterlidir	4	7	10	23	15	3.64	6.8	11.9	16.9	39	25.4
Kesme tahtası ve bıçağını kullanımdan sonra mutlaka çamaşır suyu ile muamele etmek gerekir	13	18	11	10	7	2.66	22	30.5	18.6	16.9	11.9
Buzdolabında COVID-19 yaşayamaz	21	14	17	4	3	2.22	35.6	23.7	28.8	6.8	5.1
Fast food ve self servis yapan işletmeler risklidir	1	4	13	19	22	3.97	1.7	6.8	22	32.2	37.3
Ev mutfağında hazırlanan yemekler güvenlidir	1	3	10	22	23	4.07	1.7	5.1	16.9	37.3	39
Çapraz kontaminasyonu önlemek amacıyla çiğ ve pişmiş gıdalar için farklı mutfak eşyaları ve doğrama tahtaları kullanılmalıdır	6	5	17	15	16	3.51	10.2	8.5	28.8	25.4	27.1
Çin'den ithal edilen bitkisel ürünlerde COVID-19 bulaşma riski vardır	5	10	15	11	18	3.46	8.5	16.9	25.4	18.6	30.5
Çin'den ithal edilen hayvansal ürünlerde COVID-19 bulaşma riski vardır	4	9	9	16	21	3.69	6.8	15.3	15.3	27.1	35.6
COVID-19 şebeke suyundan insanlara bulaşabilir	12	24	11	8	4	2.46	20.3	40.7	18.6	13.6	6.8
COVID-19 dünyada sağlıklı gıdaya erişim hakkı olarak tanımlanan gıda güvencesi açısından tehdit oluşturmaktadır	2	5	19	11	22	3.78	3.4	8.5	32.2	18.6	37.3

Katılımcılar şebeke suyundan korona virüsün bulaşacağını düşünmezken (ort. 2.46); korona virüsünün gıda güvencesi açısından tehdit oluşturduğunu (ort. 3.78), çapraz kontaminasyonu önlemek amacıyla çiğ ve pişmiş gıdalar için farklı mutfak eşyaları ve doğrama tahtaları kullanılması gerektiğini (ort. 3.51), ev mutfağında hazırlanan yemekler güvenli olduğunu (ort. 4.07), "fast food" ve "self servis" yapan işletmelerin risk barındırdığını (ort. 3.97) düşünmektedirler.

Shi ve diğ. (2020), COVID-19 salgınının Çin'deki tüketicilerin gıda güvenliği bilgisi ve davranışları üzerine yaptıkları çalışmalarında COVID-19 vakalarının varlığının, bölge sakinlerinin gıda güvenliği bilgisi ve davranışları üzerinde önemli ölçüde olumlu bir etkiye sahip olduğunu belirtmişlerdir. Gıda güvenliği ile ilgili bilgilere odaklanan bölge sakinleri, daha yüksek gıda güvenliği bilgisine sahip olma ve gıda güvenliği davranışını uygulama eğiliminde olduklarını bildirmişlerdir.

Katılımcıların COVID-19 - Gıda Güvenliği İlişkisine Ait Tutum ve Davranış Değişiklikleri

COVID-19 - gıda güvenliği ilişkisiyle alakalı tutum ve davranış değişikliklerini belirlemek amacıyla katılımcılara yöneltilen ifadelere verilen cevapların dağılımı Tablo 4'de sunulmuştur. Buna göre; katılımcıların % 47.5'nin salgınla beraber hazır gıdaya olan ilgisi azalmış, %30.5'nin ise değişmemiştir. Katılımcıların %64.4'ünün süpermarketten ve %59.3'ünün de mahalle/semt bakkalından yaptıkları gıda alışverişi miktarında bir değişme olmamıştır. Katılımcıların %23,7'sinin internetten yaptıkları gıda alışverişi oranında azalma yaşanırken, %35.6'sında bir değişme olmamış ve %13.6'sında artış meydana gelmiştir. Katılımcıların yarıdan fazlası (%55.9); un, yağ, makarna gibi temel gıdalara olan ilgilerinde bir değişme olmadığını ifade etmişlerdir. Bununla beraber yapılan bir çalışmada (Çakıroğlu ve diğ., 2020) COVID-19 sürecinde tüketicilerin temel ihtiyaçlara yöneldiklerini, çevrimiçi alışveriş oranlarında artış olduğunu ve dijital platformları daha çok tercih ettiklerini bildirmişlerdir. Ben Hassen ve diğ. (2020), COVID-19'un Katar'da tüketici

bilinci, gıda tüketimiyle ilgili tutum ve davranışları üzerindeki etkilerini araştırdıkları çalışmalarında, tüketicilerin yemek yeme, alışveriş yapma ve gıda ile etkileşimde bulunma şekillerinde açık değişikliklerin olduğunu belirlemişlerdir. Söz konusu çalışmadaki anket sonuçlarından; daha sağlıklı diyetlere doğru bir geçiş olduğu, gıda güvenliği endişelerinden dolayı yerli ürünlerin tüketiminde artış meydana geldiği, yiyecek edinme yönteminde değişiklikler olduğu (çevrimiçi market alışverişinde artış gibi) ve evde yemek pişirme yeteneklerinde artış yaşandığı gibi bulgular elde etmişlerdir.

Salgın ile beraber, katılımcıların %37.3'ünde fast food tüketimi azalırken, %25.4'ünde değişmemiş olup hiçbir katılımcıda artmaması (%0.0) göze çarpmıştır. Restoranların gel-al hizmetine, katılımcıların %30.5'i daha az ilgi duyarken, %27.1'i için bu oran değişmemiş, yalnızca %13.6'sı için artış göstermiştir. Katılımcılarda hazır gıdalara güvenme oranı %44,1 azalış göstermiştir. Diğer taraftan katılımcıların paketlenmiş ürünlere güven/ilgi düzeylerinde %25.4 azalış yaşanırken, %39.0'unda bir değişme olmamış, yalnızca %16.9'unda artış yaşanmıştır. Cranfield (2020), Kanada'da COVID-19 salgınının tüketicilerde gıda talebini nasıl etkileyebileceği ile ilgili çeşitli konuları araştırdığı bir çalışmasında, restoranların neredeyse evrensel olarak kapalı olmasından dolayı sipariş alma veya oturma hizmeti için düşüş yaşandığını, bunun yerine teslimatın arabadan/kaldırımdan alınması seçeneklerinin arttığını ifade etmiş, Kanadalıların ev dışında yemek yeme sıklıklarının azaldığını ifade etmiştir. Chenarides ve diğ. (2021) COVID-19 salgını sırasında gıda tüketim davranışı üzerine yaptıkları anket çalışmalarında, ankete katılanların yaklaşık yarısının normalden daha fazla yiyecek satın aldığını, çoğu katılımcı için gıda tüketim alışkanlıklarının aynı kaldığını ve "fast food" tüketiminde keskin bir düşüş gerçekleştiğini ortaya koymuşlardır.

Tablo 4. Katılımcıların COVID-19 - gıda güvenliği ilişkisine ait tutum ve davranış değişiklikleri

Table 4. Attitudes and behavioral changes of the participants regarding the COVID-19 - food safety relationship

İfade	Sayı (s)				Yüzde (%)			
	Fikrim Yok	Azaldı	Değişmedi	Arttı	Fikrim Yok	Azaldı	Değişmedi	Arttı
Salgınla beraber hazır gıdaya ilgim	9.0	28.0	18.0	4.0	15.3	47.5	30.5	6.8
Süpermarketten yaptığım gıda alışverişi	1.0	11.0	38.0	9.0	1.7	18.6	64.4	15.3
Mahalle/semt bakkalından yaptığım gıda alışverişi	3.0	16.0	35.0	5.0	5.1	27.1	59.3	8.5
İnternetten yaptığım gıda alışverişi	16.0	14.0	21.0	8.0	27.1	23.7	35.6	13.6
Temel gıdalarla olan ilgim (un, makarna, yağ vb.)	1.0	14.0	33.0	11.0	1.7	23.7	55.9	18.6
Fast food'a olan ilgim	22.0	22.0	15.0	0.0	37.3	37.3	25.4	0.0
Restoranların gel-al hizmetine ilgim	17.0	18.0	16.0	8.0	28.8	30.5	27.1	13.6
Ev yemeği tüketimim	0.0	1.0	12.0	46.0	0.0	1.7	20.3	78.0
Hazır gıdalara güvenim	11.0	26.0	19.0	3.0	18.6	44.1	32.2	5.1
Paketlenmiş ürünlere güvenim/ilgim	11.0	15.0	23.0	10.0	18.6	25.4	39.0	16.9
Helal Gıda sertifikalı ürünlere ilgim	4.0	5.0	30.0	20.0	6.8	8.5	50.8	33.9
HACCP sertifikalı ürünlere ilgim	13.0	9.0	32.0	5.0	22.0	15.3	54.2	8.5
ISO 22000 sertifikalı ürünlere ilgim	9.0	8.0	34.0	8.0	15.3	13.6	57.6	13.6
Satın aldığım gıda ürünlerinin etiketini okuma alışkanlığım	1.0	5.0	31.0	22.0	1.7	8.5	52.5	37.3
Salgın süresince genel gıda tüketimim	0.0	5.0	33.0	21.0	0.0	8.5	55.9	35.6
Salgın süresince diyet yapma isteğim	7.0	10.0	25.0	17.0	11.9	16.9	42.4	28.8
Prebiyotik gıda (yoğurt, ev turşusu vb.) tüketimim	1.0	2.0	30.0	26.0	1.7	3.4	50.8	44.1
Gıda takviyesi ve multivitamin tüketimim	10.0	10.0	25.0	14.0	16.9	16.9	42.4	23.7
Kişisel bakım ve hijyene ayrılan zaman	1.0	2.0	17.0	39.0	1.7	3.4	28.8	66.1
Yemek hazırlamaya ayrılan zaman	2.0	9.0	25.0	23.0	3.4	15.3	42.4	39.9
Günlük su tüketimim	1.0	3.0	28.0	27.0	1.7	5.1	47.5	45.8
Mutfakta maske kullanımım	21.0	11.0	22.0	5.0	35.6	18.6	37.3	8.5
Mutfakta eldiven kullanımım	15.0	10.0	27.0	7.0	25.4	16.9	45.8	11.9
Sirke ve limon ekleyerek yıkama suyu kullanımım	9,0	12,0	24,0	14,0	15,3	20,3	40,7	23,7

Katılımcıların yemek hazırlamaya ayırdıkları zaman %15.3'ünde azalırken, %39.9'unda artış göstermiştir. Garipoğlu ve Bozar (2020), "COVID-19 Salgınında Sosyal İzolasyonda Olan Bireylerin Beslenme Alışkanlıklarındaki Değişiklikler" isimli çalışmalarında, çalışmaya katılan katılımcıların %79.4'ünde sosyal izolasyon dönemi boyunca hazır yemek tüketimini önceki döneme göre azaldığını belirtmişlerdir. Bu sonuç bizim bulduğumuz, katılımcıların %78.0'inde ev yemeği tüketiminin artması, hazır yemek tüketiminin azalması sonucu ile de örtüşmektedir. Torero (2020), gelişmiş ülkelerde pirinç gibi bazı temel gıdalara olan talebin salgın başlangıcında çok yükseldiğini ve tüketicilerin gıda kıtlığı korkusuna bir yanıt olarak büyük miktarda malzeme satın aldığını belirtmiştir. Ayrıca insanların kısıtlama nedeniyle restoranlardan ziyade evde yemek yemelerinin bazı yiyecek tüketim alışkanlıklarını değiştirdiğini söylemiştir.

Helal Gıda sertifikalı ürünlere (%50.8), HACCP sertifikalı ürünlere (%54.2) ve ISO 22000 sertifikalı ürünlere (%57.6) katılımcıların yarıdan fazlasının ilgi düzeylerinde bir değişiklik olmamıştır. Ayrıca katılımcılar satın aldıkları gıda ürünlerinin etiketlerini okuma alışkanlıklarında bir değişme olmadığını (%52.5) belirtmişlerdir. Salgın süresince diyet yapma isteği katılımcılarda %42.4 oranında değişmezken, artış gösterenlerin yüzdesi (%28.8), azalış gösterenlerin yüzdesinden (%16.9) fazla bulunmuştur. Salgın süresince genel gıda tüketimi katılımcıların %55.9'unda değişmezken, %35.6'sında artış gerçekleşmiştir. Katılımcılarda kişisel bakım ve hijyene ayrılan zaman COVID-19 salgını ile beraber artış göstermiş (%66.1), gıda takviyesi ve multivitamin tüketiminde ise artış gösterenlerin yüzdesi (%23.7), azalış gösterenlerin yüzdesinden (%16.9) fazla bulunmuştur. Günlük su tüketimi katılımcıların %47.5'inde değişmezken. %45.8'inde artmıştır (Tablo 4).

Bağımsız değişkenler ile tutum ve davranış değişikliklerini belirlemek amacıyla katılımcılara yöneltilen ifadelere verilen cevaplar arasındaki ilişkiye bakıldığında, "Süpermarketten yaptığım gıda alışverişi" ifadesi ile medeni durum (χ^2=9714, P=0.021) ve salgın döneminde hanede yaşayan kişi sayısı (χ^2=7845, P=0.049) arasındaki ilişki önemli bulunmuştur. Süpermarket alışverişi ile yaşayan kişi sayısı arttıkça bir artış yaşanmış olması beklenen bir sonuçtur. Bunun dışında kalan diğer bağımsız değişkenler ile cevaplar arasında anlamlı bir ilişki bulunmamıştır (P>0.05).

COVID-19 Salgınının Kişisel Görüşlerde Sebep Olduğu Değişiklikler

Katılımcıların kişisel görüşlerinde COVID-19 salgınının sebep olduğu değişiklikleri belirlemek amacıyla ankette kendilerine yöneltilen ifadelere verdikleri cevaplar Tablo 5'de sunulmuştur.

COVID-19 salgını ile katılımcıların gıda güvenliğine (ort. 4.44), tarıma (ort. 4.36), kişisel hijyen ve sanitasyona (ort. 4.88) verdikleri önem artmıştır. Katılımcıların çoğunluğu COVID-19 salgını ile insanlarda gıdasız kalma korkusu (ort.3.47) oluştuğunu ve gıda işletmelerinde hijyen ve sanitasyon kurallarının öneminin arttığını (ort. 4.61) düşünmektedirler. Oğur ve diğ. (2020) gıda işletmelerinde görev yapan yöneticilerin bu pandemi sürecinde olduğu gibi her zaman personellerin gıda güvenliği ve hijyen kurallarına uymasının gıda kaynaklı hastalıkların önlenmesinde çok önemli olduğunu bildirmişlerdir. Gıda güvenliği ve hijyen konularında personellere eğitimlerin verilmesinin ve eğitimlerde anlatılan kuralların uygulanıp uygulanmadığının/ne şekilde uygulandığının kontrol edilmesi gerektiğinin üzerinde durmuşlardır. Huff ve diğ. (2015) işgücü mevcudiyetinde %25'ten daha fazla azalma ile ciddi bir pandeminin önemli ve yaygın bir gıda kıtlığına sebep olabileceğini belirtmişlerdir. 2014'te başlayan Ebola salgınının, Batı Afrika'da ciddi bir gıda kıtlığına neden olduğunu, mevcut durumda gıda miktarındaki azalmanın olası etkilerinin özel olarak tahmin edilmesinin zor olduğunu; ancak bunun toplum üzerinde ciddi olumsuz sonuçları olmasının muhtemel olduğunu belirtmişlerdir. Gıda sisteminin dayanıklılığının bu ve diğer tehlikelere karşı geliştirilmesi gerektiğini vurgulamışlardır. Henry (2020) "COVID-19 Pandemisine Yanıt Olarak Tarım ve Gıda Tedarikinde Yenilikler" isimli çalışmasında; birçok gelişmekte olan ülkede, COVID-19'un istihdam ve gelirler üzerinde ciddi bir etkisi olduğunu ve artan sayıda gıda alamayan insan için büyük bir gıda krizi oluşturduğunu ve sonuç olarak acil yiyecek tedarikine olan talebin artmasının muhtemel olduğunu söylemiştir.

Tablo 5. COVID-19 salgınının katılımcıların kişisel görüşlerinde sebep olduğu değişiklikler (1: Kesinlikle katılmıyorum, 2: Katılmıyorum, 3: Fikrim yok, 4: Katılıyorum, 5: Kesinlikle katılıyorum)

Table 5. Changes caused by the COVID-19 pandemic in participants' personal views (1: Strongly disagree, 2: Disagree, 3: No idea, 4: Agree, 5: Strongly agree)

İfade	Sayı (s)						Yüzde (%)				
	1	2	3	4	5	Ort.	1	2	3	4	5
Salgın gıda güvenliğinin önemini arttırdı.	1	2	3	17	36	4.44	1.7	3.4	5.1	28.8	61.0
Salgın insanlarda gıdasız kalma (aç kalma) korkusu oluşturdu.	4	11	12	17	15	3.47	6.8	18.6	20.3	28.8	25.4
Salgın tarımın önemini arttırdı.	1	4	5	12	37	4.36	1.7	6.8	8.5	20.3	62.7
Salgınla beraber kişisel hijyen ve sanitasyonun önemi arttı.	0	0	1	5	53	4.88	0	0	1.7	8.5	89.8
Salgınla beraber gıda işletmelerinde hijyen ve sanitasyon kurallarının önemi arttı.	1	1	4	8	45	4.61	1.7	1.7	6.8	13.6	76.3

Sonuç

Katılımcıların çoğunluğu COVID-19 ve gıda güvenliği konusunda yeterli bilgiye sahipken bu konuda yeterli bilgiye sahip olmayan katılımcıların da olduğu görülmüştür. Virüsün (SARS-CoV-2) doğrudan veya dolaylı bulaşma yolları hakkında çoğu katılımcının eksik bilgiye sahip olduğu sonucu ortaya çıkmıştır. Bu nedenle virüsün gıdalar aracılığıyla bulaşma yolları, ambalaj materyallerinde ve gıdalarda farklı saklama koşullarında bekletmenin virüsün bulaşıcılığına etkisi gibi konularda güncel bilimsel çalışmalardan elde edilen bilgilerle toplumun bilgilendirilmesi gerekmektedir. Salgınla beraber katılımcıların gıda güvenliğine ve kişisel hijyene verdikleri önem artmış, gıda işletmelerinde hijyen ve sanitasyon kurallarına uymanın daha önemli hale geldiği kanısı oluşmuştur. Bu nedenle gıda işletmeleri tüketicilerin bu kaygılarına uygun olarak hijyen ve sanitasyon kurallarına uyduklarını ve virüse karşı gerekli olan tedbirleri aldıklarını reklamlarında ve ambalajlarında ifade etmelidirler. Fast food ve restoran hizmetlerine olan güvensizlik de bu şekilde aşılabilir.

Etik Standart ile Uyumluluk

Çıkar çatışması: Yazarlar bu yazı için gerçek, potansiyel veya algılanan çıkar çatışması olmadığını beyan etmişlerdir.

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Effects of chestnut addition on physicochemical composition, total phenolic contents, antioxidant capacities and sensory properties of milk

Gaye I. ERDOĞAN, Ayşe Neslihan DÜNDAR

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Bursa Technical University, Faculty of Engineering and Natural Sciences, Department of Food Engineering, Yıldırım, Bursa, Turkey

RCID IDs of the authors:
G.I.E. 0000-0003-2084-7076
A.N.D. 0000-0002-1169-2079

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Correspondence:
Ayşe Neslihan DÜNDAR
E-mail: ayse.dundar@btu.edu.tr

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ABSTRACT

Chestnut-added milk (CM) was produced with 2 different methods. In the first method, chestnuts were roasted, and in the second method, they were cooked in bain-marie and then added to milk at different ratios (5, 15, 25 %). The addition of chestnuts to milk statistically increased the amount of protein, dietary fiber, carbohydrate, energy, mineral (Ca, K, P, Mg), antioxidant capacity and total phenolic content compared to the control, whereas it did not cause a significant change in sensory properties. Therefore, the chestnut is a suitable supplementation for milk.

Keywords: Milk, Chestnut, Stevia, Functional dairy product

Introduction

Chestnut tree, one of the first known food sources of humankind, is also known as 'bread tree' (Bounous et al., 2000). It is seen that although nuts generally have a high fat content, this is different for chestnuts. Chestnut, which has a higher amount of carbohydrates, is also extremely nutritious (Dassler and Heitmann, 1991). This fruit, which has an important place in Turkish and world cuisine, is preferred as a candy in addition to being consumed by roasting or boiling. Antioxidant capacity of chestnuts taken from different provinces in Turkey on walnuts and chestnuts were determined by FRAP method and determined between 9.08-14.15 mM Fe_2SO_4. In the same study, no significant difference was found in terms of antioxidant activity of raw, boiled, roasted chestnuts purchased from 3 different provinces (Selek, 2011).. Rich antioxidant content, minerals in its structure, and low but high quality fat content are among the reasons why chestnuts are preferred in diets today (Atasoy and Altıngoz, 2011).

The benefits of milk, which is one of our most nutritionally staple foods, have been described for centuries. Consumption of milk, which is known to be protected from many diseases such as osteoporosis, bowel cancer, high blood pressure, and chronic bronchitis, is extremely important (Altun et al., 2002.) The consumption of milk, which is considered to be an extremely important nutrient all over the world, unfortunately falls far behind other countries in our country. Considering all these, alternative solutions to increase milk consumption attract attention (Besler and Unal, 2008). For people who cannot consume milk and who do not appeal to the taste buds, much different flavored milk is produced with the developing technology today. Different kinds of flavored and fruit milk have been sold in the markets for a long time. In particular, the target audience of these products is children who do not like milk. However, chestnut milk samples, which suits Turkish palate and has been in our kitchens for a long time, has not been found yet.

As a natural sweetener that gives the usual sugar taste, stevia is one of the most popular products of recent time. The main feature that distinguishes stevia from other sweeteners is that it is heat resistant and does not leave an intense metallic taste in the mouth (Inanc and Cınar, 2009). Today, it is known that it is used in beverages, jam, pudding cooked by boiling, bakery foods such as cakes and cookies, confectionery industry, seafood, some vegetables, and tea sugar as well as in the production of many foods such as sushi, soy sauce, yoghurt (Kinghorn et al., 2001; Nunes et al., 2007). The objective of this study was to produce an alternative beverage with a high nutritional value, new flavor, and natural sweetener and to determine this product's features.

Materials and Methods

UHT full-fat cow's milk, frozen chestnut and stevia (Energy 0 Kcal, Fat 0 g, saturated fat 0g, monounsaturated fat 0 g, trans fat 0 g, polyunsaturated fat 0 g, cholesterol 0g, carbohydrate 0 mg, sugar 0 g, sugar alcohol 0 g, starch 0g, fiber 0 g, protein 0 g, salt sodium 0g, vitamin 0 g, mineral 0 g and 5 drops of Stevia = 1 cube of sugar) used in the production of the chestnut-added milk (CM) samples were obtained from the market. Chestnut fruit, in general has 40-45% water, 3-6% protein, 3-5% fat, 40-45% carbohydrate, 1.3% ash. However, these values may vary based on the ecological conditions, type, genus and process (Soylu, 2004). The samples were prepared fresh before the analysis.

Production of Chestnut-Added Milk Samples

In the production of the CM samples, heat treatment was applied to chestnuts according to 2 different methods. In the first method, chestnuts roasted in the oven at 150 ºC for 30 minutes were called RCs, and in the second method, chestnuts cooked in a bain-marie were called BCs. Cooked chestnuts were added to hot UHT full- fat cow's milk (100 ml) in different amounts (5, 15, and 25 g) with liquid stevia (5 mL) and homogenized by mechanical mixing with a blender (Waring, 8011S)

Physico-Chemical Analysis of Chestnut Milk Samples

The dry matter, fat, total sugar, protein, acidity, and dietary fiber of the milk (control) and CM samples were determined according to The Association of Official Analytical Chemists (AOAC) Approved Methods of Analysis Methods No: 990.20, 2000.18, 980.13, 991.20, 947.05, 991.43, respectively (Anonymous, 2000). Atwater factor was used for the calculation of the total carbohydrate and energy of the prepared samples (FAO, 2003).

The color measurements of the milk and CM samples were carried out by Minolta Spectrophotometer CM 3600d (Osaka, Japan) in order to measure L^*, a^* and b^* values. The results were expressed using the CIELab system. L^* defines lightness or darkness, a^* redness or greenness, and b^* yellowness or blueness.

Determination of Mineral Contents

In mineral determination, the samples were digested by closed system wet combustion (microwave oven) method by modifying NMKL 186 2007 and TS EN 13805 2004 methods. Microwave digestion system was used during the sample preparation. 2 mL of liquid from the homogenized samples was weighed with microwave vessels. To homogenize the sample, 8mL of HNO_3 (65%) and 2 mL H_2O_2 (35%) were

added. By applying the analysis program, which is given in Table 1, the samples were analyzed in microwave. The element content of the samples was automatically measured and calculated with a ICP-MS (7700) Agilenet which uses the calibration curve. The performance characteristics of the method for the analyzed five elements are given in Table 2.

Extraction of Phenols

The extraction method applied to the milk and CM samples was conducted according to Vitali et al., (2009) with some minor modifications. Briefly, 2 mL were taken from each samples and mixed with HCl_{conc}/methanol/water (1:80:10, v/v) and shaken in a water bath (Nuve/ ST30, Turkey) at 20°C (250 rpm, 2h). The extracts were centrifuged (Hettich / Universal 320R, Germany) at 3500 rpm and 4 °C for 10 min. The supernatant was used in the analyses of total phenolic content and antioxidant capacity.

Determination of Total Phenolic Content and Antioxidant Capacity

The total phenolic content of the milk and CM samples was determined according to Folin-Ciocalteu method (Naczk and Shahidi, 2004; Vitali et al., 2009). Gallic acid was used as a standard, and the results were expressed as mg GAE/L.

Many methods are encountered in the literature to determine the antioxidant capacity. These methods have advantages and disadvantages compared to each other. Considering the selectivity and applicability of the methods, it is recommended to compare antioxidant capacity determinations using more than one method. Therefore, DPPH (2,2diphenyl-1-picrylhydrazyl), ABTS [2,2-azinobis (3ethylbenzothiazoline-6-sulphonic acid)], and CUPRAC (Cupric ion reducing antioxidant capacity) methods were used to determine the antioxidant capacity (Apak et al., 2004; Vitali et al., 2009). A calibration curve was prepared with Trolox (6-hydroxy-2,5,7,8 tetramethyl chroman-2-carboxylic acid), and the results were expressed as μM TEAC for each method.

Sensory Evaluation

The sensory evaluation of the milk and CM samples was carried out by 45 untrained panelists whose ages were between 17 to 40. The hedonic scale with 9-points was used for sensorial evaluation. The samples were evaluated in terms of appearance, consistency, color, taste and overall acceptability.

Statistical Evaluation

The data were evaluated using SPSS 22 software program for statistical analysis. Differences among the means were analyzed by the one-way analysis of variance (ANOVA) applied for parametric tests. Based on the test results, the level of significance among the means ($p \leq 0.05$) were determined by Duncan test. The statistical analyzes made within the group are shown in lower case, whereas the analyzes for all the samples are shown in capital letters.

Table 1. Heating program in microwave digestion system

Power (W)	Pressure (PSI)	Heat (^{0}C)	Ramp (mins)	Hold (mins)
250	250	180	5	1
0	280	180	0	1
250	320	220	1	5
400	340	220	1	5
650	400	220	3	5

Table 2. Performance characteristics of the method

Elements	Detection limit (mg/L)	Quantification limit (mg/L)
Na	3.75	12.5
Ca	3.75	12.5
K	3.75	12.5
P	3.75	12.5
Mg	0.09	0.3

Results and Discussion

Physico-Chemical Analysis of CM Samples

Some physicochemical analysis results of the CM samples are given in Table 3. As the increased amount of chestnut in milk, the dry matter content also increased. In the RC samples, more dry matter amount was determined compared to the BC samples. The lowest value was determined as 5% BCs (13.67), whereas the highest value was determined as 25% RCs (20.74). It is estimated that there was some loss of dry matter dissolved in water during the bain-marie and that chestnuts might have taken water into its structure by being affected by water vapor. Although chestnut is a nut, it is rich in carbohydrates and poor in fat (1.5-2.0%) and protein (2.5-3.0%), unlike nuts, such as walnuts and hazelnuts (Johnsen, 1992). Yurdakul (2008) determined the fat values of fresh chestnuts, boiled chestnuts and roasted chestnuts as 1.8-2.5%, 1.3%, 2.2%, respectively. As the chestnut ratio of the samples increased, the percentage of the fat content decreased. The fat content of the milk used in the samples is expected to be effective in the final product. The average fat of the milk used was found as 3.10 ± 0.08%. There is no statistically significant difference between BCs. In RCs, the fat content of the sample with 25% chestnut was significantly lower than the other samples.

Table 3. Chemical analyzes of chestnut milk samples

Method	Chestnut Ratio (%)	Dry Matter Content (%)	Total Sugar (%)	Fat (%)	Protein (%)	Acidity (%)	Dietary Fiber (%)	Carbohydrate (%)	Energy (kcal/100mL)
Bain-marie	0	8.0±0.1^{dG}	4.39±0.04^{cE}	3.10±0.01^{aA}	2.90±0.02^{cE}	0.13±0.01	0^{dG}	5.93±0.06^{dG}	64.70±0.40^{dF}
	5	13.67±0.30^{cF}	4.35±0.08^{cE}	3.13±0.22^{aA}	3.18±0.02^{bC}	0.12±0.01	0.18±0.01^{cE}	6.70±0.38^{cF}	67.19±1.82^{cE}
	15	16.30±0.21^{bE}	5.83±0.16^{bB}	2.72±0.56^{aA}	3.39±0.01^{aB}	0.12±0.02	0.48±0.01^{bC}	9.40±0.60^{bD}	74.66±3.41^{bD}
	25	18.89±0.38^{aD}	6.48±0.44^{aA}	2.65±0.46^{aB}	3.38±0.01^{aB}	0.13±0.02	0.78±0.02^{aA}	12.0±0.46^{aB}	83.73±2.59^{aB}
Roasted	0	8.0±0.1^{dG}	4.39±0.04^{aE}	3.10±0.01^{aA}	2.90±0.02^{dE}	0.13±0.01	0^{dG}	5.93±0.06 ^{dG}	64.70±0.40^{dF}
	5	15.68±0.02^{cC}	4.39±0.06^{aE}	3.05±0.10^{aA}	3.09±0.01^{cD}	0.11±0.01	0.10±0.01^{cF}	8.85±0.12^{cE}	75.00±0.65^{cD}
	15	17.11±0.03^{bB}	4.81±060^{abD}	3.00±0.18^{aA}	3.18±0.01^{bC}	0.12±0.01	0.34±0.01^{bD}	10.13±0.18^{bC}	79.58±1.60^{bC}
	25	20.74±0.03^{aA}	5.27±0.84^{bC}	2.65±0.16^{bB}	3.52±0.02^{aA}	0.13±0.03	0.68±0.01^{aB}	13.69±0.18^{aA}	91.30±2.10^{aA}

All data are expressed as mean ± standard deviations (n=3). Mean values showed with different lower letters in the same column for each chestnut addition levels are significantly different ($p \leq 0.05$). Mean values showed with different capital letters in the same column for each milk samples are significantly different ($p \leq 0.05$)

Using the natural sweetener stevia in the product, which is an alternative to sweeteners used in dairy products, was tried. In a study on the addition of different sweeteners to chocolate milk, the sweetening power equivalent of stevia was stated as 70 sucrose (7%). This value remained lower than other sweeteners such as aspartame and neotame (Paixão et al., 2014). The total sugar of chestnuts in dry matter was determined to be between 10.32-22.79% (Ertürk et al., 2006). In a study conducted on 3 different chestnut species in Italy, the total sugar amount of chestnuts was found to be between 14.28-21.23% (Neri et al., 2010). It was determined that as the chestnut ratio increased, the total sugar amounts of BCs and RCs increased. The highest value was detected in the 25% BC sample (6.48%), while the lowest value was found in the control (4.39%).

Cow's milk contains high quality protein. The amount of protein in milk is stated as 3-3.5% on average. While the structure of the protein is mainly composed of casein and whey proteins, it also contains enzymes and other compounds in its structure (Fox, 2003). Milk protein with a high content of essential amino acids is accepted as a quality protein and is used as a standard reference in the evaluation of protein quality in foods (Arabacioglu, 1993; Miller et al., 2000; Baysal, 2004). While the protein values of fresh chestnuts vary between 3.2-5%, this value was determined as 2% for boiled chestnuts and 3.2% for roasted chestnuts (Yurdakul, 2008). The lowest protein content in the samples was found to be 2.90% in the control, whereas the highest value was found as 3.52% in 25% RC. The addition of chestnut increased protein contents in the milk samples significantly. The values we found in our study were similar to those in the literature.

Determining the acidity level is important for the status of storage conditions, the decision of the heat treatment to be applied, the presence of any imitation, adulteration, and animal disease (Kırdar, 2001). In a study conducted to determine some quality criteria of UHT milks, the Soxhlet-Henkel degrees values of titration acidity of milk, strawberry flavored milk and chocolate milk were 7.73; 7.73; 6.67, respectively (Sonmez et al., 2010). Titration acidity in mango milk was found to be 0.14% in a study (Bajwa, 2013). The acidity value was similar to the mango milk sample, and the values were found to be 0.11-0.14%. The acidity values of CMs were not affected by the applied method and chestnut ratio.

The fiber content of chestnuts are polysaccharides, which stems from hemicellulose, cellulose and lignin in the cell wall (Van Soest, 1994). Most of them cannot be digested by the body, but can contribute to the development of the intestinal flora. Chestnut is recommended in diets to reduce the risk of cardiovascular and cancer diseases (Yurdakul, 2008; Candemir, 2011). While the fiber content in fresh chestnuts was determined as 8-10%, this ratio decreases to 0.7% and 0.9%, respectively, in boiled and roasted chestnuts (Yurdakul, 2008). The average fiber content of chestnut used in the CM samples was found to be 2.22 ±0.01%. The highest dietary fiber value was observed in 25% BC (0.78%), while the lowest dietary fiber content was observed in the control (0%) as expected. It was seen that as the amount of chestnut increased, the ratio of dietary fiber increased. It was observed that by adding a source of fiber to milk, a beverage that does not contain dietary fiber, a functional feature was added to the final product.

When the nutritional elements of chestnuts are examined, it is seen that almost half of them are carbohydrates. It has an average carbohydrate content of 44.7%. Starch constitutes most of the carbohydrate with 25%. Amylose and amylopectin forms of starch have positive effects on human health due to energy values and intestinal activities. The distinctive taste of the fruit when cooked is due to starch (Bernárdez, 2004; Yurdakul, 2008; De Vasconcelos et al., 2010; Candemir, 2011). The carbohydrate of milk was calculated as 5.93 ±

0.06% and 39.67 ±0.01% for chestnuts. The energy values of the raw materials were calculated as 64.70 ±0.40 kcal and 181 ±4.6 kcal, for milk (100 mL) and chestnuts (100 g). As the ratio of chestnuts increased, the carbohydrate and energy values increased. While the sample with the highest carbohydrate and energy value was the 25% RC sample, the lowest sample was observed in the 5% BC sample. In the chestnuts added at the same ratio, it was observed that the roasted method had more carbohydrate and energy value than the bain-marie method. This difference was similar to the studies in the literature. In a study, it was determined that when the chestnut was boiled, the moisture content increased and the total energy value decreased by 25% to 120 kcal. The starch composition also changed during boiling. When roasted, the humidity rate decreased by 20%, the amount of sugar increased by 25% and the energy value increased to 200 kcal. (Neri et al., 2010) In another study, the energy values given for 100 grams of fresh chestnuts, boiled chestnuts and roasted chestnuts were stated to be 160-199, 131, 245 kcal, respectively (Yurdakul, 2008).

There are a few studies on the color analysis of milk and dairy products. The color values of the produced CM samples were affected by the milk and chestnuts used. Color analysis results of the CM samples are given in Table 4. In this study, the color values of chestnuts were found to be 76.50 ±0.1 for *L**; 1.88 ±0.05 for *a**; and 16.60 ±0.47 for *b**. These values were close to the literature values. At the same ratio, the *L** values of the BC samples were higher than the RC samples. The *L** value decreased as the chestnut ratio increased. The *a** value of the milk used in the samples was measured as -0.45 ±0.01. When the *a** values of the samples were examined, the highest redness value was the 25% RC sample and the lowest was the 5% BC sample. As the chestnut ratio increased, the degree of redness increased. The redness of the roasted samples added at the same ratio was higher than the bain-marie. It is estimated that the dark colored compounds formed by enzymatic and non-enzymatic reactions because this color change observed with the effect of baking. The *b** value of the milk used in the samples was determined as 12.37 ±0.03. The *b** value decreased when the chestnut ratio increased. In addition, the BC samples had higher *b** values than the RC samples.

Mineral Contents

Chestnut is especially rich in terms of K, P, Mg, Fe, Mn and Cu content (Diehl, 2002). When the CM samples were examined, it was found that the K, P, Ca, Na and Mg contents were high, respectively. As the ratio of added chestnut increases, the amount of mineral content increases (except Na). As the chestnut ratio increased, the sodium content decreased. Some studies had shown that heat treatment applied to milk reduced the amount of Na (Yurdakul, 2008; Neri et al., 2010), which was similar to this study. The mineral content results of the CM samples are given in Table 5. When the calcium values were evaluated; there was no statistically significant difference between those containing 15% and 25% chestnut. On the other hand, the samples containing milk and 5% chestnut were statistically the same. Considering the data as potassium in terms of method, it was observed that the roasted samples had a higher content than the bain-marie samples. The highest value in terms of phosphorus was observed in 25% roasted chestnut. In magnesium analysis, no statistically significant difference was observed in those containing 5% chestnut, and the roasted samples were higher than the bain-marie ones.

Antioxidant Capacity

The antioxidant capacity analysis determined according to methods of ABTS, CUPRAC, and DPPH assays. The absorbance of the extracts was determined spectrophotometrically (Jenway, 6405 UV/Vis). The antioxidant capacity results of the CM samples are given in Table 6. The ABTS values of the samples were found to be between 33-328 µM TEAC, and the antioxidant capacity of the samples increased as the amount of chestnuts added increased. Changing the heat treatment method of chestnuts had no effect on their antioxidant capacity. In a study conducted in Turkey on the antioxidant capacity of pasteurized and UHT milk, milk (3.2% fat), partially-skimmed (1.8%) and skimmed UHT milk, ABTS average values were determined as 240.30 ±1.06, 209.81 ±2.16; 216.78 ±4.81µM TEAC, respectively (Ertan et al., 2017), and it was observed to be higher than the values we determined. This difference is thought to be due to the composition of UHT milk which was used in our study.

The antioxidant capacities of the samples were determined between 60710-77496 µM TEAC values with the CUPRAC method, which were the highest values determined in the antioxidant capacity analyses. It was observed that the ratio of added chestnuts increased the antioxidant capacity and that the chestnut cooking method, however, had no effect on the capacity.

The antioxidant capacity values of 5262-6099 µM TEAC of the samples were determined with the DPPH method. As in the other methods, as the ratio of added chestnut amounts increased, the capacity values increased, and the heat treatment method applied to chestnuts had no effect.

Table 4. Color values of chestnut milk samples

Method	Chestnut Ratio (%)	*L**	*a**	*b**
Bain-marie	0	92.72±0.10^{aA}	-0.45±0.01^{cE}	12.37±0.03^{aA}
	5	87.50±0.32^{bB}	0.67±0.04^{aC}	11.79±0.36^{bB}
	15	85.75±0.43^{cC}	0.51±0.06^{bD}	11.13±0.36^{cC}
	25	84.45±0.05^{dD}	0.69±0.01^{aC}	11.01±0.08^{cC}
Roasted	0	92.72±0.10^{aA}	-0.45±0.01^{cE}	12.37±0.03 ^{aA}
	5	84.46±0.33^{bC}	1.34±0.09^{cB}	11.37±0.38^{bB}
	15	80.44±0.26^{cD}	2.52±0.14^{bA}	10.10±0.39^{cC}
	25	78.73±0.25^{dE}	2.53±0.18^{aA}	10.04±0.13^{cC}

All data are expressed as mean ± standard deviations (n=3). Mean values showed with different lower letters in the same column for each chestnut addition levels are significantly different ($p \leq 0.05$). Mean values showed with different capital letters in the same column for each milk samples are significantly different ($p \leq 0.05$).

Table 5. Mineral content values of chestnut milk samples

Method	Chestnut Ratio (%)	Na (mg/L)	Ca (mg/L)	K (mg/L)	P (mg/L)	Mg (mg/L)
Bain-marie	0	366.90±1.30^{aA}	685.20±35.20^{dC}	1247.50±79.10^{cF}	834.40±10.0^{dE}	83.70±2.10^{dD}
	5	356.83±2.22^{bB}	707.45±8.99^{cC}	1272.47±11.38^{cF}	866.18±1.91^{cD}	89.83 ±0.64^{cE}
	15	337.35±1.46^{cD}	773.75±7.99^{bB}	1474.0 ±10.97^{bD}	936.95±10.54^{bC}	93.78 ±1.01^{bD}
	25	309.83±0.81^{dE}	807.52±12.70^{aB}	1591.83±42.46^{aB}	957.95±14.20^{aB}	109.47±1.65^{aC}
Roasted	0	366.90±1.30^{aA}	685.20±35.20^{bC}	1247.50±79.10^{dF}	834.40±10.0 ^{cE}	83.70±2.10^{dD}
	5	364.35±1.14^{aA}	688.52±10.31^{bC}	1311.98±19.05^{cE}	870.88±7.10^{bD}	94.37 ±0.33^{cE}
	15	358.22±1.42^{bB}	873.73±56.51^{aA}	1477.50±40.11^{bC}	950.02±12.81^{aBC}	105.48±7.56^{bB}
	25	344.47±1.06^{cC}	885.2 ±78.67^{aA}	1729.83±28.69^{aA}	982.17±17.68^{aA}	116.35±8.22^{aA}

All data are expressed as mean ± standard deviations (n=3). Mean values showed with different lower letters in the same column for each chestnut addition levels are significantly different ($p \leq 0.05$). Mean values showed with different capital letters in the same column for each milk samples are significantly different ($p \leq 0.05$).

Total Phenolic Content

In a study on different nuts, the total phenolic content of chestnut was stated as 92 mg GAE/100g dry matter (Abe et al., 2010). In the study on chestnuts and walnuts collected from different regions, the lowest total phenolic content of chestnuts was found to be 5 GAE/g dry matter, whereas the highest total phenolic content was 32.82 GAE/g dry matter (Selek, 2011). De Vasconcelos et al., (2007) found the total phenolic content of chestnuts as 15.80 mg GAE/g dry matter.

The total phenolic contents of fat, semi-skimmed and skimmed milk were found to be 982.14 mg GAE/L, 515.19 mg GAE/L, 505.47 mg GAE/L, respectively, in Turkey (Ertan et al., 2017). In another study, strawberry milk, chocolate milk and milk were determined in the range of 1046.60-1414.60 mg GAE/L, 834.60-2347.20 mg GAE/L, 936.60-1066.60mg GAE/L, respectively (Sonmez et al., 2010). The total phenolic content results of the CM samples are given in Table 6. The total phenolic content of the samples in our study was between 1628.7-2020.1 mg GAE/L, which was similar to the above mentioned study. As the ratio of chestnuts increased, the total phenolic content of the samples increased due to the total phenolic content of the chestnut. The heat treatment method applied to chestnuts did not cause statistical differences.

Sensory Evaluation

The sensory evaluation of the CM samples was performed by forty five untrained panelists including twenty males and twenty five females with ages ranging from 18 to 35. Before starting the analysis, the necessary information was given to the panelists and the samples were given to the panelists by coding with 2-digit numbers. The product was evaluated in terms of appearance, consistency, color, taste and overall acceptability. The sensory evaluation results of the CM samples are given in Table 7 and Table 8.

When the appearance of the samples was examined, the heat treatment method and the rate of the addition of chestnuts did

not make a significant difference. The panelists considered the intensity, fluidity and homogeneity sub-criteria while evaluating the consistency. The most desired sample by the panelists was the 5% RC samples. The panelists scored for colour based on light, dark, matte and glossy sub criteria. As the amount of chestnut in the RC samples increased, the degree of liking decreased. No significant difference was observed in the evaluation of the BC samples or all the samples. the samples with 5% chestnut addition were most appreciated. In terms of taste, the most preferred one was the 5% RC sample, whereas the least preferred one was the control sample. As the final assessment of sensory analysis, the panelists were asked to rate the overall liking of the samples. There was no difference between the BC samples. On the other hand, as the ratio of chestnuts increased in the RC samples, the acceptability decreased. When all the samples were evaluated, the 5% RC sample was the most desired sample.

Table 6. Antioxidant capacity and total phenol content of chestnut milk samples

Method	Chestnut Ratio (%)	ABTS (µM TEAC)	CUPRAC (µM TEAC)	DPPH (µM TEAC)	Total Phenolic Content (mg GAE/L)
Bain-marie	0	33.0 ± 0.9^{dD}	60710 ± 1485^{cC}	5262 ± 794^{aC}	1628.7 ± 43.0^{cC}
	5	89.8 ± 2.8^{cC}	70656 ± 2008^{bB}	5581 ± 675^{aBC}	1864.3 ± 32.2^{bB}
	15	181.3 ± 6.5^{bB}	75826 ± 580^{aA}	5906 ± 556^{aAB}	1959.2 ± 16.1^{abA}
	25	328.2 ± 0.9^{aA}	77496 ± 622^{aA}	5965 ± 1706^{aA}	2020.1 ± 37.6^{aA}
Roasted	0	33.0 ± 0.9^{dD}	60710 ± 1485^{aC}	5262 ± 794^{dC}	1628.7 ± 43.0^{cC}
	5	108.4 ± 11.5^{cC}	65772 ± 2828^{aC}	5507 ± 1106^{cC}	1685.7 ± 16.1^{bC}
	15	216.2 ± 8.8^{bB}	67182 ± 693^{aBC}	5985 ± 774^{bcBC}	1754.1 ± 59.1^{bC}
	25	310.5 ± 24.0^{aA}	68622 ± 184^{aBC}	6099 ± 60^{bAB}	1993.5 ± 21.5^{aA}

All data are expressed as mean ± standard deviations (n=3). Mean values showed with different lower letters in the same column for each chestnut addition levels are significantly different ($p \leq 0.05$). Mean values showed with different capital letters in the same column for each milk samples are significantly different ($p \leq 0.05$).

Table 7. Sensory analysis sub criteria of chestnut milk samples

Method	Chestnut Ratio (%)	Appearance			Consistency			Color			
		Homogeneous	Particulate	Sediment	Density	Fluid	Homogeneity	Light	Dark	Matte	Gloss
Bain-marie	0	7.3 ± 1.8^{A}	4.7 ± 3.2^{A}	4.8 ± 3.3^{A}	4.9 ± 2.7^{A}	7.1 ± 1.8^{A}	6.9 ± 2.2^{A}	6.9 ± 2.1^{A}	4.8 ± 2.7^{AB}	5.5 ± 2.4^{A}	6.5 ± 2.1^{A}
	5	6.9 ± 1.9^{aA}	4.6 ± 2.7^{aA}	4.7 ± 2.9^{aA}	5.0 ± 2.1^{aA}	7.0 ± 1.4^{aA}	6.9 ± 2.0^{aA}	6.5 ± 1.8^{aA}	4.9 ± 2.2^{aAB}	5.7 ± 2.0^{aA}	5.9 ± 2.0^{aAB}
	15	7.1 ± 2.1^{aA}	4.4 ± 3.1^{aA}	4.5 ± 3.2^{aA}	4.6 ± 2.4^{aA}	7.1 ± 1.9^{aA}	7.0 ± 2.0^{aA}	6.7 ± 2.0^{aA}	3.9 ± 2.5^{bB}	5.02 ± 2.4^{aA}	5.7 ± 2.1^{aAB}
	25	5.8 ± 2.5^{bB}	4.7 ± 2.8^{aA}	4.5 ± 2.7^{aA}	5.1 ± 2.2^{aA}	6.0 ± 2.4^{bB}	5.7 ± 2.7^{bB}	5.5 ± 2.2^{bBC}	5.3 ± 2.2^{aA}	5.5 ± 2.3^{aA}	5.2 ± 2.1^{aB}
Roasted	0	7.3 ± 1.8^{A}	4.7 ± 3.2^{A}	4.8 ± 3.3^{A}	4.9 ± 2.7^{A}	7.1 ± 1.8^{A}	6.9 ± 2.2^{A}	6.9 ± 2.1^{A}	4.8 ± 2.7^{AB}	5.5 ± 2.4^{A}	6.5 ± 2.1^{A}
	5	7.1 ± 2.1^{bA}	4.9 ± 3.2^{bA}	5.0 ± 3.1^{bA}	5.6 ± 2.4^{bA}	7.0 ± 1.9^{cA}	7.0 ± 1.9^{cA}	6.7 ± 1.9^{cA}	5.1 ± 2.4^{cA}	5.5 ± 1.9^{bA}	6.3 ± 1.8^{bA}
	15	6.9 ± 2.3^{bA}	4.6 ± 3.0^{bA}	4.7 ± 3.0^{bA}	5.5 ± 2.4^{bA}	6.8 ± 2.1^{cAB}	6.6 ± 2.2^{cA}	6.1 ± 2.0^{cAB}	5.4 ± 2.3^{cA}	5.4 ± 2.1^{bA}	5.8 ± 1.9^{bcAB}
	25	6.6 ± 2.059^{bAB}	4.8 ± 2.8^{bA}	4.9 ± 2.9^{bA}	5.2 ± 2.3^{bA}	6.7 ± 2.0^{cAB}	6.5 ± 2.1^{cAB}	5.2 ± 2.1^{dC}	5.0 ± 2.3^{cA}	5.4 ± 2.2^{bA}	5.3 ± 2.2^{cB}

All data are expressed as mean ± standard deviations (n=3). Mean values showed with different lower letters in the same column for each chestnut addition levels are significantly different ($p \leq 0.05$). Mean values showed with different capital letters in the same column for each milk samples are significantly different ($p \leq 0.05$).

Table 8 .Sensory analysis of chestnut milk samples basic criteria

Method	Chestnut Ratio (%)	Appearance	Consistency	Color	Odor	Taste	Overall Acceptability
Bain-marie	0	5.6 ± 2.4^{A}	6.3 ± 1.8^{AB}	5.9 ± 1.8^{A}	5.4 ± 2.5^{AB}	4.4 ± 2.7^{C}	4.8 ± 2.6^{B}
	5	5.4 ± 2.0^{aA}	6.3 ± 13^{aAB}	5.8 ± 1.2^{aA}	5.7 ± 2.0^{aA}	5.1 ± 1.9^{aBC}	5.0 ± 1.9^{aB}
	15	5.3 ± 2.3^{aA}	6.2 ± 1.7^{abAB}	5.3 ± 1.5^{aA}	4.5 ± 2.1^{bB}	4.8 ± 2.3^{aBC}	5.0 ± 2.0^{aB}
	25	5.0 ± 1.9^{aA}	5.6 ± 2.0^{bB}	5.4 ± 1.7^{aA}	5.0 ± 2.0^{abAB}	4.7 ± 2.3^{aBC}	4.5 ± 2.1^{aB}
Roasted	0	5.6 ± 2.4^{A}	6.3 ± 1.8^{AB}	5.9 ± 1.8^{A}	5.4 ± 2.5^{AB}	4.4 ± 2.7^{C}	4.8 ± 2.6^{B}
	5	5.7 ± 2.4^{bA}	6.5 ± 1.7^{cA}	5.9 ± 1.5^{bA}	5.9 ± 2.2^{cA}	6.3 ± 2.2^{bA}	6.0 ± 2.2^{bA}
	15	5.4 ± 2.3^{bA}	6.3 ± 1.8^{cAB}	5.7 ± 1.4^{bcA}	5.4 ± 2.2^{cAB}	5.6 ± 2.3^{bcAB}	5.5 ± 2.2^{bcAB}
	25	5.5 ± 2.0^{bA}	6.1 ± 1.7^{cAB}	5.2 ± 1.4^{cA}	4.6 ± 2.1^{cdB}	4.8 ± 2.3^{cBC}	4.9 ± 2.0^{cB}

All data are expressed as mean ± standard deviations (n=3). Mean values showed with different lower letters in the same column for each chestnut addition levels are significantly different ($p \leq 0.05$). Mean values showed with different capital letters in the same column for each milk samples are significantly different ($p \leq 0.05$).

Conclusion

The purpose of investigating chestnut milk production and its properties is to produce a functional product and examine its properties. Chestnuts are actively processed in Turkey, especially in Bursa. Here, it is aimed to develop a product with high added value by developing a new product alternative to the market and increasing the usage possibilities of the product. The addition of chestnut to milk increased the mineral content of milk (except Na) and added dietary fiber to the product content; however, it provided a beverage with more calories and high energy than milk. However, this energy increase was similar to all other flavoured milks. The addition of chestnuts to milk increased the antioxidant capacity and total phenolic content of the milk. In the sensory evaluation of the product, it was observed that the 5% RC sample was preferred most, and even more preferred than milk. Also, stevia is a natural sweetener. Unlike artificial sweeteners, it does not leave metalish and bitter taste in the mouth. so it can be used as an alternative to artificial sweeteners.

As a result, chestnut could be expressed as a suitable nut for functional food formulations by increasing the bioactive potential and providing quality parameters and sensory evaluation. Chestnut-added milk is a beverage alternative that can be recommended especially to children who don't like to drink milk, pregnant women, sports and individuals who care about their diet.

Compliance with Ethical Standard

Conflict of interests: The author declares that for this article they have no actual, potential or perceived conflict of interests.

Ethics committee approval: Author declare that this study does not include any experiments with human or animal subjects.

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Food allergy knowledge, attitudes, and practices of food handlers working in the five-star hotel kitchens in Turkey

Uğur LOKMAN[1], Aylin AKOĞLU[2]

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[1] Istanbul Gedik University, Faculty of Fine Arts and Architecture, Department of Gastronomy and Culinary Arts, İstanbul Turkey

[2] Abant Izzet Baysal University, Faculty of Health Sciences, Department of Nutrition and Dietetics, Bolu, Turkey

RCID IDs of the authors:
U.L. 0000-0002-3004-2303
A.A. 0000-0002-0136-4928

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Correspondence:
Uğur LOKMAN
E-mail: ugur.lokman@gedik.edu.tr

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ABSTRACT

The purpose of this study is to determine the food allergy knowledge, attitudes and practices of food handlers working in five-star hotel kitchens in Turkey and to explore the association between the obtained scores and handlers' demographic and working characteristics. A cross-sectional survey involving 450 food handlers in the state of Istanbul, Ankara and Antalya, in Turkey, was conducted using a paper-based questionnaire. The total knowledge score of the participants was 11.89 ±2.22 (max 17), attitude score 60.63 ±10.34 (max 75) and practice score 55.60 ±8.01 (max 65). In the comparison based on demographic characteristics; the knowledge (12.10 ±2.15) and practice (56.33 ±5.91) scores of the food handlers who received food allergy training in the hotel they work were found to be significantly higher than those who did not receive food allergy training ($p<0.05$). Food allergy knowledge of food handlers was evaluated as "average", attitude as "positive", and practice as "low risk practice". The results obtained are expected to contribute to the development of food allergy policies, procedures, and the planning of the necessary trainings for reducing the risks of food allergies and preventing fatal allergic reactions.

Keywords: Food allergy, Knowledge, Attitude, Practices, Food handlers, Hotel kitchen

Introduction

Allergy has become one of the major problems in Western societies in the 20th century. There are estimated 220-250 million people worldwide affected by allergic diseases. Food allergy accounts for a significant part of allergic diseases (Olivier, 2013). It has been increasing in prevalence in the last 2 to 3 decades (Seth et al., 2020). Changes in the environment, lifestyle, and dietary habits (Sicherer, 2011) may have resulted in the increase of food allergies. Sicherer and Sampson (2014) stated that food allergy cases are mostly encountered in the United States. It is estimated that approximately 15 million people in the USA, 5.9 million of which are children, have food allergies (FARE, 2020). It is reported that one in every 17 children in England and 10 children in Australia has food allergy; while one out of every 17 children in Turkey have food allergy, although this varies according to region (Güler, 2019). In Turkey, as in the world, the prevalence of food allergies increases gradually (Sapan et al., 2013).

Food allergy is an excessive (abnormal-adverse) reaction initiated by the immune system to a particular food (Boyce, 2012). It has been reported that the only way to prevent reactions in case of food allergy is to remove the food that evokes the allergy from the diet (Stjerna et al., 2014). In an individual with food allergy, an allergic reaction occurs a few minutes or hours after exposure to the allergen food. While some symptoms of food allergic reactions are mild (i.e., rashes, itching, and swelling), the severe reaction known as anaphylactic shock could be lethal (National Institute of Allergy and Infectious Disease, 2019). It is estimated that every year, food allergies are responsible for roughly 30,000 medical emergencies and 150-200 deaths in the U.S. (Sampson, 2004). In addition to their life-threatening nature, allergic reactions also cause psychological problems such as increased anxiety, demoralization, limited socialization, and decreased quality of life (Gaspar-Marques et al., 2014).

Eating out is dangerous for an individual with food allergy. Providing allergen-free food to customers with food allergies is difficult as eating out habits and the prevalence of food allergies are increasing (Kwon and Lee, 2012). There are a range of factors that could potentially lead to food allergic reactions, including cross-contact, miscommunication between wait staff and cooks, ingredients not listed by restaurants on menus, and contact with food residuals. In addition, incomplete food labels and hidden allergens in mixed dishes can also lead to allergic reactions to food (Lee and Barker, 2016). Taking these factors into consideration, it is evident that food handlers play a key role in preventing food allergies (Shafie and Azman, 2015). A food handler is a person who is directly involved in preparing food, in contact with food or food contact surfaces and/or handles packaged or unpackaged food or appliances in any food premise. Food handlers in hotel consist of cooks. It is essential that these individuals should possess sufficient knowledge, attitude and practice level about food allergy and should realize the due importance of the issue very well. The best practice to achieve this is to provide food allergy training in parallel with food safety training to relevant food handlers. However, previous research has shown that many food handlers receive no or very little food allergy training (Ahuja and Sicherer, 2007; Lee and Barker, 2016; Lee and Sozen, 2016; Mandabach et al., 2005; Wen and Kwon, 2017).

Hotels, being an important branch of the tourism sector, provide catering for millions of people. Hence, food safety, hygiene, and sanitation are the most critical issues need to be considered by hotel management. If due attention is not paid for these issues during the preparation and service of the food, it might cause health threats for both staff and the customers (Baser et al., 2017). It is necessary to reveal the current situation and to identify the deficiencies in order to take corrective actions. Understanding these gaps will help plan and implement policies and training that will benefit both administrative staff and employees.

In parallel with the significant increase in fatal cases of allergic reactions, the issue of food allergy has attracted the attention of public health authorities, particularly regarding the practice among food handlers. The high knowledge, attitude, and practice of food handlers regarding food allergies have a very important effect in preventing possible reactions. For this purpose, many studies have been conducted to measure the food allergy knowledge, attitude and practice of restaurant employees (Ahuja and Sicherer, 2007; Bailey et al., 2014; Choi and Rajagopal, 2013; Common et al., 2013; Lee and Barker, 2016; Shafie and Azman, 2015; Sogut et al., 2015; Tatlı and Akoğlu, 2020; Wen and Kwon, 2017), however, no previous study has been found to measure the knowledge, attitude and practice of employees in hotels. The purpose of this study is to measure the food allergy knowledge, attitude and practice of the food handlers working in five-star hotels in Turkey. The findings to be reached are expected to help making suggestions on the subject and taking measures.

Materials and Methods

Research Design and Participants

Since the tourism sector is a service sector and the hotel workers are busy in the summer season, this study was held between December and May 2018 which are off-peak period. A total of 540 questionnaires were collected; however, 450 eligible questionnaires were used for data analysis since 90 were excluded due to missing data. The sample consists of 450 food handlers working in five-star hotels located in three major cities of Istanbul, Ankara and Antalya which are among the three largest cities in Turkey and also have high tourism potential. For the research to reach 95% confidence level, the number of 384 that corresponds to 100.000-1.000.000 sample interval was taken as basis (Lorcu 2015), and our sample size was considered sufficient since it was larger than this value. Participants were selected by simple random sampling method. While individuals who were literate and worked as executive chef, assistant chef, section chef, chef, comi and steward staff were included in this study, individuals who did not wish to enroll in the research voluntarily, had less than six months of work experience, and could not speak and understand Turkish were not included. The participants were informed about the purpose and content of the study and the researchers obtained written consent forms from the participants. The Ethics Committee of Human Studies in Social Sciences of Abant Izzet Baysal University approved the study (no: 2018/21).

Questionnaire Design

The questionnaire form was developed using related resources and some previous studies on the issue (Choi and Rajagopal, 2013; Shafie and Azman, 2015; Dupuis et al., 2016; Soon, 2019). The questionnaire constructed and divided into four sections. The first section of the questionnaire solicited demographic information from the participants. Second section consisted of 17 items to evaluate food allergy knowledge. The scores on the food allergy knowledge questions were recorded as "1" for a correct answer and "0" for an incorrect answer. As an appendix to this section, an extra part comprising 13 items to measure food handlers' knowledge of the most eight common food allergens were added. The third section contained 15 items that assessed food allergy attitudes using a 5-point Likert scale, ranging from one (1) "Strongly disagree" to five (5) "Strongly agree". The fourth section contained 13 items that assessed food allergy practice using a 5-point Likert scale (1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Usually, 5 = Always). Accordingly, knowledge score was evaluated within a range of 0-17, attitude score 15-75, and practice score 13-65.

Data Analysis

The data obtained was analyzed using Statistical Package for Social Sciences (SPSS) version 20. Descriptive statistics including frequencies, percentage distributions, means, and standard deviations were used to evaluate demographic characteristics. Cronbach's coefficient of reliability was calculated and found as 0.64 (knowledge), 0.91 (attitude) and 0.81 (practice), and these values were determined to be sufficient in terms of reliability (Ural and Kılıç, 2013). Normality test was performed using the Kolmogorov-Smirnov test. Kruskal Wallis and Mann Whitney U test were used to examine significant differences in food allergy knowledge, attitudes, and practices on demographic characteristics. Games-Howell and Tamhane's T2 non-parametric post-hoc tests were conducted to determine within group differences. Spearman's correlation coefficient was used to test the association between knowledge, attitudes and practices scores of the participants. Findings with a p-value <0.05 were considered to be statistically significant.

The scoring scale applied in the study of Shafie and Azman (2015) was used to evaluate the mean score ranges of the knowledge, attitude, and practice. The score for each section was converted to a percentage by dividing the total score by the maximum score obtainable and the obtained values were assessed over three ranges. The first range, which was <25 was interpreted as poor knowledge/negative attitude/high risk practice, the second range, 25-75 as moderate knowledge/moderate attitude and moderate risk practice, and the third range, >75 was excellent knowledge/positive attitude and low risk practice.

Results and Discussion

Sample Characteristic

Demographic characteristics of participants were shown in Table 1. Percentage of male participants (71.8%) is higher than that of female (28.2%). Nearly half of participants (44%) are high school graduates. The majority of participants consist of section chefs (28.9%) and the chefs (38.7%). When examined with regards to age ranges, nearly half of participants (46.2%) range between 25-34 years of age. In terms of years of service in the profession; it was identified that 18.7% is in food business for 1-5 years, 36.4% for 6-10 years, 20.7% for 11-15 years, 14% for 16-20 years and 10.2% for 21 years and more. It was determined that 60.3% of participants received food allergy training at workplace. It was found that the majority of participants (77.3%) had not been exposed to food allergies.

Table 1: Demographic characteristics of participants (n= 450)

Variable	Items	Frequency	%
Cities	Antalya	200	44.4
	Istanbul	150	33.3
	Ankara	100	22.3
Gender	Male	323	71.8
	Female	127	28.2
Age	≤24	57	12.7
	25-34	208	46.2
	35-44	139	30.9
	45 years and above	46	10.2
Education level	Primary school	78	17.3
	Secondary school	95	21.1
	High school	198	44
	Undergraduate/postgraduate	79	17.6
Position	Executive Chef	19	4.2
	Assistant Chef	25	5.6
	Section Chef	130	28.9
	Chef	174	38.7
	Comi	89	19.7
	Steward	13	2.9
Work experience	1-5 years	84	18.7
	6-10 years	164	36.4
	11-15 years	93	20.7
	16-20 years	63	14
	≥ 21 years	46	10.2
Have you received any training on food allergies?	Yes	306	67.8
	No	144	32.2
Have you received training on food allergies at workplace?	Yes	272	60.3
	No	178	39.7
Have you been exposed to a food allergy?	Yes	102	22.7
	No	348	77.3

Total Food Allergy Knowledge, Attitudes and Practices Score by Respondent Characteristic

The total knowledge, attitude and practice scores of the food handlers and the differences among these scores according to demographic characteristics as shown in Table 2. As a result of the analysis, Cronbach α coefficients were found as 0.64 (knowledge), 0.91 (attitude) and 0.81 (practice), and these values were determined to be sufficient in terms of reliability (Ural and Kılıç, 2013).

The mean knowledge score of participants was 11.89 ± 2.22 (max 17), the attitude score 60.63 ± 10.34 (max 75) and the practice score 55.60 ± 8.01 (max 65). Expressing these results in percentage terms (Shafie and Azman, 2015); it was determined that the participants had moderate knowledge (70%), positive attitude (81%) and low risk practices (86%). It was found that the food allergy attitude scores of the participants significantly varied based on the cities where the business is located ($p<0.05$). A significant difference was found between the food allergy knowledge and attitude scores with respect to the age range of the participants ($p<0.05$). Food allergy knowledge ($\bar{x}$:11.12) and attitude ($\bar{x}$:56.23) scores of food handlers under the age of 24 were found to be significantly lower than those aged 25 and over. A significant difference was found among the food allergy knowledge scores of the participants based on their education level ($p<0.05$). It was determined that the knowledge scores of primary school graduates ($\bar{x}$:10.88) were significantly lower than those with secondary, high school, undergraduate and higher education ($\bar{x}$:11.42, 11.77, 12.26, respectively). There was a significant

difference among the food allergy attitude and practice scores of the participants with respect to their workplace positions ($p<0.05$). The food allergy attitude ($\bar{x}$:64.52) score of the executive chefs was found to be significantly higher. A significant difference was identified among the food allergy practice scores of the participants with respect to their work experience ($p<0.05$). It was determined that the food allergy practice scores of the food handlers with 16-20 ($\bar{x}$:57.10) and 21 years or more ($\bar{x}$:57.17) work experience were significantly higher than those with 15 years or less. A significant difference was determined among the food allergy knowledge and practice scores of the participants with respect to whether they received any food allergy training at workplace ($p<0.05$). Food allergy knowledge ($\bar{x}$:12.10) and practice ($\bar{x}$:56.33) scores of food handlers who received food allergy training at workplace were found to be significantly higher than those with no training ($\bar{x}$:10.78 and $\bar{x}$:54.18, respectively). A significant difference was found among the food allergy attitude scores of the participants based on their exposure to food allergy ($p<0.05$). The attitude scores of food handlers exposed to food allergy ($\bar{x}$:64.52) were found to be significantly higher than those with no exposure experience ($\bar{x}$:60.82).

Total Food Allergy Knowledge Score

The distribution of food handlers' responses to the statements on food allergy knowledge as shown in Table 3. Participants gave mostly correct answers to statements about the definition of food allergy (93.3%), the importance of food allergy (96.2%), and allergic reactions (90.2%). They gave poor answers to the statements of "Food allergy is like food intolerance", "Lactose intolerance is like milk allergy", and "Food allergy can be result in death in severe cases" (40.9%, 50.2%, and 60.4%, respectively).

The capability of participants to select the eight most common allergens as shown in Table 4. Many participants managed to identify egg (93.3%), milk (90.2%), shellfish (86.4%), fish (81.3%), wheat (80.9%) and soy (80.7%) as six of the most common allergens, but not peanuts and tree nuts, which were identified by only 59.1% and 52.2% of the participants, respectively. A significant majority of the participants (90.7%) included gluten in the most common allergens group, although it was not an allergen.

Total Food Allergy Attitude Score

The distribution of participants' responses to the food allergy attitude statements as shown in Table 5. Participants' attitude towards the "importance of studies on food allergy" has the highest mean score (4.50 ±0.90), while the attitude regarding the capability to effectively manage a food allergy emergency in the kitchen has the lowest mean score (3.76 ±1.32).

Total Food Allergy Practices Score

The distribution of participants' responses to the practice statements as shown in Table 6. The mean score of the food handlers for food allergy practice was 4.36 ±1.02 on a five-point Likert scale. Participants had the highest mean score (4.67 ±0.80) on personal hygiene and the lowest mean score (3.60 ±1.02) on cross-contact.

Association among knowledge, attitudes, and practices of food allergy

Summary of correlation for the levels of knowledge, attitudes and practices as shown in Table 7. A significant weak positive correlation was observed between knowledge and attitude ($r_s=0.242$, $p<0.01$), knowledge and practice ($r_s=0.199$, $p<0.01$), and attitude and practice ($r_s=0.339$, $p<0.01$). The highest correlation was found to be between attitude and practice.

According to the findings obtained from the study, the knowledge score of the participants was determined as 70.9% (moderate), attitude score as 77.7% (positive) and practice score as 87.4% (low risk practice). Similarly, in the study of Shafie and Azman (2015) where they measured the food allergy knowledge, attitude, and practice of restaurant employees in Malaysia, the participants were found to have moderate knowledge (50.23%), positive attitude (54.26%) and moderate risk practice (45.90%). Lee and Barker (2016), in their study with local restaurant staff in Alabama, determined that the food allergy knowledge score of the participants were moderate (72.18%), similar to our study. Lefevre et al. (2018), different from this study and consistent with previous studies (Abbot et al., 2007; Ahuja and Sicherer, 2007; Bailey et al., 2014; Wen and Kwon, 2017; Wham and Sharma, 2014) reported that restaurant staff did not have sufficient knowledge about food allergy.

Table 2: The mean scores for knowledge, attitude and practice by demographic characteristics

Demographic characteristic			Knowledge		Attitude		Practice	
		n (%)	Mean ± SD		Mean ± SD		Mean ± SD	
	Items	450 (100)	11.89 ± 2.22 (0-17)	p	61.11 ± 11.20 (15-75)	p	55.60 ± 5.28 (13-65)	p
Cities	Antalya	200 (44.4)	12.15 ± 2.48	0.061	58.54 ± 12.81[b]	**0.050**	56.54 ± 4.86	0.055
	İstanbul	150 (33.3)	12.19 ± 1.96		64.13 ± 8.22[a]		56.08 ± 5.76	
	Ankara	100 (22.3)	10.89 ± 1.71		62.19 ± 10.49[a]		53.04 ± 7.83	
Gender	Male	323 (71.8)	11.93 ± 2.24	0.731	60.49 ± 11.11	0.405	55.11 ± 5.82	0.420
	Female	127 (28.2)	11.86 ± 2.21		60.98 ± 11.47		55.80 ± 6.67	
Age	≤24	57 (12.7)	11.12 ± 2.34[b]	**0.012**	56.23 ± 12.84[b]	**0.010**	55.44 ± 6.25	0.300
	25-34	208 (46.2)	12.01 ± 2.24[a]		60.95 ± 11.04[a]		55.07 ± 6.22	
	35-44	139 (30.9)	12.00 ± 2.05[a]		62.05 ± 10.49[a]		56.38 ± 5.84	
	≥45	46 (10.2)	12.28 ± 2.29[a]		62.19 ± 10.46[a]		55.77 ± 5.80	
Education Level	Primary school	78 (17.3)	10.88 ± 1.61[b]	**0.002**	59.50 ± 11.79	0.528	55.00 ± 6.71	0.089
	Secondary school	95 (21.1)	11.42 ± 1.92[a]		61.71 ± 10.77		56.32 ± 5.06	
	High school	198 (44)	11.77 ± 2.30[a]		60.48 ± 12.11		55.19 ± 6.17	
	Undergraduate/postgraduate	79 (17.6)	12.26 ± 2.18[a]		62.12 ± 7.51		56.33 ± 5.91	
Position	Executive Chef	19 (4.2)	12.16 ± 1.81	0.098	64.52 ± 6.42[a]	**0.010**	57.28 ± 5.73[a]	**0.034**
	Assistant Chef	25 (5.6)	12.10 ± 2.15		61.01 ± 8.33[b]		56.04 ± 6.21[a]	
	Section chef	130 (28.9)	11.91 ± 2.25		61.65 ± 10.74[b]		55.99 ± 5.73[a]	
	Chef	174 (38.7)	11.42 ± 1.92		60.43 ± 11.85[b]		55.68 ± 8.60[a]	
	Comi	89 (19.7)	11.36 ± 2.40		57.90 ± 14.23[c]		54.20 ± 5.33[b]	
	Steward	13 (2.9)	10.84 ± 2.08		57.77 ±14.12[c]		54.18 ± 5.59[b]	
Work experience	1-5 years	84 (18.7)	11.40 ± 2.45	0.121	59.00 ± 12.79	0.563	53.76 ± 6.39[c]	**0.002**
	6-10 years	164 (36.4)	11.95 ± 1.99		61.09 ± 10.87		55.78 ± 5.61[b]	
	11-15 years	93 (20.7)	12.06 ± 2.21		61.21± 10.47		55.19 ± 6.30[b]	
	16-20 years	63 (14)	12.19 ± 2.27		61.77 ± 10.22		57.10 ± 6.51[a]	
	≥ 21 years	46 (10.2)	11.52 ± 2.08		59.21 ± 11.98		57.17 ± 5.22[a]	
Received training on food allergies at workplace	Yes	272 (60.3)	12.10 ± 2.15[a]	**0.006**	61.42 ± 8.33	0.478	56.33 ± 5.91[a]	**0.017**
	No	178 (39.7)	10.78 ± 2.48[b]		61.01 ± 8.94		54.18 ± 6.21[b]	
Exposed to a food allergy	Yes	102 (22.7)	11.64 ± 2.21	0.138	64.52 ± 6.42[a]	**0.023**	55.88 ± 6.16	0.303
	No	348 (77.3)	11.95 ± 2.22		60.82 ± 11.70[b]		55.52 ± 6.06	

Table 3: Food allergen knowledge (n = 450)

Questions	Correct answers Frequency	(%)
A food allergy is an abnormal response of the immune system to an ordinarily harmless food or ingredient in a food.	420	93.3
Food allergies can adversely affect human health and may pose have serious consequences for some people.	433	96.2
Food allergens are usually proteins.	344	76.4
All steps from field to guest should be under control to avoid allergen cross-contact in foods	409	90.9
Food allergy can be serious but is not common	356	79.1
Food allergy is similar to food intolerance*	184	40.9
Food-allergic reactions occur within from 2 min to 12 hours	272	60.4
Spices are one of the most allergenic foods*	179	39.8
Individuals with food allergies can safely consume the foods that cause the allergies if only a small amount is consumed*	286	63.6
Cow milk is the most important and common allergic food for children.	330	73.3
Fish and seafood are allergic food for both adults and children.	322	71.6
Allergic reactions can be seen at the contact points of the food, such as lips or tongue, as well as throughout the body.	406	90.2
Lactose intolerance is similar to milk allergy*	226	50.2
Food allergy can be result in death in severe cases.	272	60.4
Cross-contact happens when one food meets another food and their proteins mix.	357	79.3
People with allergies come from families in which allergies are common.	351	78.0
High-temperature cooking such as roasting, baking and deep-frying can destroy food allergen	279	62.0

*Statements are incorrect knowledge

Table 4: The capability of participants to select the eight most common allergens

Eight most common allergens	Frequency	(%)
Peanuts*	266	59.1
Milk*	406	90.2
Tomato	196	43.6
Soy*	363	80.7
Fruits	173	38.4
Fish*	366	81.3
Shellfish*	389	86.4
Gluten	408	90.7
Monosodium glutamate	227	50.4
Sesame seed	362	80.4
Egg*	420	93.3
Wheat*	364	80.9
Tree nuts*	235	52.2

*Most common allergens

Table 5: Mean scores of items in attitude towards food allergy (n=450)

Attitude Statements	n (%)					
	SD	D	N	A	SA	Mean ± SD
Food allergy is an important part of my job	47 (10.4)	19 (4.2)	17 (3.8)	107 (23.8)	260 (57.8)	**4.14 ± 1.30**
I believe I will prevent food allergy if employees are careful with food allergens	32 (7.1)	26 (5.8)	25 (2.6)	107 (23.8)	260 (60.8)	**4.19 ± 1.21**
I am willing to attend food allergy training courses/workshops to learn more about food allergies	34 (7.6)	21 (4.7)	32 (7.1)	134 (29.8)	229 (50.9)	**4.11 ± 1.19**
I do not think that enough information is given about food allergy in the programs related to the field (gastronomy, cooking etc.)**	31 (6.9)	33 (7.3)	52 (11.6)	152 (33.8)	182 (40.4)	**3.93 ± 1.19**
I think individuals involved in food preparation should be more knowledgeable about food allergies	17 (3.8)	24 (5.3)	27 (6)	134 (29.8)	248 (55.1)	**4.27 ± 1.04**
I think the dishes made in the kitchen are reliable in terms of food allergies	25 (5.6)	38 (8.4)	37 (8.2)	155 (34.4)	195 (43.3)	**4.01 ± 1.16**
I do not believe I can effectively handle a food allergy emergency situation at my workplace**	45 (10)	44 (9.8)	56 (12.4)	133 (29.6)	172 (38.2)	**3.76 ± 1.32**
I think the manager in my workplace should educate me about food allergies and allergen handling	18 (4)	23 (5.1)	31 (6.9)	158 (35.1)	220 (48.9)	**4.19 ± 1.04**
I think, when allergic products are used in foods, the explanation about these allergens should be stated on the food label	19 (4.2)	14 (3.1)	33 (7.3)	143 (31.8)	241 (53.5)	**4.27 ± 1.02**
I believe that food allergy will benefit both my work and my personal life	21 (4.7)	14 (3.1)	31 (6.9)	122 (27.1)	262 (58.2)	**4.31 ± 1.04**
I believe that the disclosure of accurate allergen information to customers with a food allergy will decrease the likelihood of a food allergic reaction	23 (5.1)	14 (3.1)	30 (6.7)	143 (31.8)	240 (53.3)	**4.25 ± 1.06**
I believe that knowledge about food allergies would make me more confident about handling food at my workplace	16 (3.6)	19 (4.2)	19 (4.2)	138 (30.7)	258 (57.3)	**4.34 ± 0.99**
I believe appropriate precautions can be taken to avoid cross-contact between foods at my workplace	11 (2.4)	22 (4.9)	35 (7.8)	128 (28.4)	254 (56.4)	**4.31 ± 0.90**
It is important to me that accurate information about food ingredients is provided to customers with a food allergy	207 (46)	130 (28.9)	56 (12.4)	22 (4.9)	35 (7.8)	**3.96 ± 1.19**
I think studies on food allergy have an important place in order to ensure food safety	11 (2.4)	13 (2.9)	24 (5.3)	93 (20.7)	309 (68.7)	**4.50 ± 0.90**

Scale for statements: SD= Strongly Disagree; D= Disagree; N= Neutral; A= Agree; SA= Strongly Agree
*SD; standard deviation
** Item was reversely coded

Table 6: Mean scores of items in practice towards food allergy (1: Never to 5: Always) (n = 450)

Practice Statements (α = 0.81)	n (%)					
	Never	Rarely	Sometimes	Usually	Always	Mean ± SD
I wash my hands thoroughly with soap and water and wear a fresh pair of gloves before preparing an allergen-free meal.	12 (2.7)	2 (0.4)	24 (5.3)	69 (15.3)	343 (76.1)	**4.62 ± 0.83**
I wear clean uniforms in food preparation.	22 (4.9)	9 (2.0)	12 (2.7)	76 (16.9)	331 (73.8)	**4.52 ± 1.05**
I use cap or bone when preparing food.	9 (2.0)	11(2.4)	9 (2)	61 (13.5)	360 (79.8)	**4.67 ± 0.80**
I store allergen-free foods and allergen foods in the same places. *	225 (50)	60 (13.4)	25 (5.5)	41 (9.1)	99 (22)	**3.60 ± 1.07**
If a mistake is made when preparing a meal for a food allergic customer, I remake the food.	17 (3.8)	11 (2.4)	19 (4.2)	109 (24.2)	294 (65.2)	**4.44 ± 0.96**
When preparing fried food for patrons with a food allergy, I make sure that I change the oil in the deep fryer to prevent cross contact.	28 (6.2)	17 (3.8)	13 (3.1)	108 (23.9)	284 (63)	**4.32 ± 1.12**
I clean all the utensils before preparing food to prevent cross-contact.	6 (1.3)	20 (4.3)	16 (4)	103 (22.8)	305 (67.6)	**4.51 ± 0.85**
I use separate equipment (tongs, ladles) for handling allergen-containing foods.	31 (6.9)	52 (11.5)	26 (5.8)	93 (20.6)	248 (55.2)	**4.05 ± 1.30**
I use clean and sanitized equipment and utensils at my workplace to prevent cross-contact between allergens.	22(4.9)	15 (3.30)	18 (4)	113 (25.1)	282 (62.5)	**4.37 ± 1.05**
I prepare allergen-free foods to prevent cross-contact.	43 (9.5)	16 (3.5)	18 (4)	105 (23.3)	268 (59.4)	**4.19 ± 1.26**
When preparing the eight most common food allergens, I pay more attention to food processing practices.	37 (8.2)	54 (12)	27(6)	104 (23.1)	228 (50.6)	**3.96 ± 1.33**
I check the ingredients and read the contents before using the packaged foods.	15 (3.3)	12 (2.7)	20 (4.4)	93 (20.6)	311 (69)	**4.49 ± 0.94**
If one of my customers has a food allergy, I check again to make sure that the food is prepared safely and does not contain allergens.	26 (5.8)	20 (4.4)	19 (4.2)	105 (23.3)	280 (62.1)	**4.31 ± 1.12**

* Item was reversely coded

Table 7: Correlation among knowledge, attitudes, and practices of participants (n=450)

		Knowledge	Attitude	Practice
Knowledge	R	1.000		
	P	0.000		
Attitude	R	0.242**	1.000	
	P	0.000	0.000	
Practice	R	0.199**	0.339**	1.000
	P	0.000	0.000	0.000

*<0.05; **<0.01

In our study, the participants were able to define egg (93.3%), milk (90.2%), shellfish (86.4%), fish (81.3%), wheat (80.9%) and soy (80.7%) as the most common allergens at high percentages. As different results, in the studies of Tatlı and Akoğlu (2020) and Sogut et al. (2015), which were conducted with restaurant staff in Turkey, it was reported that most participants were not able to identify the eight most common allergenic foods. Choi and Rajagopal (2013) reported that participants working in a university foodservice operation were knowledgeable about food allergy; however, most of them lacked knowledge about top eight food allergens from a particular allergen list.

In similar studies conducted on food allergy, areas that need improvement are like those in previous studies. One of them is the finding that the participants lacked a sufficient level of

knowledge and practice on the difference between food allergy and food intolerance. Nonallergic food reactions, such as food intolerance, are commonly mistaken as food allergies (Seth et al., 2020). Features related to the ingredients of the food, or the enzymatic functions of the digestive system play a role in food intolerance. Food allergies affect the immune system, yet food intolerance affects the digestive system. While food intolerance is not life-threatening, food allergy can lead to death (FARE, 2020). Participants' poor rate of correct answers about the differences between food allergy and intolerance showed that they had insufficient knowledge on this subject. One of the most remarkable findings is that the vast majority of participants (90.7%) included gluten in the most common allergen group, although it was not an allergen. This is another result supporting that the difference between food allergy and intolerance is not fully comprehended. Similarly, Kwon and Lee (2012) and Lee and Sozen (2018) found that employees lacked knowledge about the difference between food allergy and food intolerance. Another striking result is that almost half of the participants did not know that food allergy is a fatal reaction. In contrast, Dupuis et al. (2016) showed that nearly all restaurant staff participating in their study knew that food allergy is a fatal reaction. This result indicated that food handlers should definitely be made aware of this situation, which has such serious consequences.

In our study, it was observed that the participants received poor scores in effectively handling food allergy emergencies. Similarly, Madsen et al. (2010) indicated that food handlers without sufficient knowledge on food allergies were more likely to inappropriately handle food allergy emergencies or address the needs of allergic customers. Considering that the most serious food allergy reactions and fatalities occur among adults (Bock et. al., 2001), the emergency responds conducted by employees prove to be crucial.

As another aspect that needs to be fixed with the participants, it has been determined that there is a lack of knowledge and practice regarding cross-contact. It was determined that the participants received low scores regarding cross-contact in food allergy knowledge and practice statements. Similarly, Kwon et al. (2020) found that participants' food allergy knowledge in general was high (82.3%), but they lacked sufficient knowledge about cross-contact. It is crucial for food handlers to have sufficient knowledge of cross-contact to reduce the risks posed by food allergies. On the other hand, individuals with food allergies should caution service staff about allergy while dining at the restaurant and share responsibility for preventing food allergy cases.

Food allergy knowledge and practice scores of food handlers who received food allergy training at workplace were found to be significantly higher than those with no training. In the study of Bailey et al. (2014), the knowledge level of employees officially with no former training on food allergy increased from 82% to 91% after food allergy training. In addition, the percentage of participants to identify at least three common allergens increased from 9% to 64%. These results reveal the necessity of staff training in order to increase the level of knowledge on food allergy. Since there is still no obligation for food allergy training in Turkey, there is lack of training on the subject as seen in this study. In numerous studies, the significance of increasing food allergy knowledge of food service employees through education is particularly emphasized (Choi and Rajagopal, 2013; Shafie and Azman, 2015). Although it is highlighted that food allergy training should be given within the context of food safety trainings, there are some challenges in the implementation of food allergy training such as cost of training employees, high turnover, time constraints, and indifference of employees towards food allergies (Choi and Rajagopal, 2013).

In the correlation analysis, it was determined that the knowledge, attitude, and practice of the participants were correlated. A positive change in any of the variables leads to a positive change in other variables as well. Accordingly, it can be asserted that if the food handlers had sufficient knowledge about food allergy, this would reflect positively on their attitudes and practices. Therefore, kitchen managers in charge in the hotels should put emphasis on in-service training and raise food allergy awareness among staff. It is anticipated that such efforts may have a positive impact on practices in improving food allergy knowledge and that the higher level of attitude of the staff will also reflect on their practices. In a similar study, Tatlı and Akoğlu (2020) reported that the increase in food allergy knowledge level of restaurant employees will positively affect their attitudes and practices in ensuring food safety. Unlike this study, Ansari-Lari et al. (2010) reported that there is a positive correlation between knowledge-attitude but a negative correlation between knowledge-practice and attitude- practice. Similarly, Clayton et al. (2002), Seaman and Eves (2010) stated that food safety training is not effective on practice and attitude.

Conclusion

This study provided information on food allergy knowledge, attitudes and practices of the food handlers working in five-star hotels in Turkey. Examining the participants' mean scores for knowledge, attitudes, and practices, it was found that they had moderate knowledge, positive attitude, and low risk practices. In addition, it was identified that the participants had deficiencies in particular issues such as cross-con-

tact, effective handling of food allergy emergencies, the distinction between intolerance and allergy, and the consequences of allergic reactions. It was found that more than half of the food handlers received food allergy training and the fact that level of knowledge turned out to be moderate emphasizes the importance of training on food allergy. Results strongly emphasize the need for continuous interventions, training and regulations of food safety to enhance food handlers' knowledge and improve food safety in hotels. Food handlers working in hotels in Turkey attach importance to food allergies; however, necessary measures should be taken for a more effective implementation. Most of the research on food allergy in Turkey has been carried out made in the form of review articles or pediatrics studies. Survey-based studies aimed at measuring the knowledge, attitude and practice of food handlers mostly remained in the background. Therefore, in the future, such studies should be carried out to raise food allergy awareness. The recent increase in allergic diseases should be taken into consideration and due importance should be placed in this regard. It is necessary to draw attention to the fact that food allergies are a growing food safety and public health problem, and their prevalence in our country should be examined, individuals at risk should be identified, and preventive measures should be taken. The involvement of government agencies is also important for the development of educational campaigns for consumers regarding this issue.

Compliance with Ethical Standard

Conflict of interests: The author declares that for this article they have no actual, potential or perceived conflict of interests.

Ethics committee approval: "Abant İzzet Baysal University Humanities Ethics Committee in Social Sciences" was received on 24.01.2018 with the document number 2018/21.

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Physical, nutritional, textural and sensory qualities of Turkish noodles produced with siyez wheat (*Triticum monococcum*), kale (*Brassica oleracea* var. *acephala*) and chia seed (*Salvia hispanica* L.)

Derya ÇAKMAKÇI[1], Ülgen İlknur KONAK[1], Yasemin YAVUZ ABANOZ[2]

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[1] Avrasya University, Faculty of Engineering and Architecture, Department of Food Engineering, 61250, Trabzon, Turkey

[2] Recep Tayyip Erdoğan University, Coordinating Office of Tea Specialization, 53020, Rize, Turkey

RCID IDs of the authors:

D.Ç. 0000-0002-6586-6847
Ü.İ.K. 0000-0002-0686-9116
Y.Y.A. 0000-0002-0093-3535

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Correspondence:
Ülgen İlknur KONAK
E-mail:
ulgen.ilknur.konak@avrasya.edu.tr

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ABSTRACT

In this study, physical (cooking time, water absorption, cooking loss and color), chemical (proximate composition, pH, total phenolic content, mineral matter (Ca, K, Fe, Mg and Zn)), textural (hardness and adhesiveness) and sensory (color, taste, flavor, appearance, hardness, adhesiveness and overall acceptability) attributes were determined in different types of noodles produced from siyez wheat flour, kale powder and chia seed mucilage. Results were statistically evaluated using SAS software. The optimal cooking time for the noodles were 20 min and cooking loss varied between 8.36-12.22%. Kale powder and chia mucilage addition decreased L* and a* values of the noodles. Ash, crude fiber, mineral matter and total phenolic contents of the noodles were higher and fat contents of the noodles were lower than the control sample. Hardness and adhesiveness of the noodles were decreased by addition of the kale powder at 10%. The noodles with higher hardness and lower adhesiveness were preferred by the panelists in sensory evaluation. Increasing the kale powder level in the noodle formulation from 5% to 10% resulted in higher color scores. However, the control sample was the most preferred sample in terms of taste.

Keywords: Einkorn, Freeze-dried powder, Mucilage, Turkish noodle

Introduction

Noodles have been produced in various contents and shapes and consumed widely in many Asian countries since ancient times. As become an internationally accepted food, worldwide consumption of noodle has been gradually increasing. Taste, nutritional content, easy and safe consumption, long shelf life and affordable prices of noodles have increased their popularity (Gulia *et al.*, 2014). Noodles have been also produced and consumed widely in Anatolia. Although industrial-based production of Turkish noodles (erişte) has been made in Turkey, they are made in rural areas and consumed locally. Noodles are usually prepared with three main ingredients; flour, water and salt. Noodle production steps are mixing, resting, dough rolling, thinning, cutting and drying, respectively (Bilgiçli, 2009; Levent, 2019). Noodle quality varies depending on the characteristics of the raw materials used in production. Important quality features used in the evaluation of noodle quality are color, flavor, texture and cooking quality. The structure of the cooked noodles should remain firm and not lose too much solid matter in cooking water. Additionally, they should not become sticky when standing after cooking (Khouryieh *et al.*, 2006). Wheat flour used as a raw material in noodle production is generally rich in starch; but the dietary fiber content of the flour is usually low. Thus, addition of fiber rich ingredients, especially fruit and vegetables, into baked products will improve their nutritional properties and also have positive effects on human health (Wani *et al.*, 2013). As a cold climate plant, kale is resistant to drought and has a wide production area in the world. It is the most typical winter vegetable grown and consumed in Turkey, especially in the Eastern Black Sea Region. Kale production of Turkey was 56 thousand tonnes in 2020 (TUIK, 2021). This vegetable is a very important source of phenolic compounds. It is beneficial for eyes, skin and respiratory system thanks to its β-carotene, provitamin A, lutein and zeaxanthin compounds. It is a good source of calcium (35-300 mg/100 g), magnesium (20-123 mg/100 g), iron (0.7-1.5 mg/100 g), copper (2-116 µg/100 g) and potassium (188-873 mg/100 g). In addition, it contains 2-5% protein, 0.5-4% fiber, 0.4-1.3% lipid, 1-10% carbohydrate and 1.55-2.18% ash depending on the environmental and growing factors (Acikgoz and Deveci, 2011; Pathirana *et al.,* 2017; Šamec *et al.*, 2019).

Chia is a seed originated from Mexico and Northern Guatemala. Chia seed contains 20-22% protein, 30-35% fat, 25-41% carbohydrate, 18-30% crude fiber (mainly cellulose, pentosans and lignin) and 4-6% ash. Chia seed is balanced in terms of essential amino acid composition and rich in polyunsaturated fatty acids mainly omega-3 (17.8-20.4%) and omega-6 (5.2-5.7%). Additionally, it is a good source in terms of total dietary fiber (35%) that contains high amount of insoluble dietary fiber (Muñoz *et al.*, 2013; Zettel and Hitzmann, 2018; Grancieri *et al.*, 2019). Besides its nutritional content, chia seed also has important technological functions in food industry. The seed can form a gel structure called mucilage that surrounds the seed coat when the seed is immersed in an aqueous medium. This structure is composed mainly of soluble fiber and used as fat replacer, stabilizer and thickener agent in food products (Zettel *et al.*, 2015; Chavan *et al.*, 2017; Fernandes and Salas-Mellado, 2017; Menga *et al.*, 2017). Einkorn (Siyez) is the oldest known diploid type of wheat which was first cultivated in Karacadağ region of Turkey approximately 10,000 years ago. Nowadays, it has been grown in Turkey, Balkan countries, Germany, Switzerland, France, Spain and Italy (Brandolini and Hidalgo, 2011). Einkorn has higher content of ash (2.1-2.8%) and significant advantages in terms of both protein (15-23%) and mineral content, especially manganese (34.4-68.2 mg/kg), zinc (42.7-71.1 mg/kg), iron (37.2-62.6 mg/kg), copper (4.9-8.3 mg/kg) and selenium (99-279 µg/kg), compared to other types of wheat. In addition, it contains more yellow pigments such as lutein and carotenoid than the other types of wheat. However, dietary fiber content (8.7%) is lower than the other cultivated wheats (12.5%) (Løje *et al.*, 2003; Brandolini and Hidalgo, 2011; Zaharieva and Monneveux, 2018). It has been reported that einkorn was used in noodle (Levent, 2019), bread (Brandolini and Hidalgo, 2011), pasta (Brandolini *et al.*, 2018) and cookie (Nakov *et al.*, 2018) production.

The object of this study was to promote consumption of einkorn wheat (siyez) and regional vegetable (kale) as an ingredient in Turkish noodle (erişte) and to improve the health benefits of noodles for consumers in terms of high fiber and mineral content. Further, using chia mucilage as an egg replacer in the noodle production was also aimed.

Materials and Methods

Materials

All chemicals were of high purity grade and supplied by Sigma-Aldrich (Steinheim, Germany). Siyez wheat flour, kale leaves, table salt and chia seeds were purchased from the local market in Trabzon, Turkey. Chia mucilage was extracted according to Coorey *et al.* (2014) with some modifications. Chia seeds were ground by a spice grinder and sieved through a 0.6 mm sieve. Then, 5 g of ground chia seeds were placed in a 1 L beaker and distilled water was added in 1:20 proportion (w:v). The seed-water mixture was stirred with a magnetic stirrer at 1000 rpm for 4 h. The extraction was performed at room temperature (26±1 ºC). After extraction, the mixture was centrifuged at 4500 rpm for 50 min at 26±1 ºC.

Chia seed and mucilage mixture (chia mucilage) was obtained by removing the water accumulated in the upper layer. Freeze-drying was carried out in a freeze dryer (Labconco FreeZone, USA) at Central Research Laboratory of Recep Tayyip Erdoğan University. Kale leaves were homogenized and frozen at -20 ºC for 24 hours and then placed on the trays of the freeze dryer. The homogenized leaves were dried to a water content of below 10% (9.47±0.06%). The freeze-dried (-80 ºC, $3x10^{-3}$ torr) leaves were ground by a spice grinder and sieved through a 0.6 mm sieve.

Preparation of Noodles

Noodles production was carried out according to a previous study applied by Bilgiçli *et al.* (2009) with some modifications. Noodles were prepared with the formulations given in Table 1. Siyez wheat flour (100 g) and salt (1 g) were kept at constant level for each treatment. The raw materials were mixed by using a mixer (Prochef Xl, Schafer, Germany) for 5 min at medium speed and then rested for 15 min. After resting, the dough was passed through a noodle machine (Atlas 150, Marcato, Italy) with the roller gap reduced gradually to get dough sheets 2 mm in thickness and 6 mm in width. Then, the dough sheet was cut into 4 cm in length. The cut product was dried for 17 hours at 40 ºC. After drying, the noodles were cooled to room temperature (26±1 ºC) in desiccator and analyzed for further analysis. Control sample was produced by the same preparation procedure with 100 g of siyez wheat flour, 20 g of whole liquid egg, 1 g of salt and 40 mL of water.

Cooking Properties

The cooking properties (cooking time, water absorption and cooking loss) were determined according to AACC method 66-50 (Anonymous, 2000). For the cooking time, approximately 25 g of noodles were cooked in 250 mL of boiling distilled water in a 400 mL beaker and the cooking times were determined by crushing cooked noodles between a pair of glass plates until the opaque core in the noodle strand disappeared during cooking (every 1 min). For the cooking loss, 25 g of noodles was weighted into 250 mL of boiling distilled water in a 400 mL beaker and cooked for 20 min. Cooking water was collected in a 500 mL graduated cylinder and made to volume 350 mL with distilled water. A liquid of 50 mL was dried in a conventional oven at 105 ºC until constant weight was obtained. The residue was weighted and the cooking loss was calculated as a percentage of the starting material. For the water absorption, the cooked samples were drained for 5 min until no dripping was observed and then the weights were recorded. The water absorption was expressed as the weight ratio of the cooked noodles to the uncooked noodles.

Color Measurement

The color of uncooked and cooked noodles were measured with a chroma meter (Konica Minolta CR400, Japan) using CIE L* (lightness), a* (redness-greenness), b* (yellowness-blueness) color measurement system. A standard white plate was used for calibration. After calibration, two noodle strands were stacked together and three readings were taken on each side of the both uncooked and cooked noodles (Niu *et al.*, 2014).

Chemical Analysis

The proximate composition of dried noodles was determined according to the ICC methods. Moisture and ash content were determined after drying in a conventional oven at 100 ºC (ICC, 1976) and combustion in a muffle furnace at 550 ºC, respectively (ICC, 1990) until constant weight was obtained. Protein and fat content were determined by Kjeldahl method (ICC, 1994) and Soxhlet method (ICC, 1984), respectively. Crude fiber content was determined by gravimetric method (ICC, 1972).

Table 1. Formulation of noodles with kale powder, chia mucilage and water

Sample code	Kale powder (g)	Chia mucilage (g)	Water (mL)
KL1	5	20	30
KL2	5	20	40
KL3	5	30	20
KL4	5	30	30
KL5	10	20	30
KL6	10	20	40
KL7	10	30	20
KL8	10	30	30

pH

After uncooked noodles were ground to a size that can pass through a sieve with a hole size of 1 mm, 10 g of sample was mixed with 100 mL distilled water and stirred using a magnetic stirrer. The pH value of the filtrate that filtered through a coarse filter paper was measured by a pH meter (Jenco 6173, USA) (Ho and Dahri, 2016).

Total Phenolic Content

Total phenolic content was determined according to the method applied by Menga *et al.* (2017). After grinding, 1 g of sample was extracted with 8 ml of a mixture contained methanol/distilled water/HCl (80:19:1 v/v/v) for 30 min with orbital shaker (GFL 3005, Germany). After that, the extract was centrifuged at 4000 rpm for 15 min. Then, 200 µL of the extract was added to the tubes containing 1.5 mL of 10-fold diluted Folin-Ciocalteu reagent. The tubes were mixed and kept for 5 min. Later, 1.5 mL of sodium carbonate solution (6%) was added to the mixture and the mixture was kept at room temperature (26±1 ºC) for 90 min. After incubation, the absorbance of the mixture was measured at 725 nm. The results were expressed as mg gallic acid/g dry matter.

Mineral Content

Finely ground noodle samples (0.5 g) were digested with a mixture of HNO_3 (4 mL, 65%), H_2O_2 (1 mL, 30%) and deionized water (3 mL) in a microwave digestion system (Speedwave, Berghof, Germany). The mixture was mineralized at 170 ºC during 30 min. After digestion, the samples were cooled to room temperature (26±1 ºC) and diluted up to 25 mL with deionized water (Nascimento *et al.*, 2014). The elements including Ca, K, Fe, Mg and Zn were determined using ICP-OES (Optima 7000 DV, Pelkin Elmer, USA) at Central Research Laboratory of Recep Tayyip Erdoğan University. Measurements were performed at the following emission lines (nm): Ca (317.933), K (766.490), Fe (238.204), Mg (285.213) and Zn (206.200).

Textural Properties

The textural parameters (hardness and adhesiveness) of the cooked noodles were determined by using a texture analyzer (TA-XTPlus, UK) with 50 kg load cell at Central Research Laboratory of Ordu University. The method was applied according to Application Study NOO2/P35 with some modifications (SMS, 2000). The noodles (25 g) were cooked for the optimal cooking time and evaluated within 5 min after cooking. Superficial water layer on the noodle strands was soaked with filter paper. Two strands of cooked noodles were put on top of each other and were compressed by a cylindrical probe (3.6 cm dia) until to get 50% in strain. Pre-test speed, test speed and post-test speed were set as 1 mm/s and trigger force was set as 5 g.

Sensory Evaluation

Thirty semi-trained panelists from the Department of Food Engineering at Avrasya University participated in sensory analysis. The sensory evaluation of the cooked noodles was performed using five-point hedonic scale (1: very bad and 5: very good). Cooked noodles were evaluated for color, taste, flavor, appearance, hardness and adhesiveness. The samples were served on white plates and coded with different three-digit random numbers. Drinking water was served to panelists for rinsing during evaluation.

Statistical Analysis

All data obtained in this study were analyzed with SAS statistical software (SAS Institute Inc., Cary, NC, USA) using analysis of variance (ANOVA). Significance was defined at $P< 0.05$ by using Duncan's multiple range tests.

Results and Discussion

In this study, the optimum cooking times of the KL samples were not significantly affected by the evaluated treatments and were within the range of the control sample. The dry matter content of the uncooked control sample was the lowest (92.60%), whereas the dry matter content of the KL samples produced with the addition of 5% (KL1, 2, 3, 4) and 10% (KL5, 6, 7, 8) kale powder were between 93.47-93.80% and 94.33-94.64%, respectively (Table 2). Table 2 shows water absorption and cooking loss of the noodles. Generally, the quality of noodle can be evaluated by cooking parameters in terms of low cooking loss and high water absorption and by textural parameters in terms of high hardness and low adhesiveness (Piwińska *et al.*, 2016). As mentioned before, cooking losses indicated the amount of dry matter passed into the cooking water. Cooking loss values of the KL samples were between 9.41-12.22%, whereas the value of the control sample was 8.36%. There was no significant difference in terms of cooking loss values among themselves of KL1-2-3-4-5 or among themselves of KL6-7-8. Foshia *et al.* (2015) and Bouasla and Wójtowicz (2019) were explained that the starch-gluten network could be weakened because of higher fiber content; therefore the release of dry matter into the cooking water was increased. On the other hand, at constant chia mucilage level, it was observed that the water absorption was higher in the KL samples which had higher water level in the noodle formulation prepared with either 5% or 10% kale powder. Additionally, increasing chia mucilage amount from 20 g to 30 g resulted in higher water absorption at constant water level in the noodle formulation. When the inter-

action between chia mucilage and water amount was evaluated, the formulations with 20 g of chia mucilage and 40 mL of water (KL2 and KL6) showed the highest water absorption. Moreover, a slight increase in water absorption was observed by adding kale powder into the noodle formulation. For instance, the mean values in the water absorption of the KL samples produced with the addition of 5% (KL1, 2, 3, 4) and 10% (KL5, 6, 7, 8) kale powder were 155.91% and 157.41%, respectively (Table 2). Due to higher fiber content, the KL samples gained the ability of higher water absorption than the control sample. Similar results were reported by Foshia *et al.* (2015) and Bouasla and Wójtowicz (2019).

The results of the textural characteristics of cooked noodles are presented in Table 2. The hardness and adhesiveness were influenced significantly (P<0.05) by the level of kale powder and water in the noodle formulation. Formation of gluten matrix plays a major role in texture development of pasta and also noodle products. Further, water is another important factor for defining the stability and quality of these products through interaction of water with other molecules existed in the structure (Carini *et al.*, 2012). It was observed that increasing the level of kale powder in the noodle formulation resulted in decreased hardness and adhesiveness values of the noodles, whereas increasing the level of chia mucilage had no significant effect on the textural parameters. It could be associated with fiber content of the kale that caused weaker gluten network. Also, increasing the level of water in the noodle formulation decreased the hardness and increased the adhesiveness of the cooked noodles. As reported similarly by Park and Baik (2002), hardness was significantly affected by water absorption parameter and a reduction in water absorption was resulted in harder noodles.

It was observed that pH of the control sample (6.31±0.02) was the highest and that of the KL samples was decreased depending on increased level of kale powder. The noodles made with 5% kale powder exhibited significantly (P<0.05) higher pH (5.88±0.02) than those made with 10% (5.67±0.02). There was no significant difference in terms of pH values among themselves of KL1-2-3-4 and among themselves of KL5-6-7-8 (Table 2). However, increasing amount of chia mucilage in the noodle formulation from 20 g to 30 g did not have a significant effect on pH value of the KL samples. The color values of the samples before and after cooking are presented in Table 3 and Table 4, respectively. The results indicate that addition of kale powder and chia mucilage had a significant effect (P<0.05) on the color values of the KL samples. It was determined that addition of the kale powder into the noodle formulation decreased L* and a* values of both uncooked and cooked samples significantly (P<0.05) in comparison with control sample. That means the KL samples were darker and greener because of natural pigment color of the kale powder. Additionally, increasing the amount of chia mucilage from 20 g to 30 g resulted in also decreased L* and a* values. After cooking, L* value of the control sample was increased, however there was no significant difference in terms of a* and b* values. On the other side, all cooked KL samples had increased L* values and also a* values as a consequence of passing the natural coloring compounds into the cooking water. The results obtained from the present study were similar with the studies regarding the noodles made by green tea powder and spinach puree reported by Li *et al.* (2012) and Shere *et al.* (2018), respectively.

Table 2. Cooking properties and textural parameters of noodles

Sample	pH	Cooking times (min)	Dry matter* (%)	Cooking loss (%)	Water absorption (%)	Hardness (g)	Adhesiveness (g.sec)
Control	6.31±0.04^{a}	20.50±0.71	92.60±0.30^{d}	8.36±0.12^{c}	152.73±3.22^{ab}	3969.64±148.51^{abc}	-62.47±4.46^{a}
KL1	5.90±0.08^{b}	20.50±0.71	93.47±0.27^{c}	9.52±0.13^{b}	150.32±0.58^{b}	4267.24±289.55^{ab}	-111.72±5.40^{bcd}
KL2	5.90±0.08^{b}	20.50±0.71	93.54±0.04^{c}	9.42±0.03^{b}	162.47±0.90^{a}	4071.88±231.95^{abc}	-147.63±11.10^{e}
KL3	5.86±0.09^{bc}	20.50±0.71	93.62±0.24^{c}	9.41±0.19^{b}	153.62±1.15^{ab}	4337.94±110.30^{a}	-120.19±7.32^{cde}
KL4	5.88±0.01^{b}	20.50±0.71	93.80±0.28^{bc}	9.96±0.03^{b}	157.24±0.23^{ab}	4256.29±49.97^{ab}	-125.04±4.74^{de}
KL5	5.70±0.01^{bc}	20.00±0.00	94.52±0.19^{a}	10.26±0.54^{b}	154.19±1.94^{ab}	3536.76±49.29^{c}	-80.67±10.18^{ab}
KL6	5.67±0.02^{c}	20.00±0.00	94.64±0.06^{a}	11.38±0.55^{a}	161.58±4.14^{a}	3486.50±72.29^{c}	-103.10±21.25^{bcd}
KL7	5.67±0.02^{c}	20.00±0.00	94.57±0.05^{a}	11.55±0.53^{a}	153.94±0.46^{ab}	3738.51±128.24^{bc}	-62.77±3.40^{a}
KL8	5.67±0.02^{c}	20.00±0.00	94.33±0.01^{ab}	12.22±0.16^{a}	159.94±1.15^{ab}	3444.68±111.06^{c}	-87.04±5.66^{abc}

Mean±standard deviation. Different letters in the same column presented significant differences P<0.05.
*Dry matter values of uncooked samples

Table 3. Color parameters of uncooked noodles

Sample	L*	a*	b*
Control	44.88±0.52^{a}	4.56±0.19^{a}	14.34±0.51^{ab}
KL1	40.79±0.47^{b}	-0.75±0.04^{e}	14.55±0.29^{ab}
KL2	37.31±0.05^{e}	0.53±0.04^{b}	13.97±0.13^{b}
KL3	38.94±0.03^{cd}	-0.42±0.02^{d}	13.19±0.01^{c}
KL4	38.32±0.02^{d}	0.20±0.02^{c}	14.13±0.05^{ab}
KL5	41.04±0.08^{b}	-2.70±0.03^{h}	14.79±0.01^{a}
KL6	37.36±0.06^{e}	-2.01±0.01^{g}	14.10±0.02^{ab}
KL7	39.74±0.42^{c}	-1.97±0.04^{g}	14.19±0.25^{ab}
KL8	33.75±0.29^{f}	-1.53±0.02^{f}	12.01±0.24^{d}

Mean±standard deviation. Different letters in the same column presented significant differences P<0.05.

Table 4. Color parameters of cooked noodles

Sample	L*	a*	b*
Control	50.32±0.52^{a}	4.39±0.19^{a}	14.28±0.51^{ab}
KL1	42.27±0.54^{c}	-0.61±0.03^{cd}	13.94±0.34^{abc}
KL2	44.24±0.39^{b}	-0.75±0.04^{d}	14.85±0.41^{a}
KL3	41.73±0.23^{c}	-0.28±0.01^{b}	13.41±0.11^{bc}
KL4	40.44±0.11^{d}	-0.40±0.01^{bc}	13.05±0.03^{c}
KL5	38.54±0.31^{e}	-1.07±0.03^{f}	14.01±0.28^{abc}
KL6	39.13±0.34^{e}	-1.09±0.04^{f}	14.74±0.25^{a}
KL7	39.28±0.42^{e}	-1.04±0.11^{ef}	13.46±0.29^{bc}
KL8	36.40±0.11^{f}	-0.79±0.09^{de}	13.20±0.08^{c}

Mean±standard deviation. Different letters in the same column presented significant differences P<0.05.

Color is one of the most essential quality attributes that directly has an impact on perception of consumers. Therefore, colored products that produced by using natural compounds have gained much attention day by day (Vimercati *et al.*, 2020). Results in Table 5 indicated that greener color occurred within the noodles by the increased level of kale powder influenced the color scores of the panelists positively. There was no significant difference among the samples in terms of appearance. The flavor scores were also affected positively by adding kale powder, whereas the control sample was the most preferred sample in terms of taste. Texture was an important criterion that affected the final acceptance of the consumers. In general, the samples with higher hardness and lower adhesiveness according to textural analysis received higher scores in sensory analysis in terms of hardness and adhesiveness attributes. After the overall sensory appreciation score of the control sample, KL1 and KL5 samples received the highest scores among all samples.

Table 5. Sensory evaluation of cooked noodles

Sample	Color	Taste	Flavor	Appearance	Hardness	Adhesiveness	Overall acceptability
Control	3.40±0.41^{a}	3.70±0.36^{a}	2.50±0.39^{b}	3.50±0.39^{a}	3.10±0.38^{ab}	3.05±0.40^{ab}	3.75±0.29^{a}
KL1	3.55±0.26^{a}	2.95±0.26^{ab}	2.45±0.27^{b}	3.30±0.29^{ab}	3.40±0.23^{ab}	3.00±0.28^{ab}	3.35±0.20^{ab}
KL2	2.65±0.25^{abc}	2.60±0.26^{b}	2.50±0.31^{b}	2.70±0.25^{ab}	2.65±0.27^{ab}	2.75±0.30^{ab}	2.70±0.26^{b}
KL3	2.25±0.25^{bc}	3.00±0.35^{ab}	2.40±0.32^{b}	2.45±0.31^{b}	3.05±0.36^{ab}	2.75±0.30^{ab}	2.80±0.27^{b}
KL4	2.10±0.31^{c}	2.95±0.32^{ab}	2.75±0.30^{ab}	2.45±0.29^{b}	2.55±0.26^{b}	2.50±0.27^{b}	2.70±0.30^{b}
KL5	3.40±0.31^{a}	3.20±0.34^{ab}	3.75±0.27^{a}	3.35±0.33^{ab}	3.60±0.29^{a}	3.60±0.30^{a}	3.45±0.32^{ab}
KL6	3.10±0.34^{ab}	2.75±0.34^{ab}	3.30±0.37^{ab}	3.25±0.32^{ab}	3.05±0.34^{ab}	3.35±0.33^{ab}	3.15±0.24^{ab}
KL7	3.05±0.34^{abc}	2.90±0.33^{ab}	3.05±0.37^{ab}	3.00±0.35^{ab}	2.85±0.33^{ab}	2.90±0.32^{ab}	2.95±0.32^{ab}
KL8	3.55±0.31^{a}	2.70±0.33^{ab}	3.05±0.34^{ab}	3.35±0.32^{ab}	2.95±0.33^{ab}	3.00±0.29^{ab}	3.00±0.32^{ab}

Mean±standard deviation. Different letters in the same column presented significant differences P<0.05.

Table 6. Chemical composition (dry basis) of uncooked noodles

	Control	KL1	KL5
Ash (g/100 g)	2.81±0.01^{c}	3.33±0.01^{b}	4.06±0.02^{a}
Crude fiber (g/100 g)	2.08±0.02^{c}	2.74±0.03^{b}	3.05±0.02^{a}
Crude protein (g/100 g)	14.97±0.09^{a}	14.14±0.10^{b}	14.91±0.13^{a}
Crude fat (g/100 g)	6.17±0.06^{a}	4.45±0.05^{c}	4.88±0.04^{b}
Ca (mg/100 g)	50.00±0.26^{c}	249.52±1.54^{b}	438.97±6.24^{a}
K (mg/100 g)	367.5±5.05^{c}	564.37±2.02^{b}	672.37±7.15^{a}
Mg (mg/100 g)	111.42±2.31^{c}	161.67±1.73^{b}	177.63±3.24^{a}
Fe (mg/100 g)	4.00±0.02^{b}	6.49±0.10^{a}	6.58±0.09^{a}
Zn (mg/100 g)	4.23±0.02^{b}	5.61±0.05^{b}	5.91±0.07^{a}
Total phenolic content (mg gallic acid/g)	1.06±0.07^{c}	1.61±0.02^{b}	1.97±0.10^{a}

Mean±standard deviation. Different letters in the same column presented significant differences P<0.05.

According to the sensory evaluation, KL1 and KL5 were selected for further analyses to determine nutritional composition of the noodles. It was determined that the compositions of the KL samples were significantly (P<0.05) affected by the increased level of kale powder (Table 6). Control sample showed higher moisture and crude fat content than KL1 and KL5. As expected, significant increases in the ash and crude fiber contents were obtained in the noodles with the addition of kale powder. The ash content increased from 2.81% to 3.33% and 4.06% with the addition of kale powder at 5% and 10%, respectively. In addition, crude fiber contents increased from 2.08% to 2.74% and 3.05% with the addition of kale powder at 5% and 10%, respectively. However, there was no significant difference between the control sample and KL5 in terms of crude protein content. Moreover, higher level of kale powder addition into the noodle formulation increased the protein content of the KL samples. Besides its high fiber content, kale has significant concentration of essential minerals and medium level of protein (Acikgoz and Deveci, 2011; Vimercati *et al.*, 2020). Further, chia is also a rich source of valuable proteins (Muñoz *et al.*, 2013). Therefore, the protein contents of the KL1 and KL5 samples were at the same level with that of the control sample which produced with egg. Crude fat content was the highest in the control sample possibly due to egg content and there was a decrease in crude fat content approximately 28% and 21% in KL1 and KL5 samples, respectively, compared to the control sample. Low-fat products were produced by using chia mucilage as a fat substitute in pound cake (Ferrari Felisberto *et al.*, 2015) and cookie (Punia and Dhull, 2019) formulation.

Results showed that addition of kale powder and chia mucilage into the noodle formulation enhanced the nutritional quality of the noodles by increasing the mineral content. As reported by Jahangir *et al*. (2009), kale was a good source of mineral matters among the green leafy vegetables. There was a significant increase in mineral content of KL samples with the addition of kale powder into the noodle formulation. The mineral content of the KL samples produced with 10% of kale powder had the highest values in terms of K, followed by Ca and Mg. This result could be attributed to the high K, Ca and Mg content of kale (Jahangir *et al.*, 2009; Acikgoz and Deveci, 2011; Vimercati *et al.*, 2020). Among the minerals,

the most increment (76%) was observed in Ca content by increasing the kale powder level in the noodle formulation from 5% to 10%. Similar to previous study (Morais *et al.*, 2020), kale flour provided a significant increase in Ca content in cookie production. Besides macro nutrients, content of Fe and Zn as micro nutrients in the KL samples (KL1 and KL5) were also higher than those of the control sample. However, there was no significant difference in terms of Fe content between KL1 and KL5. According to recommended daily intake values of the mineral matters, per 100 g of KL1 and KL5 could be a good source in terms of nutrients (Anonymous, 2016). Ferioli *et al.* (2013) reported that geographic origin and growing environment had a major effect on phenolic content of fresh kale. The kale used in our study collected from Maçka district of Trabzon in Turkey and the total phenolic content was 4.56 ± 0.07 mg gallic acid/g dry matters. As seen in Table 6, the addition of kale powder increased the content of total phenolic in the KL samples. Compared to the control sample, total phenolic content of the KL samples increased 55% and 84% with addition of kale powder at 5% and 10%, respectively. There was no significant difference in terms of total phenolic content values among themselves of KL1-2-3-4 or among themselves of KL5-6-7-8.

Conclusion

The physical qualities of the noodles in terms of cooking properties (cooking loss and water absorption) showed significant differences between the treatments. Cooking loss of the control sample was the lowest and the water absorption of the KL samples produced with 20 g of chia mucilage and 40 mL of water was the highest. The textural properties were affected by both the water content in the formulations and the water absorption values of the samples. Although the control sample showed the highest score in taste, increasing level of kale powder positively affected the appreciation of the panelists in terms of color and also flavor. Higher content of ash, crude fiber and also mineral matter (especially in Ca and K) was obtained with the addition of kale powder and chia mucilage into the noodle formulation. Further, decreased content of crude fat resulted in lower calorie in the samples. Additionally, increasing level of kale powder had a positive effect on the functional properties of the noodles in terms of total phenolic content. Consequently, the noodle produced with 10 % of kale powder, 20 g of chia mucilage and 30 mL of water was the most preferred by the panelists in terms of sensory attributes and its nutritional value was the highest.

Compliance with Ethical Standard

Conflict of interests: The author declares that for this article they have no actual, potential or perceived conflict of interests.

Ethics committee approval: Author declare that this study does not include any experiments with human or animal subjects.

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Disclosure: -

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Effects of different ingredients on antioxidant and oxidant status of brewed roasted coffee

Yasemin ERTAŞ ÖZTÜRK[1], Duygu AĞAGÜNDÜZ[2]

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[1] Ondokuz Mayıs University, Faculty of Health Sciences, Department of Nutrition and Dietetics, Samsun, Turkey

[2] Gazi University, Faculty of Health Sciences, Department of Nutrition and Dietetics, 06490 Emek, Ankara/Turkey

ORCID IDs of the authors:
Y.E.Ö. 0000-0002-8232-103X
D.A. 0000-0003-0010-0012

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Correspondence:
Yasemin ERTAŞ ÖZTÜRK
E-mail:
yasemnertas@gmail.com

Available online at
http://jfhs.scientificwebjournals.com

ABSTRACT

It was aimed to evaluate the effects of different ingredients on total antioxidant status (TAS) and total oxidant status (TOS) of the brewed Brazil mild roasted coffee. Sugar, sucralose, butter, coconut-oil, animal and plant-based milk types were added and milk types&sweeteners were combined separately. TAS and TOS were measured and oxidative stress indice (OSI) was calculated. TAS value of coffee with whole milk was the highest among all coffee types. TOS values of coffee with soy milk, with soy milk+sugar and soy milk+sucralose were lower than all other coffee types. When compared to OSI values, coffee with soy milk, with soy milk+sugar and soy milk+sucralose had the lowest OSI values among all coffee types. Moreover, addition of coconut-oil to coffee samples increased the TOS and OSI values of coffees. While the TOS and OSI of the sugar and sucralose addition were found higher in comparison to plain coffee; TOS and OSI of the sucralose addition was lower than those sugar combinations. In conclusion, the OSI of the coffee may change depending on the alterations of chemical structures and nutritional matrices by the added ingredients. The addition of soy milk or sucralose instead of sugar or whole cow milk instead of oil-based ingredients could be a promising strategy of reducing the oxidative capacity.

Keywords: Coffee, Milk, Sugar, Antioxidant, Oxidant

Introduction

Coffee is one of the most popular beverages due to its aroma and potential health effects worldwide (Samoggia & Riedel, 2019). Coffee compounds such as caffeine, chlorogenic acids, trigonelline, tryptophan alkaloids, diterpenes and other secondary metabolites are mainly responsible for its health benefits (Hu, Wang, Zhang, & Qiu, 2019). To date, numerous studies have suggested that acute or habitual coffee consumption has been positively related with multiple health outcomes with its antioxidant, anti-inflammatory, anticancer and antidiabetic properties due to having such large bioactive chemical compounds (Poole et al., 2017).

Recently it has been hypothesized that coffee has a potential protective role of against oxidative stress mediators and associated diseases. Martini et al. (2016) reported that chronic consumption of coffee may increase some antioxidant biomarkers (glutathione levels) and reduce the levels of Deoxyribonucleic acid (DNA) damage (Daniela Martini et al., 2016). In another study, daily 400 mL coffee consumption for 8 weeks contained medium or high chlorogenic acids (CGAs) increased plasma antioxidant capacity without any detrimental effect on vascular function in healthy adults (Agudelo-Ochoa et al., 2016). On the other hand, receiving 3 or 5 cups of study coffee (freshly brewed Arabica coffee using a filter machine and drunk for 2 times/day as 1–2 cups or 2–3 cups) or control (water) for 8 weeks had no beneficial effect on either DNA or plasma lipid levels (Shaposhnikov et al., 2018). However, CGAs the main phenolic component of coffee is primarily responsible of health benefits and has been associated with reduction in oxidative stress and consequently inflammation and chronic disease prevention like cancer and diabetes. (Tajik, Tajik, Mack, & Enck, 2017). Furthermore, other brewed coffee components such as some types of advanced glycation end products (AGEs) and/or colonic metabolites may responsible to inhibit plenty of diseases caused by oxidative damage as well (Gómez-Ruiz, Leake, & Ames, 2007; Yanagimoto, Ochi, Lee, & Shibamoto, 2004).

Roasting, manufacturing processes and preparation methods can alter antioxidant and phenolic substances of coffee (del Castillo, Ames, & Gordon, 2002; Niseteo, Komes, Belščak-Cvitanović, Horžić, & Budeč, 2012). Coffee can be consumed either plain or with desired flavoring ingredients such as sweeteners and/or milk (Samoggia & Riedel, 2019). Nutritional value of the consumption trends of beverages are usually ignored in exploring the health effects of consumption habits. However, active substances of coffee can interact with additives and thus alterations might occur within its health benefits (Nakilcioğlu-Taş, 2018; Niseteo et al., 2012). Sugar addition to Turkish coffee while cooking is shown to reduce antioxidant capacity (Nakilcioğlu-Taş, 2018). *In vitro* gastrointestinal digestion model showed milk addition can alter the bioaccessibility of coffee phenolic compounds in addition with particular processing methods (Quan et al., 2020). Additionally, coffee added with milk that contains 7.1% of fat increased chlorogenic acid bioaccessibility upon *in vitro* digestion after using high-pressure homogenization (Alongi, Calligaris, & Anese, 2019) suggesting higher milk fat enhances the bioaccessibility. On the other hand, milk additive (25%) was found insignificant on coffee antioxidant status in another study (Dupas, Marsset-Baglieri, Ordonaud, Ducept, & Maillard, 2006). However, milk addition on coffee brews decreased antioxidant capacity and polyphenolic content of brews, which refers to potential interactions between polyphenols and milk nutrients (Niseteo et al., 2012). Furthermore, adding milk and sugar into decaffeinated coffee before a high glycaemic index meal may positively effect on postprandial glycaemic and insulinaemic responses in healthy adults (Tommy, Jennifer, Iris, Sit, & Louie, 2020).

Impact of additive ingredients while consuming coffee and its health implications is poorly understood and results are conflicting. Especially, new trends like adding butter or coconut oil into brewed coffee and their effects on oxidation status have not been studied before. Since having important antioxidant properties, coffee might provide beneficial effects on oxidative stress markers as well and hence, human health (Martini et al., 2016). Therefore, we aimed to evaluate the effects of different ingredients on antioxidant and oxidant properties of brewed roasted coffee in the present study.

Materials and Methods

Sample Selection and Brewing Conditions

Roasted coffee beans (Brazil mild, roasted to 156-165 °C) were supplied from a local coffee supplier. A coffee grinder (Russell Hobbs 23120-56, United Kingdom) were used to obtain grounded filter coffee. All samples were prepared with filter coffee machine in compliance with The Specialty Coffee Association's (2020) coffee cupping standards within 5 minutes. According to this standards brewing were done with the ratio of 8.25 ±0.25 grams (whole bean) coffee to 150 mL water. Water temperature was 92.2-94.4 °C when poured on grounds. Then, tempered glass cups were used for cupping.

Ingredients

It was prepared plain (black) filter coffee as described above and added sugar (5 g), sucralose (0.5 g), butter (5 g), coconut oil (5 g), ultra high temperature (UHT) cow milk types (20% v/v, ~30 mL); whole milk, light milk, lactose-free milk, and

UHT coconut milk and soy milk at room temperature. Additionally, milk types and sweeteners were combined separately. Amount of milk was decided based on earlier literature (Al-Ghafari et al., 2017; Dupas et al., 2006); while the others were taken as one teaspoon (sucralose taken as equaling to same amount of sucrose). All ingredients were purchased from the local markets. Characteristics and nutrition facts of added ingredients to coffee were given in Table 1. The final temperatures of samples with ingredients were shown in Table 2.

Sample Analyses

Brewed coffee was taken to tempered glass and added the ingredients. The final temperature of samples was measured. Then, coffee samples collected into micro tubes and analyzed immediately. All samples were analyzed in duplicate.

Measurement of Temperature

Water used for preparing coffee samples was heated using a heat adjustable kettle with glass chamber (Rossman™), and brewing temperatures were measured by a probe thermometer (Arcone TP101™).

Measurement of Water-Soluble Dry Matter Content

A portable ATC Brix refractometer was used to measure of dry matter of brewed coffee samples. Briefly, the zero-calibration using distilled water was performed. Then, a few drops of the sample were placed on the measurement prism. The cover plate was closed for spreading the liquid across the entire surface of the prism and avoided to produce any air bubbles or dry spots. While holding the instrument under a light source, the Brix concentration (◦) was determined by the intersection of the boundary of the light and dark fields on the scale. After reading, the instrument was cleaned with distilled water immediately.

Analysis of Total Antioxidant Status (TAS) and Total Oxidant Status (TOS)

Total antioxidant status (TAS) and total oxidant status (TOS) of coffee samples were analyzed using commercially available kits (Relassay, Turkey) and Mindray BS300 Auto Biochemistry Analyzer™ following the kit protocol. Coffee samples were centrifuged (Selecta Centronic BLII) at 3000 rpm for 2 minutes at 4℃. For the measurement of TAS values the novel automated method were used based on the bleaching of characteristic color of a more stable 2,2 Azino-bis (3-ethylbenzothiazoline-6-sulfonic acid (ABTS) radical cation by antioxidants. The precision value of assay was lower than 3%. The change of absorbance at 660 nm is related with total antioxidant level of the sample. The results were expressed as mmol Trolox equivalent/L (Ozcan Erel, 2004).

For the measurement of TOS values, oxidants present in the sample oxidized the ferrous ion-o-dianisidine complex to ferric ion. The oxidation reaction was enhanced by glycerol molecules abundantly present in the reaction medium. The ferric ion produced a colored complex with xylenol orange in an acidic medium. The color intensity, measured by spectrophotometrically in 530 nm, was related to the total amount of oxidant molecules present in the sample. The assay was calibrated with hydrogen peroxide and the results were expressed in terms of micro molar hydrogen peroxide equivalent per liter (mol H_2O_2 equivalent/L) (O. Erel, 2005).

Calculation of Oxidative Stress Index (OSI)

Oxidative stress index (OSI) were used as an indicator of oxidative stress (the ratio of TOS to TAS) calculated using the following formula (Yumru et al., 2009): OSI (arbitrary unit) =TOS (μmol H_2O_2 equivalent/L) / TAS (μmol Trolox equivalent/L).

Table 1. Characteristics and nutrition facts of added ingredients

Ingredients	Brand	Nutrition Facts (g/100 g)					
		Carbohydrate	Sugars	Fat	SFA	Protein	Fiber
Sugar	A	99.9	99.9	-	-	-	-
Sucralose	B	98.8	7.1	-	-	-	-
Butter	C	0.8	N/A	82	51.3	0.6	N/A
Coconut oil	D	-	-	100	93	-	N/A
Whole milk	C	4.5	4.5	3.3	2.1	3.0	N/A
Light milk	C	5.0	5.0	0.1	-	3.1	N/A
Lactose-free milk	C	4.7	4.7	1.5	0.9	3.0	N/A
Coconut milk	E	2.7	1.9	0.9	0.9	0.1	0.1
Soy milk	E	2.5	2.5	1.8	0.3	3.0	0.5

SFA: Saturated fatty acids, N/A: Not available

Statistical Analysis

All data were analyzed using SPSS 22.0 statistical package program. Arithmetic mean and standard deviation values ($\bar{x}$ ±SD) are given as descriptive statistics for variables. Kruskal-Wallis test was to determine differences among TAS, TOS and OSI values of different coffee samples. Moreover, pair-wise comparisons of OSI values among coffee types were shown with Mann-Whitney U test. Statistically significance level was accepted as $p<0.05$ for all analyses.

Results and Discussion

Coffee is one the most consumed beverages on a global scale due to its flavor and certain potential effects (Wang & Ho, 2009). Many people add some ingredients to coffee instead of consuming it plain in order to obtain a smooth taste or to increase its flavor and health contributions (Al-Ghafari et al., 2017). However, information about the effects of the added ingredients on coffee, which is known for its polyphenol and antioxidant capacity, is limited, and research in this regard still continues. On this context, the study was conducted in order to investigate the effects of adding ingredients with very different chemical properties and matrices on their own and/or in combination on the antioxidant/oxidant status of coffee in a wide range.

Table 2. Temperature (°C), dry matter content ($Brix^0$), TAS (mmol/L), TOS (µmol/L) and OSI values of roasted coffee with added ingredients brewed with filter coffee machine

Ingredients and quantity	Temperature (°C)	Dry matter ($Brix^o$)	TAS (mmol/L)	TOS (µmol/L)	OSI
Black (just brewed coffee)	61.8	1.336	2.97±0.00	49.11±7.29	1.65±0.25
Sweeteners					
Sugar (5 g)	46.8	1.349	2.98±0.01	59.97±2.42	2.02±0.08
Sucralose (0.5 g)	48.2	1.336	2.97±0.01	52.38±1.01	1.77±0.03
Fats and Oils					
Butter (5 g)	42.7	1.336	2.98±0.00	48.33±6.16	1.62±0.21
Coconut oil (5 g)	41.1	N/A	2.96±0.01	55.54±1.50	1.87±0.05
Milks					
Whole milk (30 mL)	42.9	1.342	3.12±0.04	36.32±3.69	1.16±0.10
Light milk (30 mL)	39.1	1.338	3.03±0.01	34.96±3.93	1.16±0.13
Lactose free milk (30 mL)	42.8	1.340	3.04±0.00	30.24±1.09	0.99±0.04
Coconut milk (30 mL)	39.5	1.337	3.00±0.01	42.99±4.59	1.43±0.15
Soy milk (30 mL)	40.8	1.338	2.92±0.01	6.58±0.27	0.23±0.01
Milk with sweeteners					
Whole milk (30 mL) with sugar (5 g)	39.4	1.353	3.16±0.01	38.48±0.31	1.22±0.01
Light milk (30 mL) with sugar (5 g)	41.4	1.353	3.04±0.02	36.14±3.41	1.19±0.12
Lactose free milk (30 mL) with sugar (5 g)	40.3	1.350	3.04±0.00	36.51±2.62	1.20±0.09
Coconut milk (30 mL) with sugar (5 g)	39.8	1.347	3.02±0.02	46.54±3.36	1.54±0.10
Soy milk (30 mL) with sugar (5 g)	39.3	1.347	2.92±0.01	6.41±0.61	0.22±0.02
Whole milk (30 mL) with sucralose (0.5 g)	41.1	1.341	3.09±0.06	33.80±1.59	1.09±0.03
Light milk (30 mL) with sucralose (0.5 g)	41.1	1.339	3.04±0.02	36.78±2.70	1.21±0.10
Lactose free milk (30 mL) with sucralose (0.5 g)	42.8	1.340	3.04±0.00	34.92±0.01	1.15±0.00
Coconut milk (30 mL) with sucralose (0.5 g)	43.5	1.336	3.02±0.03	39.56±0.79	1.31±0.01
Soy milk (30 mL) with sucralose (0.5 g)	40.5	1.339	2.88±0.00	4.62±0.59	0.16±0.02
p value*			***p=0.000***	***p=0.000***	***p=0.000***

Dry matter: Water soluble dry matter content, TAS: Total antioxidant status, TOS: Total oxidant status, OSI: Oxidative stress index, N/A: Not available

*Kruskal Wallis test

In the present study, TAS value of plain/black Brazilian mild roasted coffee brewed with filter coffee machine was determined to be 2.97 ±0.00 mmol/L (Table 2). Before it is roasted, the green coffee bean has a complex matrix of carbohydrate (~60% in dry substance), lipid (8%–18% in dry substance), protein, peptide and free amino acid (9%–16% in dry substance), caffeine and trigonelline, theobromine, theophylline. It is reported that coffee bean contains 6-10% polyphenol in dry substance, that the most dominant of these polyphenols are chlorogenic acids (CGAs) – including the caffeoylquinic acids (CQAs), especially 5-CQA, and that it contains feruloylquinic acids and dicaffeoylquinic acids in less amounts (Acar-Tek, Ağagündüz, & Ayhan, 2018). It has also been reported that coffee polyphenols, especially chlorogenic acid, have health improving anti-inflammatory, anticarcinogenic, antidiabetic, and antihypertension effects. Besides, there is evidence that chlorogenic acid protects vascular endothelial cells and reduces metabolic syndrome risk by increasing endothelial nitric oxide synthase expression and nitric oxide generation with its antioxidant properties (Yamagata, 2018). Although partial reductions and/or transformations may occur in these components following the roasting of coffee beans (180-250 °C), coffee continues to show its antioxidant activity (Acar-Tek et al., 2018; Richelle, Tavazzi, & Offord, 2001) In a study in which the effects of the production and roasting conditions of coffee on the antioxidant effects of coffee brews were investigated, it was reported that especially light and medium roasted coffee brews had the highest antioxidant activity compared to dark coffee, and that they might protect cells from oxidative stress damages (Duarte, Abreu, Menezes, Santos, & Gouvêa, 2005). Similarly, as it was aimed to examine the antioxidant activities of coffee brews in this study, medium roasting method was employed. Furthermore, when antioxidant activity and bioactive substances are handled, extraction mechanisms in obtaining coffee brews play an important role as well (Caprioli, Cortese, Sagratini, & Vittori, 2015). Filtering method is one of the leading extraction techniques in terms of the antioxidant activity of coffee. In a study that supports this, the antioxidant capacities of the aqueous spent coffee extracts were determined as 46.0-102.3% (filter), 59.2-85.6% (espresso), and <42% (plunger) (Bravo et al., 2012). The results of this study reflect the results of brewing method using filter coffee machine.

One of the most significant findings of this study was that the added milk types could change the antioxidant/oxidant capacity of coffee in different ways depending on the fractions and sources/types of milk (Table 2, Figure 1). In the study, it was determined that the antioxidant activities of the coffee types (with/without sucralose) to which various cow milk fractions (whole, light, lactose-free), especially whole cow milk (20%), were added were significantly higher compared to other coffee types, including black coffee (Table 2). Among the ingredients that can be added to coffee, especially milk is one of the leading ingredients due to its nutritional composition (protein, fat, sugars and vitamins-minerals). Milk is a food product that contains many essential nutrients as well as many components with antioxidant effects. Protein fractions in milk, especially casein, show antioxidant activity (Fardet & Rock, 2018). Antioxidant enzymes in milk, such as superoxide dismutase (SOD), catalase (CAT) and glutathione peroxidase (GSH-Px) and conjugated linoleic acid, coenzyme Q10, vitamins C, E, A and D3, equol, uric acid, carotenoids, and minerals contribute to the antioxidant activity of milk (Fardet & Rock, 2018; Khan et al., 2019). However, when milk is added to coffee, milk proteins such as whey and casein interact with coffee polyphenols by forming a complex. This condition may have an effect on functional and nutritional properties of coffee (Al-Ghafari et al., 2017). Similar to this study, in a study, it was determined that milk added to coffee by 10% and 20% enhanced the scavenging of 2,2-diphenyl-1-pycrylhydrazyl (DPPH) or decreased the metal chelating and metal reducing activity of polyphenol (Al-Ghafari et al., 2017). In contrast to this study, it was determined that adding milk to instant coffee brews decreased the total phenol and chlorogenic acid variety components, and ABTS and ferric-reducing antioxidant power (FRAP) antioxidant activities (Niseteo et al., 2012). Even in a study, addition of fresh whole milk or evaporated milk affected antioxidant activity through different mechanisms due to solid substance ingredients (fat and protein) (Alsufiani, 2017). In another study conducted, it was determined that when milk was added to coffee by 25%, approximately 40% of chlorogenic acid in coffee was in a bonded condition and its bioavailability decreased, but that addition of milk did not have a significant effect on coffee's DPPH and 2-2′-azobis (2-amidinopropane) dihydrochloride (AAPH)-antioxidant effect (Dupas et al., 2006). As issues such as the type of coffee and the amount of added milk mostly are not clearly stated, and a standard evaluation method is not used, it becomes difficult to evaluate the studies. Also, the studies conducted in the literature mostly focused on how the milk added to coffee changed the bioavailability of coffee (Duarte & Farah, 2011; Quan et al., 2020; Renouf et al., 2010). In a study conducted, it was reported that addition of whole milk did not change the overall bioavailability of coffee polyphenols, but that sugar and non-dairy creamer affected the maximum plasma concentration-C(max) of coffee polyphenols and the time needed to reach C(max)-T(max) (Renouf et al., 2010). In another study, consumption of coffee and milk together was determined to decrease the bioavailability of chlorogenic acid and metabolites (40% vs 68%) compared to consuming coffee plain (Duarte & Farah, 2011). In yet another study, the effect of addition of milk in

different matrices (skimmed milk and whole milk) on antioxidant capacity in in vitro gastrointestinal digestion model and the bio-accessibility of phenolics was investigated, and following the additions of milk, the antioxidant capacity of all samples were reduced or did not change. However, it was determined that especially the addition of whole milk displayed better phenolic bio-accessibility compared to skimmed milk (Quan et al., 2020). These results shed light on the necessity in future studies for a focus not only on nutritional matrix and capacity changes, but also on how it changes bioavailability and antioxidant capacity in different models.

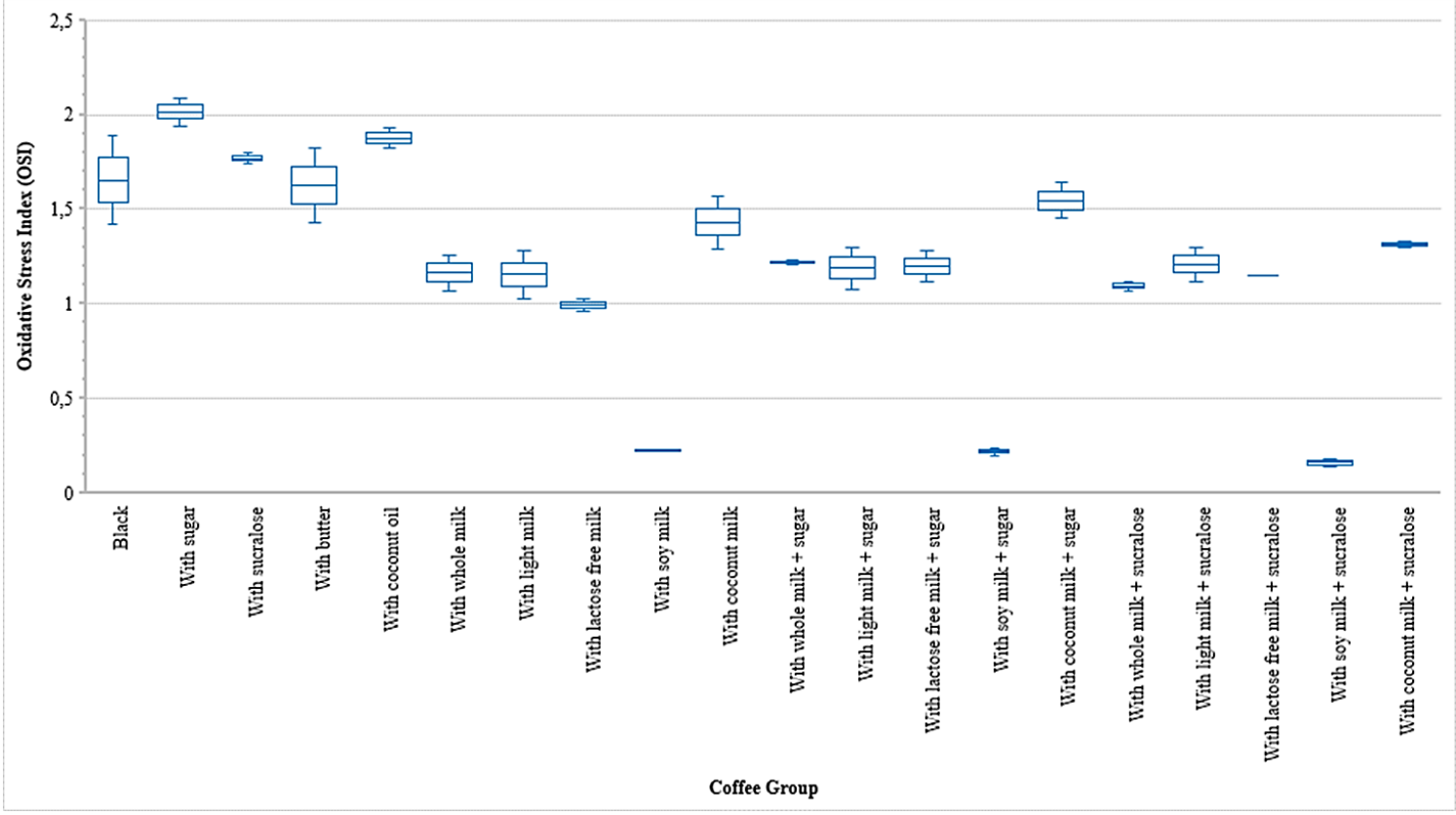

Figure 1. The OSI values of coffee samples with different ingredients. Pairwise comparisons of coffee groups according to OSI (Mann Whitney U test, $p<0.05$): 1) OSI of the coffee "with whole milk" was statistically lower than OSI of the "black coffee", "coffee with sugar", "with sucralose", "with butter" and "with coconut oil". 2) OSI of the coffee "with light milk" was statistically lower than OSI of the "coffee with sugar" and "with coconut oil". 3) OSI of the coffee "with lactose-free milk" was statistically lower than OSI of the "black coffee", "coffee with sugar", "with sucralose", "with butter", "with coconut oil", "with coconut milk" and with coconut milk+sugar". 4) OSI of the coffee "with soy milk", "with soy milk+sugar" and "with soy milk+sucralose" were statistically lower than OSI of the "black coffee", "coffee with sugar", "with sucralose", "with butter", "with coconut oil", "with coconut milk", with coconut milk+sugar" and "with coconut milk+sucralose

Reactive oxygen species (ROS) are formed during cellular metabolism of macronutrient elements in energy production. As they are highly reactive molecules, lipids cause damage to biological structures such as proteins, polysaccharides, and DNA. Under normal physiological conditions, antioxidants can block the harmful effects of ROS, but in case of an imbalance between ROS and antioxidant defense mechanisms, oxidative stress can occur (Kalyanaraman, 2013). One of the important findings of this study was that the added ingredients could change oxidant activity/oxidative stress rather than antioxidant activity (Table 2, Figure 1). TOS value and OSI value of plain/black roasted coffee brewed with filter coffee machines was found to be 49.11 ±7.29 μmol/L and 1.65 ±0.25, respectively, and especially addition of soy milk from plant-based milk types (sucralose and sugar combinations included) decreased these values significantly. Soybean and soy products have a matrix composed of bioactive components such as saponins, protease inhibitors, phytic acid and isoflavones (Barrett, 2006). Soy bean stands out with its high

isoflavones content (McCue, Horii, & Shetty, 2004). Isoflavones, also known as phytoestrogens, are compounds with estrogen-like structures (Barrett, 2006). Polyphenols are mostly found in the form of glucosides (daidzin and genistin) and aglycones (daidzein and genistein), and the antioxidant activity of soy bonds with these compounds (McCue et al., 2004). In a similar study to the present study, the antioxidant capability of UHT soy milk was found to be higher compared to normal UHT milk, and it was claimed that these antioxidant properties could not be explained only by phenolic compounds, and that peptides and amino-acids in soy milk resulting from the UHT production process could also display antioxidant properties (Baghbadorani et al., 2017). In another study conducted, it was reported that adding soy milk to tea types increased and/or did not change total antioxidant activity, but that it could be a better alternative in terms of antioxidant activity compared to bovine milk (Ryan & Sutherland, 2011). It was reported that when green coffee extract was enhanced with soy milk (0.025-1 mg), phenolic substance content increased up to 70 %, and that the antiradical activity and reducing power increased by 2 to 10 times (Sęczyk, Świeca, & Gawlik-Dziki, 2017). In another study carried out, consumption of probiotic soymilk with the dosage of 200 mL per day by Type 2 diabetic kidney patients improved their oxidative stress markers (Miraghajani, Zaghian, Mirlohi, Feizi, & Ghiasvand, 2017). As reported in other studies as well, it is thought that the antioxidant content and activity of soy is the main reason for the positive effect of soymilk on oxidative stress in this study.

In the present study, another finding was that the oxidant status and oxidative stress of coffee samples added with sugar and sucralose (single or in combination) were found to be higher in comparison to coffee samples with no addition (Table 2, Figure 1). In a similar study conducted on Turkish-style coffee brews, it was determined that light roasted coffee had higher polyphenol content, but that medium roasted coffee brews showed higher antioxidant capacity, and that especially those without sugar provided more health benefits (Nakilcioğlu-Taş, 2018). On the other hand, in another study, addition of sugar, milk, and lemon juice to green tea was determined not to change the antioxidant capacity of tea infusions significantly (Bartoszek, Polak, & Chorążewski, 2018). Again, in a study on black tea, it was observed that radical scavenging activity of black tea was the highest, followed by black tea + sugar and black tea + milk+sugar (Sharma, Vijay Kumar, & Jagan Mohan Rao, 2008). Even in a study, it was determined that alternative sweeteners to refined sugar such as dark and blackstrap molasses (FRAP: 4.6 to 4.9 mmol/100g), maple syrup, brown sugar, and honey (FRAP: 0.2 to 0.7 mmol/100g) had higher antioxidant activities (Phillips, Carlsen, & Blomhoff, 2009). In this study too, it was determined that the use of sucralose, which is a non-nutritive, zero-calorie artificial sweetener, instead of sugar could be a better alternative in terms of oxidative status and stress (Table 2, Figure 1). Sucralose, 600 times sweeter than sugar, is a chlorinated (three chlorine atoms replace three hydroxyl groups) sugar substitute approved by the U.S. Food and Drug Administration (AlDeeb, Mahgoub, & Foda, 2013). Although there is an accumulated literature regarding the use of artificial sweeteners like sucralose in the struggle against obesity (Khan, 2015), there is almost no information on its potential antioxidant/oxidative effects. Though the health effects of these sweeteners are still being discussed, it was found in this study that they had more promising effects in terms of oxidative status in comparison to common table sugar. This situation can be associated with the fact that consumers put less amounts of sucralose than common table sugar equivalent to the taste of sugar in order to consume their coffee for sensorial reasons.

In this study, the oxidant status and oxidative stress of especially coffee samples with coconut oil addition (single or in combination) were found to be higher (Table 2, Figure 1). Coconut oil is an edible oil that is extracted from the kernel of mature coconuts harvested from the coconut palm. Coconut oil has an increasing popularity recently due to its bioactive substance and particularly medium-chain fatty acids content (Wallace, 2019). However, there are contradictory findings regarding its effects on health and nutrition, especially on blood lipids (Boateng, Ansong, Owusu, & Steiner-Asiedu, 2016). In the literature, it is stated that coconut oil intake should not exceed 10% of total caloric intake, especially due to its saturated fatty acid content and cardiometabolic profile. It was also determined in the same study that its addition to coffee samples was not a good strategy in terms of oxidative status (Santos, Howell, Earnest, & Teixeira, 2019). For those who are fond of its flavor, coconut milk consumption could be a better choice instead of consuming oil fraction.

Conclusion

In conclusion, in this study, in which the effect of ingredients with different chemical structure and nutritional matrix on the antioxidant and oxidant status of brewed coffee was investigated and it was determined that mostly the oxidant status/oxidative stress of coffee rather than its antioxidant capacity could change depending on the added ingredients.

There are some limitations in this study. The first of these limitations is that characterization of nutrients and bioactive substances which may affect the antioxidant/oxidant capacity of coffee samples was not conducted in this study. Secondly, all antioxidant/oxidant capacity values of coffee samples added ingredients found in this study could not be compared

since there was not any similar study related to some ingredients in the literature. Thirdly, this study only reflects the results of the filtered- Brazilian mild roasted coffee. Therefore, it is thought that the results obtained in this study may be partially limited in the generalization of the all coffee types using different beans, extraction and preparation methods. It is recommended to consider these conditions in future studies.

Compliance with Ethical Standard

Conflict of interests: The author declares that for this article they have no actual, potential or perceived conflict of interests.

Ethics committee approval: Author declare that this study does not include any experiments with human or animal subjects.

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Disclosure: -

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Investigation of the effects of animal and plant based milk on satiety and postprandial glucose levels

Hilal HIZLI GÜLDEMİR[1], İlkim GÜNEY[2], Duygu GÖKSU[2], Büşrahan SANCAK[2], Havvagül PEKDEMİR[2]

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[1] Anadolu University, Faculty of Health Sciences, Department of Nutrition and Dietetics, Eskişehir, Turkey

[2] Graduate Student of Istanbul Medipol University, Faculty of Health Sciences, Department of Nutrition and Dietetics, Istanbul, Turkey

ORCID IDs of the authors:
H.H.G. 0000-0002-3951-5023
İ.G. 0000-0002-9523-5034
D.G. 0000-0001-7390-4199
B.S. 0000-0002-2200-2184
H.P. 0000-0002-3160-5091

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Correspondence:
Hilal HIZLI GÜLDEMİR
E-mail:
hilalhizli@gmail.com

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ABSTRACT

The aim of this study was to determine the short-term effects of animal and plant-based milk consumption on postprandial glycemia, toughness, food intake of healthy individuals. Cow milk and soymilk were used as the test drink and commercial fruit juice as the control group. In the study in which 19 healthy adult subjects participated, fasting blood glucose and postprandial blood glucose analysed, visual analog scale and appetite were questioned. Then, 24-hour food comsumption records were taken and energy and macronutrients were calculated and compared. While the highest energy intake was on the day that cow milk was consumed, no significant relationship was found between test groups in terms of energy and macronutrient intake ($p>0.05$). It was determined that the difference between fasting and postprandial blood glucose was in the week in which the highest cow milk was consumed and this change was significant ($p< 0.05$). It was thought that the satiety effect of cow milk may be higher than that of soy milk due to its animal protein and saturated fat content.

Keywords: Appetite, Blood glucose, Cow milk, Satiety, Soymilk

Introduction

Animal milk is defined as the non-colostrum secretion produced by the mammary glands of healthy mammals to feed their young after birth and can be secreted from 15 days before to 5 days after birth (Godden, 2008). Milk consumption from domestic animals can be attributed to the seventh millennium BC in Northwest Anatolia (Evershed et al., 2008). Since then, consumption of milk and its use as a food ingredient, especially cow milk, have emerged and proliferated on every inhabited continent, playing an important role in the diet of people of all ages (Evershed et al., 2008; Wijesinha-Bettoni and Burlingame, 2013).

It is stated that milk and dairy products with a content rich in calcium play an important role in the protection of cardiovascular diseases, high blood pressure, osteoporosis, type 2 diabetes, stroke and colon cancer in adults, and in the healthy development of bones and teeth in childhood and adolescence periods. In the Turkish Dietary Guidelines (TDG), our national nutrition guideline, it is recommended to consume three servings of milk and dairy products daily for adult men and women aged 18-49 years (TDG, 2016). Global milk production is projected to increase by 23% compared to 2013 global production level for the year 2025 worldwide. Demand growth is expected to occur mainly in Africa, South Asia and East Asia (FAO, 2016). The global plant based milk market is expected to triple in 2025 with a growth rate of 12.5% and reach a market volume of 24.6 billion United States Dollar (USD). The largest share in this market is soy milk (Haas et al., 2019). In our country, according to the results of the most recent Turkey Nutrition and Health Survey (TNHS) (2017), the frequency of those who consume pasteurized milk as cow milk every day is 2.1%, the frequency of those who consume ultra-high temperature (UHT) milk every day is 4.8%, and the frequency of those who consume street milk every day is 3.7% (TNHS, 2019).

The definition of milk as an ingredient, beverage and nutrient source has come under scrutiny in recent years, as the presence of many different plant-based milk-like beverages on the market favors using the term "milk" to describe products formulated to mimic and replace cow milk. Cow milk has been studied recently due to its environmental effects and ethical considerations regarding animal welfare. In addition to ethical issues related to the use of animals, health problems such as dietary restrictions, allergies and lactose intolerance, and sustainability as a current issue have affected consumer demand for alternatives to cow milk (Sethi et al., 2016; Vanga and Raghavan, 2018). In line with this demand, the widely preferred options are plant-based milk substitutes, namely "plant-based milk". Plant-based milks are suspensions containing plant substitutes dissolved in water and fragmented plant material, and they resemble cow milk in appearance (Erk et al., 2019). The main varieties are plant milks such as soy, almond, rice and coconut milks, and less common hemp, hazelnut, macadamia nut, flax, oat and spelled (Vanga and Raghavan, 2018, Astolfi et al., 2020).

Plant-based milk alternatives are becoming increasingly popular, but most are nutritionally unbalanced compared to cow milk. However, milk alternatives contain bioactive components that have health-promoting properties and appeal to conscious consumers. Therefore, their ingredients and effects need to be carefully evaluated, as they can significantly affect human health (Liu, 2004; Sethi et al., 2016).

Production of animal dairy products has a significant environmental impact. The main environmental problems associated with milk production are soil degradation, air and water pollution, and biodiversity loss (Haas et al., 2019). Plant-based milks are often presented as a healthy, sustainable and animal welfare-friendly alternative (Clayton, 2021). According to Chapman's research, when the environmental impact of each milk type is examined, the results show that the carbon emission of cow milk per 200 mL is 0.63 kg, the land use is 1.79 m^2 and the water consumption is 125.6 liters, while the carbon emission for soy milk is 0.2 kg, land use is 0.13 m^2 and water consumption and has been shown to be 5.6 liters (Chapman, 2021).

The great interest of nutritionists in soy milk is due to the fact that it has a well-proportioned amino acid pattern compared to other vegetable proteins and is an alternative to cow milk. Soy milk has a nutritional composition comparable to cow milk. Compared to the compositions of cow milk, soy milk composition contains higher vegetable protein, iron, unsaturated fatty acids and niacin, while the amounts of fat, carbohydrates and calcium are lower. Its main advantage is that it does not contain cholesterol and lactose and contains 0.25 mg/g total isoflavones on wet weight (Gursoy et al., 1999).

Due to the high protein content and fatty acid composition of cow milk, satiety effects have been investigated and these studies show that consumption of cow milk products can increase satiety (Onvani et al., 2017). One mechanism explaining the effect on satiety of dairy products concluded that, given its rapid digestion and absorption, it is related to whey protein resulting in increased plasma concentration of gut hormones and total plasma amino acids (Anderson and Moore, 2004; Boirie et al., 1997). Milk proteins are thought to increase satiety and suppress short-term food intake com-

pared to other sources, but the effect of milk proteins or casein is still unclear (Paddon-Jones et al., 2008). Whey protein has been shown to suppress hunger more potently, resulting in lower food intake compared to casein (Hall et al., 2003). Therefore, the aim of this study is to investigate the effect of consumption of animal and plant dairy products (cow milk and soy milk) on satiety and postprandial blood glucose.

Materials and Methods

Research Location, Time and Sample Selection

The research was carried out in three consecutive weeks, on the same days and times each week, between April 10 and June 7, 2019. The research sample consists of 19 healthy female individuals aged between 18-25 years, without any acute or chronic disease and not using chronic medication, with a normal body mass index (BMI) range, without allergy or intolerance to cow milk and soymilk. Ethical approval (number: 10840098-604.01.01-E.14958, date: 06.05.2019) from Istanbul Medipol University Non-Interventional Clinical Research Ethics Committee and written consent form were obtained from the participants.

General Plan of the Study

A total of 19 female were included in this study. The experiment process lasted about three hours and was carried out at one-week intervals. The same individuals participated in all three experimental groups and came to the experiment site after at least eight hours of overnight fasting. During the experiment, in the laboratories of Istanbul Medipol University, individuals sat and waited in the laboratory, and light activities such as reading books were allowed.

First, a questionnaire form containing general and demographic information and evaluating milk consumption habits were filled, then fasting blood glucose levels were measured and visual analog scale (VAS) was recorded. Afterwards, the first meal, the test breakfast, was presented. All of the test meals were consumed within 15 minutes. Subsequently, visual analog scale (VAS) responses were recorded every half hour and blood glucose levels were measured at 120 minutes after the first bite. The next day, the 24-hour food consumption record was taken by the researchers by calling the individuals by phone. The research flowchart is summarized in Table 1.

Energy and Macro Nutrient Content of Drinks and Test Meal Given During the Experiment

For the test meal, breakfast, a sandwich consisting of two thin slices of whole wheat bread (50 g) with tomato, cucumber and lettuce and a test drink were served. The test drink was given on the same day and at the same time each week, along with the sandwich for three consecutive weeks, respectively, cow milk (200 mL) in the first week, soymilk (200 mL) in the second week, and mixed aroma containg fruit juice as commercially prepared with no added sugar (200 mL) as the control group in the last week. Participants were informed about the content of the meal they would consume. Carbohydrate, protein and fat contents of three different breakfast test meals are given in Table 2.

Table 1. Research Flow Chart

Hour	Intervention
09:00	Filling out a questionnaire evaluating the voluntary consent form, general and demographic information and milk consumption habits and determining the fasting blood glucose of the individuals.
09:15-09:30	VAS application and test meal consumed within 15 minutes
10:00	VAS application
10:30	VAS application
11:00	VAS application
11:30	VAS application and 2nd hour postprandial blood glucose determination
Next Day 12.00	Obtaining a daily food consumption record

Table 2. Energy and macronutrient content of test meals

Groups	Energy (kcal)	Carbohydrate (g)	Protein(g)	Fat (g)
Cow Milk + Sandwich	232.8	31.44	10.6	6.9
Soy Milk + Sandwich	200.4	31.2	7	4.9
Juice + Sandwich	214.4	35.6	4.6	0.9

Data Evaluation

The demographic information of the participants was collected by answering the questions in the given questionnaire, and body mass index (BMI) values were calculated by the researchers. Blood glucose level was measured by glucometer (Accu Check, USA) in the second blood drop taken from the first capillary blood from the fingertip.

In this study, the visual analog scale (VAS) applied evaluate the hunger, satiety, desire to eat and the amount they can eat. The visual analog scale is a scale made by looking at food requests according to appetite, satiety and taste. Classifications are determined by selecting the appropriate point from both ends with a horizontal line of ten mm. The measure in millimeters from the last point of the line to the marked place was determined as VAS (Wewers and Lowe, 1990).

On the next day after the experiment, 24-hour food consumption was recorded by the researcher using the retrospective method. Energy and macronutrient consumption of individuals were calculated with the Nutrition Information System (BeBiS) program (BeBiS, 2004).

Statistical Analysis

SPSS 22.0 statistical package program was used for the statistical evaluation of the data. Data obtained from individuals are expressed as arithmetic mean ($\bar{x}$), standard deviation (S), number and percentage (%). The change between fasting and postprandial blood glucose obtained from individuals was evaluated using the Wilcoxon T test. VAS scores by weeks and the change between total energy and macronutrient intakes were evaluated using the Friedman test. In statistical analysis, the significance value within and between groups was taken as $p < 0.05$.

Results and Discussion

According to the results of the visual analog scale, at the end of the two-hour period following the consumption of the test meal, it was determined that the lowest hunger, desire to eat and amount to eat scores and the highest satiety score were in the cow milk group (Table 3). It was found that these values for hunger and desire to eat significantly different at the end of the two-hour period ($p < 0.05$). Changes in satiety status also showed a significant difference between cow milk and other groups during the process ($p < 0.05$). Visual analog scale (VAS) applied at five different times in each application at 0, 30, 60, 90 and 120 minutes in order to understand how the appetite parameters of individuals change depending on time, shown in Table 3. Results can be shown in Figure 1-4. A review was published by Bendtsen et al in 2013 to examine the evidence from controlled clinical studies investigating the effects of milk protein consumption and other protein sources on appetite regulation, energy expenditure and body weight. According to this review, it has been observed that cow milk protein is beneficial in increasing and maintaining weight loss due to its effects on appetite regulation and energy expenditure and whey protein, one of the milk proteins, has a more satisfying effect in the short term and casein in the long term (Bendtsen et al., 2013). According to a meta-analysis by Onvani et al. in which 3617 human clinical studies of milk and dairy products were reviewed and the effects on satiety and food intake were examined in seven studies involving 237 participants, it was stated that there was a significant decrease in hunger and there was a significant difference between study heterogeneity. In subgroup analyzes based on intervention dose, it was found that consumption of more than 500 ml/day dairy products significantly reduced hunger. It is said to be associated with an insignificant reduction in dairy consumption of less than 500 ml (Onvani et al., 2017). In a study by Alfenas et al. conducted on appetite and energy metabolism of different protein types in Brazil in 2009, a control group formed using whey protein, casein protein, soy protein and a comparison between them. As a result, casein protein offers a stronger satiety power than whey protein, due to its high dietary thermogenesis. It is stated that soy protein also can have a significant effect on postprandial energy expenditure compared to whey protein and control. It is highlighted that whey protein consumption can be effective on body weight and body fat control (Alfenas et al., 2010). In this study, the lowest average visual analog scale score applied every half hour determined that, the feeling of desire to eat

was less when the individuals consumed cow milk. It was assumed that two studies point to similar results. This can be explained by the animal-derived protein and saturated fat content of cow's milk.

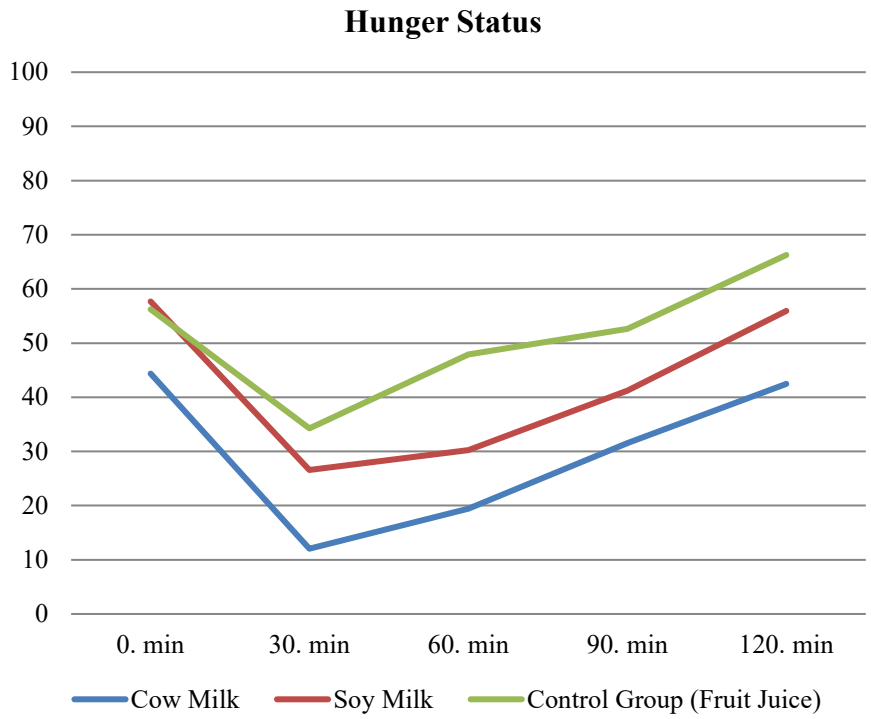

Figure 1. Time-dependent change of individual hunger scores

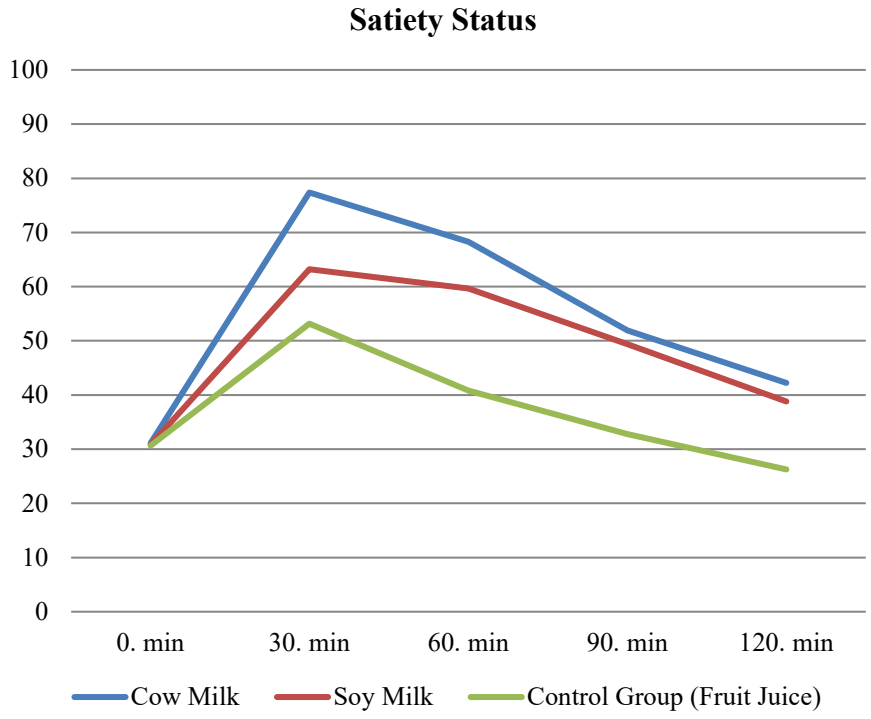

Figure 2. Time-dependent change of individual satiety scores

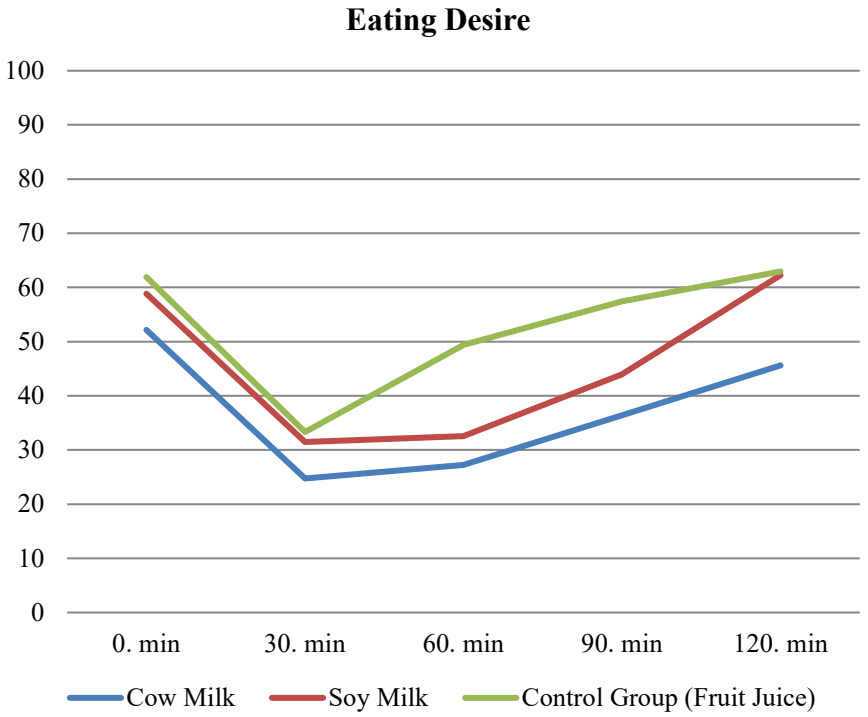

Figure 3. Time-dependent change of individual eating desire scores

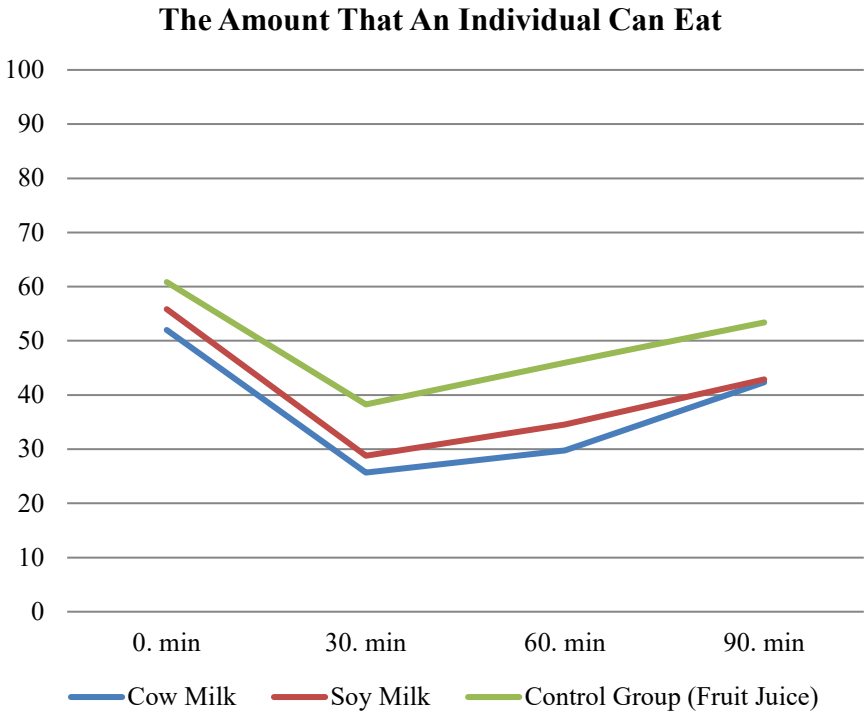

Figure 4. Time-dependent change of the amount that an individual can eat scores

Table 3. Visual analog scale scores

	Cow Milk	Soy Milk	Fruit Juice	p
Hunger Status				
09.30	44.37±26.97	57.68±30.88	56.21±29.98	0.094
10.00	12.05±13.74	26.58±22.25	34.26±24.87	**0.001**
10.30	19.42±20.40	30.26±24.21	47.89±24.55	**0.001**
11.00	31.53±25.18	41.21±22.36	52.63±24.21	0.170
11.30	42.47±28.02	55.95±24.75	66.26±25.17	**0.001**
Satiety Status				
09.30	31.11±26.44	30.84±24.97	30.63±24.72	0.841
10.00	77.37±15.24	63.21±22.78	53.16±27.00	**0.001**
10.30	68.26±20.16	59.68±25.37	40.79±26.15	**0.001**
11.00	51.89±23.11	49.36±24.73	32.79±18.44	**0.033**
11.30	42.21±25.89	38.79±25.20	26.26±18.37	0.065
Eating Desire				
09.30	52.16±19.59	58.84±28.51	61.89±23.68	**0.029**
10.00	24.74±18.26	31.47±24.05	33.32±23.16	0.201
10.30	27.26±19.66	32.53±23.25	49.37±22.06	**0.016**
11.00	36.42±19.33	43.95±20.93	57.42±22.98	**0.040**
11.30	45.63±21.79	62.26±18.58	62.95±22.41	**0.003**
The Amount That an Individual Can Eat				
09.30	52.00±15.38	55.84±26.23	60.84±23.05	0.564
10.00	25.68±19.01	28.79±22.74	38.26±24.84	0.128
10.30	29.79±20.82	34.58±23.26	45.95±24.62	**0.008**
11.00	42.32±23.36	42.89±21.50	53.37±21.84	0.175
11.30	48.68±24.13	57.53±16.87	62.11±21.70	0.075

Values are given as mean ± standard deviation. $p<0.05$ was considered significant. Visual analog scale form is determined as linear line length mm.

The total energy intake and percentages of carbohydrate, protein and fat of the 24-hour food consumption records of the individuals according to the groups are shown in Table 4. It was found that the average daily energy intake of the individuals participating in the study was 1872.26 ±520.97 kcal on the day they consumed cow milk as a test drink, 1721 ±598.47 kcal on the day they consumed soymilk, and 1702.42 ±345.42 kcal on the day they consumed fruit juice. There is no significant difference between the average daily energy intakes according to the groups ($p > 0.05$). In a study conducted with individuals with low (<1 portion / day) or high (> 3 portions / day) milk consumption in which the effects of dairy consumption on food intake and appetite were investigated. Consuming three portions of dairy products every day contributes significantly to energy intake. It was observed that the increase in energy intake was higher in men than in women and that increased intake of dairy products did not cause a change in feelings of satiety enough to compensate for the additional calories taken (Hollis and Mattes, 2012). Considering the 24-hour food consumption records of the individuals in the study group, the highest total energy intake is the week of cow milk consumption as the test drink, and the lowest is the week of fruit juice consumption. The reason for the difference from other studies in the literature may be related to the change in food consumption of individuals within 24 hours according to various environmental and sensory stimuli.

Fasting and postprandial blood glucose levels of the individuals are given in Table 5. The postprandial blood glucose levels of the individuals participating in the study were found as 103.42 ± 11.59 mg/dl in the week that cow milk was consumed, 97.84 ± 11.15 mg/dl in the week that soymilk was consumed, and 95.47 ± 9.82 mg/dl in the week fruit juice consumed. It was determined that the change between fasting and postprandial blood glucose for the week in which only cow milk was consumed as a test drink was significant ($p < 0.05$). In a study published in 2011 in Greece by Vallianou et al. on the effects of high blood glucose levels on hypertensive individuals' consumption of full-fat dairy products, 490 volunteers were included in the study. Multiple linear regression models were applied to determine the effect of full-fat dairy consumption on blood glucose levels considering age, gender and BMI factors. As a result, it was found that full-fat dairy products are associated with higher blood glucose levels; however, they stated that the relationship between dairy groups did not show any significance (Vallianou et al., 2011). On the other hand, a study published in 2014 stated that low-fat dairy products increase fasting blood glucose more than full-fat dairy products (Anekwe and Rahkovsky, 2014). A study conducted on thirty healthy individuals in 2017 compared the effect of dairy products and a non-dairy beverage, consumed together with carbohydrates on subjective appetite, food intake and postprandial glycemia in healthy elderly adults. Between the groups of soy drink, 2% cow milk, cheese, yoghurt and the control group showed that there is no difference in terms of nutritional intake (Law et al., 2017). When compared with this study, it is seen that postprandial blood glucose is in cow milk group as the highest, and the difference between satiety and hunger levels is also the highest in the same group. The reason for this is thought that cow milk has more carbohydrate and fat than soymilk, as well as protein content of animal origin. However, the reason why the other results are not meaningful may be that they are carried out for a short time with a small number of people.

Table 4. 24-hour energy and macronutrient intake of individuals after the experiment

	Total Energy (kcal)	CHO %	Protein %	Fat %	p*
Cow Milk	1872.26±520.97	46.47±5.28	14.31±2.56	39.26±4.60	
Soy Milk	1721.00±598.47	52.26±7.55	15.31±3.35	32.42±7.08	0.274
Fruit Juice	1702.42±345.42	45.47±6.04	14.94±2.43	39.89±7.37	

* p value for total energy, Friedman test. Values are given as mean ± standard deviation. $p < 0.05$ was considered significant. CHO: Carbohydrate

Table 5. Fasting and postprandial blood glucose levels of individuals

	Fasting Blood Glucose Level (mg/dL)	Postprandial Blood Glucose Level (mg/dL)	p
Cow Milk	86.21±7.26	103.42±11.59	**0.012**
Soy Milk	87.68±9.40	97.84±11.15	0.731
Juice	88.15±8.14	95.47±9.82	0.277

Values are given as mean ± standard deviation. p <0.05 was considered significant. Fasting and postprandial blood glucose was determined in mg / dl by glucometer.

Some of the limitations of this study are that participants have information about the content of meals consumed without blinding, and that blood glucose levels were measured with a glucometer, not with venous blood.

Conclusion

As a result of the study conducted to investigate the effects of animal and plant-based milk on satiety, and postprandial glucose levels; cow milk was found to cause higher feelings of satiety and higher blood glucose levels after two hours compared to soy milk and fruit juice as a control group. It is thought that long term and more studies are needed on the effects of various animal and plant-based milks on short-term satiety, food intake, hunger and satiety.

Compliance with Ethical Standard

Conflict of interests: The author declares that for this article they have no actual, potential or perceived conflict of interests.

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Propolisin besinlerde kullanımı ve koruyucu özellikleri

Damla GÜMÜŞ , Mevlüde KIZIL

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Hacettepe Üniversitesi Sağlık Bilimleri Fakültesi Beslenme ve Diyetetik Bölümü, Ankara, Türkiye

ORCID IDs of the authors:
D.G. 0000-0002-4871-8981
M.K. 0000-0003-1380-3243

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Correspondence: Damla GÜMÜŞ
E-mail: damla.gumus@hacettepe.edu.tr

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ÖZ

Propolis bal arıları tarafından çeşitli bitkilerden toplanan salgıların, tükürük ve enzimle karışımından elde edilen ve kovanın dış etkenlere karşı korunması amacıyla kullanılan doğal bir üründür. Propolisin biyolojik özellikleri ve kimyasal bileşimi bitki kaynaklarına, toplandığı bölgeye ve toplanma zamanına göre değişmekle birlikte bileşiminde fenolik bileşikler, aromatik asitler, uçucu yağlar, mineral ve vitaminler yer almaktadır. Çeşitli tedavi amaçlarıyla geleneksel tıpta uzun süredir kullanılmakta olan propolis, besinlerde de doğal bir koruyucu olarak kullanılma potansiyeline sahiptir. Propolis et ürünleri, kümes hayvanları, balık, süt ürünleri, sebze ve meyveler, meyve suları gibi birçok besinde mikrobiyal büyümeyi yavaşlatması, oksidasyonu azaltması, ağırlık kaybını önlemesi, mantar oluşumunu ve çürümeyi engellemesi, ürün stabilitesi sağlaması, raf ömrünü uzatması gibi koruyucu etkiler gösterebilmektedir. Bunun yanında propolisin kendine has koku ve tat özelliklerinin eklendikleri besinlerin duyusal kalitesini etkileyebilmesi besin endüstrisinde kullanımının önünde engel oluşturabilmektedir.

Anahtar Kelimeler: Propolis, Antimikrobiyal, Antioksidan, Besin koruma

ABSTRACT

Use of propolis in foods and its protective properties

Propolis is a natural mixture of saliva, enzymes and plant secretions which collected by bees from various plants and used for protection of hives against external factors. Biological activities and chemical composition of propolis may vary according to the plant sources, location and time, and it contains phenolic compounds, aromatic acids, essential oils, minerals and vitamins. Propolis has been used in traditional medicine for various therapeutic purposes, and it has a potential as a natural preservative in foods. Propolis may have various protective effects such as reducing microbial growth and oxidation, preventing fungus, rotting and weight loss, maintaining product stability and extending shelf life in meat, poultry, fish, dairy, vegetables, fruits and fruit juices during storage. However, propolis's unique odor and taste may alter the sensory quality of foods and that may effect its use in the food industry negatively.

Keywords: Propolis, Antimicrobial, Antioxidant, Food preservation

Giriş

Propolis, bal arılarının müsilaj, gum, reçine gibi bitki salgıları ve palmiye, çam, kızılağaç, kavak, kayın, huş ağacı gibi farklı ağaç türlerinin yapraklarından topladıkları maddelerin enzimatik salgı ile karışımından elde ettikleri bir maddedir (Bankova vd., 1992). Arı tutkalı olarak da bilinen propolis, kovanların rüzgar ve su gibi dış etkenlere ve istilacılara karşı korunması, kovanlardaki boşlukların kapatılması, arı larvaları, bal depoları ve petekte oluşabilecek mikrobiyal gelişimin önlenmesi, kovanın uygun iç sıcaklık ve nem değerlerinde tutulması amacıyla kullanılmaktadır (Pasupuleti vd., 2017).

Karakteristik bir kokusu ve tadı olan propolisin bileşimi toplandığı bölge koşullarına, toplanma zamanına ve üretildiği bitki çeşidine göre değişiklik göstermektedir. Örneğin, Çin'de üretilen propolisin bitki kaynağı çoğunlukla kavak ağacı iken, Brezilya'da Baccharis bitkisidir. Bu farklılıklara bağlı olarak Çin kavak propolisinin ana bileşenlerini, flavonoid aglikonlar, fenolik asitler ve fenolik asit esterleri oluştururken, Brezilya propolisi, p-kumarik asit, asetofenonun prenile edilmiş türevleri, diterpen ve flavonoidler bakımından zengindir (Yuan vd., 2020). Propolis genel olarak %50 reçine ve bitkisel balsam, %30 arı mumu, %5 polen, %10 esansiyel ve aromatik yağlardan oluşmakla birlikte, içeriğinde 420'den fazla bileşen tespit edilmiştir. Propolisin ana bileşenleri arasında aromatik asitler (Sinamik asit, kafeik asit, ferulik asit), aromatik esterler (Sinamik ve kafeik asit etil esterleri), uçucu bileşikler (Geraniol, nerol, farnesol, β-eudesmol), aromatik bileşikler (Vanilin), hidrokarbonlar (Eikosan, trikosan, pentakosan), steroidler (Kolinasterol, fukosterol, stigmasterol), enzimler (α-amilaz, β-amilaz), flavonoidler (Pinocembrin, chrysin, galangin, apigenin, kaempferol), asitler (Palmitik asit, melisik asit, serotik asitler), mineraller (Kalsiyum, potasyum, magnezyum, sodyum, çinko, klor, demir), vitaminler (Tiamin, riboflavin, pridoksin, C ve E vitamini) ve uçucu yağlar (Monoterpenler ve seskiterpenler) yer almaktadır (Kubiliene vd., 2015).

Ham propolis, kullanım öncesi çözücü ekstraksiyonu yoluyla etanol, metanol, kloroform, eter, aseton ve su gibi çözücüler kullanılarak ekstrakte edilmektedir. Propolis ekstresinin besin desteği olarak farmasötik alanda kullanımı yakın zamanda yaygınlaşmakla birlikte dental ürünler, krem, antiseptik yapımında ve kozmetik ürünlerde de kullanılmaktadır (Bankova vd., 2016; Chandna vd., 2014). Bu yaygın kullanımının yanında propolisin bileşimindeki fonksiyonel bileşenler ile besinlerde doğal bir koruyucu olarak kullanılabilme potansiyeli bulunmaktadır (Wagh, 2013). Bu derleme yazıda güncel araştırma sonuçlarına göre propolisin besinlerde doğal koruyucu olarak kullanımının değerlendirilmesi amaçlanmıştır.

Propolisin Biyolojik Aktiviteleri

Propolisin insanlar tarafından çeşitli tedavi amaçlarıyla M.Ö. 300 yıllarından itibaren kullanıldığı bilinmektedir (Fokt vd., 2010). Genel olarak propolisin antibakteriyel, antioksidan, antifungal, antiinflamatuar, antiviral, anestezik, antitümöral, antiprotozoal, antikanser, antihipertansif ve anti hepatotoksik aktiviteleri ile insan sağlığı üzerine olumlu etkileri olduğu kabul edilmektedir (Azemin vd., 2017). Ayrıca propolisin, çiftlik hayvanlarının büyüme performansı ve verimliliği üzerinde iyileştirici etkileri bulunmaktadır (Bankova vd., 2016).

Propolis, bakterilerin bölünme ve protein sentezini durdurma, hücre duvarı ve bakteriyel sitoplazmayı yıkma yoluyla bakterisidal bir ajan olarak etki edebilmekte ve antibakteriyel aktivite gösterebilmektedir (Fokt vd., 2010). Literatürde, propolisin yüksek antioksidan bileşimi sayesinde serbest radikalleri temizleme ve söndürme, lipit peroksidasyonunu önleme gibi aktiviteler gösterdiğini bildiren çalışmalar yer almaktadır. Ayrıca propolisin, flavonoidler, 3-asetil pinobanksin, pinobaksin, pinocembrin, p-kumarik asit ve kafeik asit gibi bileşenler başta olmak üzere yapısındaki 26'dan fazla bileşenin antifungal akitiviteye sahip olduğu çeşitli çalışmalarda gösterilmiştir (Fokt vd., 2010; Wagh, 2013). Propolisin bileşimi çeşitli faktörlere göre değişiklik gösterse de farklı bölgelerden toplanan propolis örneklerinin yüksek biyolojik aktivitelerinin olduğu bildirilmiştir (Bankova vd., 2016).

Propolisin Besinlerde Kullanımı

Günümüzde sağlıklı ve doğal beslenme üzerine artan tüketici farkındalığı ile besinlerde yapay koruyucuların yerine antioksidan ve antimikrobiyal ajan olarak aktivite gösterebilen doğal katkı maddelerini içeren ürünlere yönelik talep gittikçe yaygınlaşmaktadır (Takwa vd., 2018). Doğal koruyucu olarak besinlerdeki etkinliği incelenen maddelerden biri olan propolis, kimyasal bileşimi ve biyoaktif özellikleri ile besin endüstrisi için güçlü bir potansiyele sahiptir. Propolisin bakteri, mantar, virüs gibi farklı mikroorganizmalar üzerindeki etkisi ile ilgili çok sayıda araştırma yapılmış, bu çalışmaların sonuçları propolisin bakterisidal, fungisidal, antiviral ve nematisidal etkilerini göstermiştir (Doğan ve Hayoğlu, 2012). Koruyucu katkı maddeleri besinlere mikroorganizmaların üremesini kontrol etmek amacıyla antimikrobiyal olarak; depolama sırasında meydana gelen oksidasyonu ve bozulmayı önlemek ve raf ömrünü uzatmak amacıyla antioksidan olarak eklenmektedir. Propolis, antioksidan ve antimikrobiyal özellikleri bir arada içeren, toksisitesi düşük doğal bir maddedir (Bankova vd., 2016). Propolis besinlere ekleme, püskürtme veya daldırma uygulanmalarında ve besin kaplamalarında

kullanılarak ürün stabilitesinin korunması, patojenlerin önlenmesi, saprofik mikrobiyotanın azaltılması ve raf ömrünün uzatılması gibi etkiler gösterebilmektedir (Silici ve Karaman, 2014; Viera vd., 2016).

1. Propolisin Besinlere Ekleme Yöntemi ile Kullanılması

Propolis, antimikrobiyal ve antioksidan koruma amacıyla doğrudan besinlere eklenebilmektedir. Yapılan çalışmalar, et ürünlerine propolis eklenmesinin besin kaynaklı patojenlerin büyümesini inhibe ettiğini ve bu etkinliğin konsantrasyona bağlı olarak değiştiğini göstermiştir. Propolisin etanolik ekstresinin (PEE) sosislere %0.5 ve %1 konsantrasyonlarında eklenmesi ile küf ve mayaların aktiviteleri ve proteolitik ve lipolitik mikrofloranın büyümesinin inhibe edildiği saptanmıştır (Ali vd., 2010). PEE'nin sığır eti ile hazırlanmış köfte (Vargas-Sánchez vd., 2014) ve sosis örneklerine (Viera vd., 2016) %2 konsantrasyonunda eklenmesinin, kontrol örneklerine kıyasla mezofilik ve psikrotrofik bakteri sayısını düşürdüğü ve ürünlerin raf ömrünün önemli ölçüde uzadığı görülmüştür. Propolisin etanolik (PEE) ve sulu ekstresinin (PSE) kıyılmış sazan balık etine %3, %5 ve %7 konsantrasyonlarında eklenmesinin psikrotrof bakteriler ve laktik asit bakterileri ile toplam plak sayısını azalttığı tespit edilmiş, her iki ekstre türünde de en etkili konsantrasyonun %7 olduğu saptanmıştır (Payandan vd., 2017).

Besinlerde gerçekleşen lipit oksidasyonunu azaltmanın en etkili yöntemlerden biri antioksidan bileşiklerin kullanılmasıdır (Kročko vd., 2014). Propolisin, et ve balık ürünlerindeki antioksidan etkileri çeşitli araştırmalarda incelenmiştir (Ali vd., 2010; Gutiérrez-Cortés ve Suarez Mahecha, 2014). Sığır köftelerine %2 konsantrasyonlarında PEE eklendiğinde, soğuk depolamada kontrol gruplarına göre lipit oksidasyonu, konjuge dienler ve metmiyoglobin düzeylerinin daha düşük olduğu ve daha yüksek renk korunumu sağlandığı bildirilmiştir (Vargas-Sánchez vd., 2014). Sosislere %0.6 konsantrasyonunda PEE ilave edildiğinde, soğuk depolamada kontrol grubundaki sosislerin raf ömrü 12 gün olarak saptanırken, PEE eklenen sosislerin 21 güne kadar bozulmadığı tespit edilmiş, tiyobarbitürik asit reaktif maddeleri (TBARS) ve toplam uçucu bazik nitrojen değerlerinin daha düşük olduğu gözlenmiştir (Ali vd., 2010). Mikrokapsüllenmiş propolis ekstresinin hamburger örneklerine 0.3 g/kg oranında eklendiğinde lipit oksidasyonunun önlenmesi açısından, sentetik bir antioksidan olan sodyum eritrobattan daha etkili olduğu bildirilmiştir (dos Reis vd., 2017). Farklı et ürünleri ile yapılan çalışmalar incelendiğinde, PEE'nin %0.06 konsantrasyonunda jambon örneklerinde oksidasyon stabilitesini olumlu yönde etkilediği (Kročko vd., 2014), 0.14 g/kg oranında salam örneklerinde 90 günlük soğuk depolama sırasında lipit oksidasyonunu önlediği (Bernardi vd., 2013), salamlara %0.05 ve %0.1 konsantrasyonlarında eklendiğinde oksidatif aktivitenin azaldığı (Kunrath vd., 2017) görülmüştür.

Propolisin süt ürünlerindeki etkilerini inceleyen bir araştırmada PEE, *Listeria monocytogenes* ile yapay olarak kontamine edilmiş pastörize yağsız çikolatalı süt örneklerine eklenmiş ve örnekler mikrobiyolojik açıdan analiz edilmiştir. PEE eklenmesi 4°C'de depolanan sütte 20 günlük depolama boyunca *L. monocytogenes* büyümesinin inhibisyonunu sağlamış ve uygun olmayan (10°C) saklama koşullarında depolanan çikolatalı sütte *L. monocytogenes*'in büyüme oranını kontrol grubuna kıyasla 5 kat azaltmıştır (Michailidis vd., 2021). Yoğurt üretiminde koruyucu olarak kullanılan potasyum sorbat ile propolis ekstresinin etkinliğinin karşılaştırıldığı bir çalışmada, probiyotik yoğurtlara %0.05 PEE eklenmesinin pH, yağ asidi profili, kimyasal bileşimi ve raf ömrü açısından potasyum sorbat ile benzer koruyuculukta olduğu, 28 günlük depolama sırasında yüksek mikrobiyolojik stabilite, toplam fenolik içerik ve laktik asit bakteri içeriğinde daha yüksek koruma sağladığı gözlenmiştir (Santos vd., 2019). Propolisin steril yağsız süt, pastörize inek sütü, inek ve keçi ricotta peynirine koruyucu olarak eklendiğinde *S. aureus, L. monocytogenes* ve *B. cereus* (Pedonese vd., 2019), Kareish peynirinde *S. thermophilus* ve *L. bulgaricus* üzerinde kontrol gruplarına kıyasla yüksek antimikrobiyal aktivite gösterdiği tespit edilmiştir (El-Deeb ve Omar, 2017).

Propolis antifungal ve antimikrobiyal etkinliği nedeniyle meyve sularının hazırlanmasında da kullanılabilmektedir. Pastörize edilmemiş elma, portakal, üzüm ve mandalina sularına %0.1 - 3.75 konsantrasyonlarında PEE ilavesi, mayaların büyümesini engellemiş, PEE'nin meyve sularının üretiminde koruyucu olarak kullanılan sodyum benzoattan daha yüksek antimikrobiyal aktiviteye sahip olduğu bildirilmiştir (Silici vd., 2005). Elma sularında Patulin üremesi üzerine propolisin etkisini inceleyen bir çalışmada, *P. expansum* inokülasyonundan sonra elma sularına 0.1, 1 ve 2 mg/mL oranlarında PEE ve 0.35 mg/mL sodyum benzoat eklenmiş ve Patulin konsantrasyonlarının azaltılmasında en yüksek etkinin 2 mg/mL PEE eklenmesi olduğu görülmüş ve propolisin doğal bir antifungal ajan olarak kullanılabileceği ifade edilmiştir (Silici ve Karaman, 2014). Meyve suları ile yapılan çalışmalarda PEE'nin taze sıkılmış nar suyunun depolanması sırasında maya ve küf oluşumunu engellediği (Kahramanoglu ve Usanmaz, 2017), portakal suyuna 0.2 mg/mL propolis içeren bir emülsiyonun eklenmesinin *Bacillus* sporlarının sayısını azalttığı (Yang vd., 2017), elma suyuna %2 ve %5 PEE ilavesinin *E. coli* üremesini önlediği (Sagdic vd., 2007) tespit edilmiştir. Meyvelerin antioksidan içeriklerinin korunması üzerine propolisin etkilerinin incelendiği çalışmalarda, taze sıkılmış nar suyunun 1 yıl donuk depolanması (Kahramanoglu ve Usanmaz, 2017) ve portakal suyunun oda

sıcaklığında 35 günlük depolanması sonunda antioksidan kapasitesinin kontrol gruplarına kıyasla etkili şekilde korunduğu görülmüştür (Yang vd., 2017).

Bal örneklerine %0.1, %0.3 ve %0.5 konsantrasyonlarında PEE eklenmesi ile örneklerin antioksidan aktivitesi, toplam fenolik ve flavonoid içeriği artmıştır (Osés vd., 2016). PEE'nin biraya eklenmesi ile oksidasyonun önlendiği ve üretim basamakları sırasında kontrol örneklerinde azaldığı saptanan fenolik içeriğin propolis eklenmesi sonucu daha yüksek düzeyde korunduğu tespit edilmiştir (Ulloa vd., 2017).

2. Propolisin Daldırma ve Püskürtme Yöntemleri ile Besinlerde Kullanılması

Propolisin besinlerde kullanılmasına alternatif yöntemler arasında besine kısa süreli püskürtülmesi veya besinin propolis ekstresi içeren solüsyonların içine daldırılması gibi yüzeysel uygulamalar yer almaktadır. Bir çalışmada, balık filetoları 30 dakika boyunca %0.6 propolis içeren sulu bir çözeltide bekletildikten sonra 6 ay -18°C'de depolanmış, depolama sonunda psikrotrof bakteri sayısında kontrol grubuna kıyasla azalma gözlenmiş ve raf ömrünün uzadığı rapor edilmiştir (Hassanin ve El-Daly, 2013). PSE'nin vakumla paketlenmiş taze şabut balıklarının (*Barbus grypus*) kimyasal, mikrobiyolojik ve duyusal kalite özellikleri üzerindeki etkilerinin incelendiği bir araştırmada, %0.1, %0.3 ve %0.5 konsantrasyonlarında PSE eklenmesinin balıkların duyusal kalite, toplam uçucu bazik nitrojen değeri ve mikrobiyolojik üreme üzerine anlamlı koruyucu etkileri olduğu ve PSE içeren örneklerin kontrol örneklerine göre daha uzun raf ömrüne sahip olduğu saptanmış, raf ömrünün uzatılması yönünden en etkili PSE konsantrasyonunun %0.5 olduğu bildirilmiştir (Duman ve Özpolat, 2015).

Sebze ve meyve ürünlerinin üretimi sırasında yüksek miktarda klor kullanılarak yapılan dezenfeksiyon işlemlerinde, trihalometanlar, kloraminler, haloketonlar, kloropikrinler ve halojenoasetik asitler gibi karsinojen yan ürünler oluşabilmektedir. Yemeye hazır ürünler ve minimum düzeyde işlenmiş sebzelerin sterilizasyon işlemlerinde propolis kullanılması, başta sodyum hipoklorit olmak üzere en yaygın kullanılan klorlu bileşiklerin yerine potansiyel doğal bir alternatif olarak görülebilmektedir (Bachelli vd., 2013). Marulların dezenfeksiyonu sırasında %2 konsantrasyonunda propolisin metanol ekstresi (PME) ve sodyum hipoklorit kullanımı karşılaştırıldığında, mikrobiyal kontaminasyonun azaltılmasında PME'nin daha etkili olduğu, marulların PME içeren solüsyonda 15 ve 30 dakika bekletilmesinden sonra, aerobik mezofil ve psikrofil bakterilerde yüksek düzeyde azalma olduğu saptanmıştır (Feás vd., 2014). Minimum işlenmiş sebze üretimi için kereviz, pırasa ve balkabağına PEE çözeltisi püskürtüldükten sonra 5°C'de 10 gün depolamanın sonunda kontrol grubuna kıyasla daha düşük *E. coli O157:H7* tespit edildiği, fakat mezofilik aeroblar, psikrotroflar, koliformlar ile maya ve küf sayımlarında azalma gözlenmediği rapor edilmiştir (Alvarez vd., 2015). Başka bir çalışmada, PEE ile kombinasyon halinde ısı uygulaması yapıldığında, sebzelerin 70°C'de 90 saniye boyunca su banyosuna daldırılmasıyla mikrobiyal yükün 2 log CFU/g düzeyinde azaldığı görülmüştür (Alvarez vd., 2017).

Bir araştırmada, ejder meyveleri %0.25, %0.5, %0.75 ve %1 konsantrasyonlarında PEE ile hazırlanan çözeltilerde 2 dakika bekletildikten sonra, 20 günlük depolamanın sonunda ağırlık kaybı, sertlik, asitlik, karbondioksit ve etilen üretimi üzerine kontrol grubuna kıyasla olumlu etkiler gözlendiği ve meyvelerin toplam fenolik içerik, toplam flavonoidler ve toplam antioksidan seviyelerinde yüksek korunum sağlandığı tespit edilmiştir (Zahid vd., 2013). Kiraz meyveleri %1, %5 ve %10 konsantrasyonlarındaki propolisin sulu (PSE) ve etanolik (PEE) ekstrelerine daldırılmış ve daha sonra 0°C'de depolanmış, mantara bağlı çürüme ve çeşitli kalite kriterleri (Ağırlık kaybı, toplam çözünmüş katı maddeler, titre edilebilir asitlik, kabuk rengi, gövde kararması, yüzey çukurluğu, görünüm ve tat) depolama sırasında belirli aralıklarla değerlendirilmiştir. Mantara bağlı çürümenin önlenmesinde en etkili yöntemin PEE olduğu, fakat kirazların duyusal kalitesi ve gövde renginin olumsuz etkilendiği tespit edilmiştir (Candir vd., 2009). Bitki antraknozuna neden olan *Colletotrichum* türleri üzerine propolisin etkilerini incelemek amacıyla yapılan araştırmalarda PEE'nin, papaya, biber (Ali vd., 2015) ve mango (Mattiuz vd., 2015) örneklerinde *C. gloeosporioides* gelişimini inhibe ettiği saptanmıştır.

Sucuk örneklerinin fermentasyondan önce propolis, kekik uçucu yağı ve hidrosol ile yüzeysel muamelelerinin mikrobiyolojik özellikler, renk ve uçucu bileşikler üzerindeki etkilerini değerlendirmek amacıyla yapılan bir çalışmada, maya ve küf sayısının azaldığı ve Laktik asit bakterileri ve *Micrococcaceae* sayısının etkilenmediği saptanmış, sucuk örneklerinin tat, aroma ve renk gibi özelliklerinin korunduğu tespit edilmiştir (Ozturk, 2015).

3. Propolisin Besin Kaplamalarında Kullanılması

Yenilebilir film ve kaplamaların tek başına veya çeşitli bileşenlerle birlikte kullanılması, besinlerin korunmasında kullanılan yeni bir yaklaşımdır. Propolisin, besin kaplamalarında kullanımı besin endüstrisindeki alternatif kullanımlarından biri olarak uygulanma potansiyeline sahiptir. Propolisin filmler veya kaplamalara eklenmesi ile özellikle mikroorganizmaların çok sayıda olduğu ve hızla çoğalabildiği besin yüzeylerinde antimikrobiyal koruma sağlanabilmektedir (Mascheroni vd., 2010). Besinlerin propolis içeren kaplama-

lar ile kaplanması, sentetik ambalajlama, kontrollü ve modifiye atmosfer gibi daha maliyetli diğer yöntemlerin kullanımını azaltabilen bir alternatif olarak kabul edilebilmektedir (Passos vd., 2016).

Yapılan bir çalışmada, tavuk filetoları %1 ve %2 konsantrasyonunda PEE eklenmiş kitosan kaplama ile kaplandığında, depolama sırasında kalite korunumunun arttığı, PEE içeren kaplamaların 12 gün boyunca mezofilik, psikrotrofik, laktik asit üreten bakteriler, koliformlar ve *S. aureus*'un büyümesi üzerinde önemli bir azaltıcı etkiye sahip olduğu saptanmış, kaplama uygulanmayan filetoların raf ömrünün 3 gün, kitosan - propolis kaplamalı filetoların raf ömrünün ise 10 gün olduğu bildirilmiştir (Jonaidi Jafari vd., 2018). Başka bir çalışmada, chia müsilajı ve propolis ekstresi ile kaplanan levrek filetolarının 2°C'de depolanması ile kaplama uygulanmayan kontrol gruplarında 8 gün olan raf ömrünün 20 güne çıktığı, depolama sırasında toplam canlı ve psikrotrofik bakteri sayısının daha düşük olduğu saptanmıştır (Coban ve Coban, 2020). Alabalık filetolarının %2, %8 ve %16 propolis içeren jelatin filmle kaplandığı bir araştırmada 15 gün depolamanın sonunda toplam uçucu bazik nitrojen değerinin %16 propolis içeren kaplama ile kaplanan örneklerde en düşük düzeyde olduğu, propolis içeren filmlerin mikrobiyal büyümenin ve lipit oksidasyonunun önlenmesi açısından etkili olduğu rapor edilmiştir (Ucak vd., 2020). Polilaktik asit (PLA) film kaplamalarına propolis eklenmesinin sığır kıymalarının depolanması sırasında oluşan kimyasal ve mikrobiyal değişikliklere etkilerini inceleyen bir araştırmada, propolis eklenen filmlerle kaplanan örneklerin mezofilik ve psikrotrofik bakteri sayısı, uçucu bazik nitrojen ve peroksit değerlerinin daha düşük, raf ömrünün daha uzun olduğu tespit edilmiştir (Shavisi vd., 2017). Propolis içeren PLA kaplamaları ile yapılan başka bir çalışmada, sosis örnekleri %10, %20 ve %40 propolis içeren PLA kaplama ile kaplanmış, 4 gün soğuk depolamanın sonunda *S. aureus* ve *Pseudomonas aeruginosa* bakterilerinin propolis içermeyen kaplamalara kıyasla daha düşük olduğu gözlenmiştir (Safaei ve Azad, 2020).

Sebze ve meyvelerde PEE ile kombinasyon halinde biyopolimer kaplama uygulamaları, hasat sonrası mantarlara bağlı oluşan bozulmalara karşı koruyucu olabilmektedir (Ali vd., 2015). Papaya meyvesinin kitosan kaplama ile kaplandığı bir araştırmada propolis içeren (%1 kitosan ve %5 PEE) ve içermeyen (%1 kitosan) örnekler 25°C'de depolanmış, PEE içeren kaplamaların 9 günlük depolamanın sonunda *C. gloeosporioides* mantarına karşı daha yüksek fungisidal aktivite gösterdiği ve meyvenin fizikokimyasal özelliklerinin korunduğu saptanmıştır (Barrera vd., 2015). Üzümlerin %1.5 PEE eklenmiş hidroksipropil metil selüloz (HPMC) kaplama ile kaplanması 2°C'de 22 gün depolama sonunda PEE içermeyen HPMC kaplamaya kıyasla mezofilik aerobik bakteri, maya ve küf sayılarını daha yüksek oranda düşürmüştür (Pastor vd., 2011).

Propolisin Besinlerin Duyusal Özelliklerine Etkisi

Propolisin besinlerde koruyucu olarak kullanılabilmesi için besinlerin duyusal özellikleri üzerindeki etkileri de göz önünde bulundurulmalıdır. Propolis karakteristik bir tat ve kokuya sahip olması nedeniyle besinlere eklenirken besinin kendine has yapı, tat ve kokusunu etkilemeyecek veya duyusal kalitesini düşürmeyecek konsantrasyonda, uygun yöntem ile kullanılmalıdır (Osés vd., 2016). Propolisin kaplama ve daldırma uygulamalarında kullanımının besinlerin duyusal özelliklerini etkilemediği, besinlerin içine eklendiği uygulamalarda ise duyusal özellikler üzerindeki etkinin daha yüksek olduğu bilinmektedir. Yapılan çalışmalarda propolisin balık, sosis, kümes hayvanları, elma suyu, süt ve bal gibi çeşitli besinlere düşük konsantrasyonlarda (Yaklaşık %0.5) eklendiğinde duyusal olarak kabul edilebilir özellikte olduğu görülmüştür (Pobiega vd., 2019).

Propolisin besin içerisine eklendiği çalışmalarda duyusal kalite üzerine etkisi, besinin türüne ve ekstrenin konsantrasyonuna bağlı olarak değişebilmektedir. Propolis eklenen bal ile yapılan bir çalışmada bal örneklerine %0.1, %0.3 ve %0.5 konsantrasyonlarında propolis eklendiğinde %0.5 propolis içeren bal örneklerinin, koku ve tat açısından duyusal olarak kabul edilebilir olmadığı görülmüştür (Osés vd., 2016). Balın propolis ile zenginleştirilmesinin kalite parametrelerine etkisini inceleyen başka bir araştırmada, örneklere farklı konsantrasyonlarda propolis eklendiğinde fenolik içerik ve antioksidan kapasitenin eklenen konsantrasyonla artış gösterdiği, fakat renk, yapı, koku ve tat açısından duyusal kalitenin düştüğü saptanmıştır (Habryka vd., 2020). Bir çalışmada, hamburgerlere 0.3 g/kg propolis ekstresi eklendiğinde duyusal kalite yönünden etin rengi, görünümü ve dokusu etkilenmezken, etin kokusu ve tadının kabul edilebilirliği düşmüştür (dos Reis vd., 2017). Başka bir çalışmada ise, kıyılmış sazan balığına yüksek konsantrasyonlarda (%3, %5 ve %7) PEE ve PSE eklendiğinde renk, koku, doku ve genel kabul edilebilirlik açısından artış olduğu bildirilmiştir (Payandan vd., 2017). Koruyucu olarak potasyum sorbat ve propolis ekstresi (%0.05) içeren yoğurt örnekleri duyusal özellikleri yönünden incelendiğinde, propolis ekstresi içeren yoğurtların doku, tat, koku, kıvam ve aroma özelliklerinin potasyum sorbat içeren yoğurtlar ile benzer olduğu tespit edilmiştir (Santos vd., 2019).

Tavuk göğüs etlerinin propolis içeren (%0, %0.5 ve %1) kitosan kaplama ile kaplanarak 16 gün depolandığı bir araştırmada, başlangıçta tüm grupların duyusal kalite özelliklerinin benzer olduğu, depolama süresinin sonunda ise propolis içeren kaplamaların kullanıldığı örneklerin duyusal kalitesinin

kontrol grubuna kıyasla daha yüksek olduğu ve bu durumun mikrobiyolojik bozulmanın daha az olmasından kaynaklandığı rapor edilmiştir (Mehdizadeh ve Langroodi, 2019). %1 ve %2 konsantrasyonlarında PEE içeren PLA ile kaplanmış sığır eti kıymalarının duyusal özelliklerinin, 11 gün depolamanın sonunda propolis içermeyen örneklerle benzer olduğu görülmüştür (Shavisi vd., 2017).

Propolisin meyvelerin duyusal özelliklerine etkisi incelendiğinde papaya meyvesi %2.5 ve %5 konsantrasyonlarında, muz %2.5 konsantrasyonunda (Passos vd., 2016), armut ve elma 10 mg/mL oranında (Bakeer vd., 2016) PEE içeren kaplama ile kaplandığında meyvelerin duyusal özelliklerinin kabul edilebilir düzeyde olduğu görülmüştür.

Propolisin Besinlerde Kullanımının Güvenliği

Propolis, genel olarak toksik olmayan ve güvenli bir madde olarak kabul edilmektedir. Bugüne dek propolis kullanımında görülen olası yan etkiler duyarlılık/hassasiyet veya alerji olarak bildirilmiştir. Bununla birlikte, genel olarak propolisin nadiren oral yol ile alerjiye neden olduğu, lokal propolis uygulamasına bağlı alerjik reaksiyonların daha sık görüldüğü rapor edilmiştir (Jacob vd., 2008). Propolis alerjisi görülme sıklığının, arıcılık mesleği yapan kişilerde bal toplama ve kovan temizliği sırasında gerçekleşen temasa bağlı olarak %0.76 - 4.3 oranında olduğu rapor edilmiş, propolisin içeriğindeki 3-metil-2-butenil kafeik asit, benzil kafeik asit, fenetil kafeik asit ve geranil kafeik asit gibi kafeik asit esterlerinin propolise karşı duyarlılığın gelişmesinden sorumlu olabileceği bildirilmiştir (Basista-Soltys ve Filipek, 2013).

Sonuç

Propolis, medikal, farmasötik ve kozmetik ürünlerde geniş kullanım alanına sahip doğal bir maddedir. Propolis, antibakteriyel, antifungal ve antioksidan özelliklere sahip doğal bir koruyucu olarak etki göstermesinin yanında, besinlerin fiziksel ve kimyasal özelliklerinde meydana gelebilecek olumsuz değişiklikleri önleyebilmekte veya geciktirebilmektedir. Propolis içeriğindeki biyoaktif bileşenler ile besinlerin raf ömrünün uzatılması ve kalitesinin artırılması açısından önemli bir potansiyele sahiptir. Bugüne kadar propolisin besinlerde kullanımı ile ilgili çok sayıda araştırma yapılmış olmasına karşın, karakteristik tat ve kokusunun, besinin duyusal özellikleri üzerinde baskın bir etki yaratabilmesi ve değişken kimyasal bileşimi, besin endüstrisinde kullanılması önünde engel oluşturabilmektedir. Bu nedenle propolisin besinlerde doğal bir koruyucu olarak kullanılabilmesi amacıyla propolis ekstrelerinin hazırlanması, besinler için uygun konsantrasyonun ve uygulama yönteminin seçilmesi ve eklendiği besinin duyusal özelliklerinin geliştirilmesi ile ilgili daha fazla çalışmaya ihtiyaç duyulmaktadır.

Etik Standart ile Uyumluluk

Çıkar çatışması: Yazarlar bu yazı için gerçek, potansiyel veya algılanan çıkar çatışması olmadığını beyan etmişlerdir.

Etik izin: Araştırma niteliği bakımından etik izne tabii değildir.

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Kaynaklar

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Fermente süt kreması ve özellikleri

Tülay ÖZCAN, Miray ÖZCAN

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Bursa Uludağ Üniversitesi, Ziraat Fakültesi, Gıda Mühendisliği Bölümü, Bursa, Türkiye

ORCID IDs of the authors:
T.Ö. 0000-0002-0223-3807
M.Ö. 0000-0001-9811-6404

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Correspondence: Tülay ÖZCAN
E-mail: tulayozcan@uludag.edu.tr

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ÖZ

Süt yağı, süt ve süt ürünlerinde lezzet, aroma, tekstür özellikleri ve kalitenin oluşmasında önemli rol oynamakta olup, süt yağı globül zarı içerisinde kapsüllenmiş olacak şekilde bulunmaktadır. Süt yağı, trigliseritler, fosfolipitler, serbest steroller, β-karoten (provitamin A), yağda eriyen vitaminler (A, D, E, K), sfingomyelinler ve yağ asitlerini içermektedir. Süt yağında bulunan spesifik kısa zincirli ve orta zincirli yağ asitleri besin değerinin yanı sıra, kas, kalp, karaciğer, böbrek, kan trom-bositleri ve sinir sistemi için enerji kaynağı olarak sağlık için önemli bir değer taşımaktadır. Ayrıca bu yağ asitleri obezite riski de oluşturmamakla birlikte ülseratif kolit, kanser, ateroskleroz ve hi-pertansiyonu önlemekte, anti-inflamatuar ve anti-bakteriyel etkileri ile de doğal bağışıklığı artır-maktadır. Yüksek yağ içeriğine sahip olan fermente krema, besin içeriği ve mutfak kültüründe kullanımı ile birçok ülkede her geçen gün daha popüler hale gelmektedir. Fermente edilmiş kre-maların sınıflandırılması, yağ içerikleri, üretim şekli ve kullanılan starter kültürler ülkelere göre değişiklik göstermektedir. Bu çalışmada dünyada ve Türkiye'de üretilen fermente kremaların sı-nıflandırılması, üretim aşamaları, duyusal ve tekstürel özelliklerini etkileyen parametreler incelen-miştir.

Anahtar Kelimeler: Süt yağı, Fermente krema, Probiyotik

ABSTRACT

Fermented milk cream and its properties

Milk fat has an important role in the formation of flavour, aroma, texture properties and quality in milk and dairy products, and milk fat is encapsulated in the globule membrane. Milk fat contains triglycerides, phospholipids, free sterols, β-carotene (provitamin A), fat-soluble vitamins (A, D, E, K), sphingomyelins and fatty acids. In addition to its nutritional value, specific short-chain and medium-chain fatty acids found in milk fat are important for health as an energy source for muscle, heart, liver, kidney, blood platelets and nervous system. In addition, these fatty acids do not pose a risk of obesity; they also prevent ulcerative colitis, cancer, atherosclerosis and hypertension, and increase natural immunity with their anti-inflammatory and anti-bacterial effects. Fermented cream, which has a high fat content, is becoming more and more popular in many countries with its nutritional value and its use for many purposes in culinary culture. The classification of fermented creams, fat content, production method and used starter cultures vary by country. In this study, fermented cream produced in Turkey and in the world classification, production stages, the parameters affecting the sensory and textural properties was investigated.

Keywords: Milk fat, Fermented cream, Probiotics

Giriş

Beslenme ve sağlık üzerindeki etkileri ile önemli bir tüketici talebine sahip olan fermente süt ürünleri son yıllarda giderek artan bir pazar eğilimi göstermektedir. Özellikle fonksiyonel hale getirilmiş süt ürünleri bağırsaktaki bakteriyel mikrobiyota üzerindeki etkileri ile sağlıklı bir metabolizmaya katkıda bulunmakta ve kaliteli yaşam beklentisini artırmaktadır (Bourrie ve ark., 2016; Chen ve ark., 2019). Fermente gıdalar genel olarak "kontrollü mikrobiyel gelişme ve gıda bileşenlerinin enzimatik dönüşümü yoluyla üretilen yiyecekler veya içecekler" olarak tanımlanmaktadır. Yüzyıllardır gıda muhafaza yöntemi olarak kullanılan fermantasyon sonucunda üretilen süt ürünleri ise, insanlar tarafından tüketilen ilk "işlenmiş" gıda ürünleri arasında yer almaktadır (Savaiano ve Hutkins, 2020). Günümüzde Türk Gıda Kodeksi Fermente Süt Ürünleri Tebliği'ne göre fermente süt ürünü "sütün uygun mikroorganizmalar tarafından fermantasyonu ile pH değerinin koagülasyona yol açacak veya açmayacak şekilde düşürülmesi sonucu oluşan ve içermesi gereken mikroorganizmaları yeterli sayıda, canlı ve aktif olarak bulunduran süt ürünü" şeklinde tanımlanmaktadır (Anonim, 2009).

Fermente bir süt ürünü matriksinde laktik asit bakterilerine ek olarak, fermantasyon sırasında bakteriler tarafından oluşturulan ve beslenme açısından yüksek değere sahip biyoaktif bileşikler ve metabolitler de bulunmaktadır (Garcia-Burgos ve ark., 2020). Fonksiyonel süt ürünlerinin formülasyonlarında ise ayrıca, probiyotik mikroorganizmalar, prebiyotik lifler, fitosteroller, konjuge linoleik asit (KLA), omega-3 ve omega-6 yağ asitleri, mineraller ve biyoaktif peptitler de ilave bileşenler olarak yer almaktadır (Ortiz ve ark., 2017; Rad ve ark., 2020).

Fonksiyonel süt ürünleri gastrointestinal sağlığın korunması, hipertansiyonun kontrolü, kolesterolün düşürülmesi, birçok kanser türünün (özellikle kolorektal, mesane ve meme kanseri) ve alerjik reaksiyonların önlenmesi, kemik sağlığının gelişimi ve bağışıklık sistemi yanıtının güçlendirilmesi gibi sağlık sorunlarının çözümlenmesinde ayrı bir öneme sahip bulunmaktadır (Lampe, 2011; Panesar, 2011; Vaughn ve Sivamani, 2015; Ortiz ve ark., 2017).

Süt doğal içeriği ile fonksiyonel değere sahip bir üründür. Sütte bulunan ana bileşenler su, laktoz, yağ, protein, mineral ve vitaminlerdir. Sütün temel bileşenlerinden yağ içeriği, sütün kurumaddesi ve kıvamını da belirleyen bir faktördür. Süt yaklaşık %3.4 oranında süt yağı içermektedir. Süt yağı, süt ürünlerinin tat ve aroması ve ayrıca fiziksel, biyokimyasal ve tekstürel özellikleri ile besin değeri üzerinde rol oynayan bir bileşendir. Süt yağı, meme bezleri tarafından globüller şeklinde salgılanmaktadır. Süt yağı globülleri (MFG), süt yağı globül zarı/membranı (SYGM, esas olarak fosfolipitler ve proteinler) adı verilen 3 katmanlı bir zar yapısı ile kaplanmış lipit yapıdaki bir çekirdekten (esas olarak trigliseritler) oluşmaktadır. Büyükbaş hayvanlarının sütlerindeki yağ globüllerinin çapı 0.1-15 µm arasında değişmektedir (Lopez ve Menard, 2011; Mesilati-Stahy ve ark., 2011).

Beslenme fizyolojisi açısından iyi bir enerji kaynağı olması ile birlikte süt yağı, kısa ve orta zincirli yağ asitleri, linoleik ve araşidonik asit gibi esansiyel doymamış yağ asitleri, yağda çözünen A, D, E, K vitaminleri ve özellikle konjuge linoleik asidi (KLA) bileşiminde bulundurması ile büyük öneme sahiptir (Ebringer ve ark., 2008; Tanuja ve Purohit, 2008; Ramel ve Marangoni, 2019). Konjuge linoleik asit (KLA), süt yağında düşük oranda bulunmasına rağmen, süt beslenmede en önemli KLA kaynaklarından birisi olarak yer almaktadır. Süt ve süt ürünlerindeki KLA içeriği, ineklerin beslenmesine bağlı olarak büyük ölçüde farklılık göstermekte ve süt lipitlerinde oranı %0.1-2 arasında değişmektedir (Khanal ve Olson, 2004). Anti-kanserojen bir bileşen olan KLA, ateroskleroz oluşumunu ve adipoz dokunun gelişimini önlemekte, enflamatuar etki ile birlikte aynı zamanda bağışıklığı da düzenlemektedir (Krichevsky, 2004; Kim ve ark., 2016).

Süt yağı, biyoaktif özelliklere sahip pek çok bileşeni içermektedir. Süt yağı globülünün yapısında omega-3 ve omega-6 yağ asitleri ile toplam süt lipitlerinin %98'ini temsil eden triaçilgliseroller bulunmaktadır. Ayrıca yağda çözünen bileşenler (örneğin karotenoidler, vitaminler) ve ayrıca zarda yer alan biyoaktif bileşenler (örneğin fosfolipitler, sfingolipitler, kolesterol, SYGM proteinleri) de bulunmaktadır (Ozcan ve Demiray-Teymuroglu, 2020).

Süt yağında bulunan sfingolipitler ve aktif metabolitleri antimikrobiyel etki göstermektedir (Kurdal ve ark., 2019**;** Ozcan ve Demiray-Teymuroglu, 2020). Süt yağında bulunan sfingolipitler antikarsinojenik etkilere sahiptirler ve krema/tereyağı gibi yüksek yağlı süt ürünleri de bu biyoterapötik lipit bileşenlerinin çoğunu içermektedir (Ribar ve ark., 2007). Ayrıca yapılan çalışmalarda, ekşi krema gibi yağ oranı yüksek süt ürünlerinin tüketiminin kolorektal kanser riskini azaltabileceği de belirtilmiştir (Larsson ve ark., 2005).

Süt yağı, ilave edildiği gıdaların teknolojik özelliklerini önemli ölçüde etkilemektedir. Süt yağı, krema ve tereyağı gibi yağ açısından zengin ürünlerin reolojik özellikleri üzerinde belirleyici özellik taşımaktadır. Süt yağı; su içinde yağ emülsiyonu olarak O/W (kremada, yoğurt ve peynir) ya da yağ içinde su emülsiyonu W/O (tereyağında olduğu gibi) şeklinde süt ürünlerinde ürün matriksinde dağılmaktadır (Lopez ve ark., 2006).

Besin değerini ve duyusal özellikleri geliştirmenin yanı sıra tüketici tercihleri için önemli olan yapısal özelliklerin oluşturulmasında da süt yağının kristal yapısı, fiziksel özelliği ve kaynağı oldukça önemli olmaktadır. Ayrıca sütteki yağ globülleri (MFG'ler), sütün viskozitesi ve emülsiyon stabilitesi, sütün krema oluşturma kapasitesi, yoğurt, peynir ve tereyağının mikroyapı, reolojik, kimyasal ve duyusal özelliklerini etkilemektedir (Huppertz ve Kelly, 2006; Rybak, 2016; Ceylan ve Ozcan, 2020).

Süt homojenize edilmeden önce yüzeyde toplanan yüksek yağ içeriğine sahip süt ürününe krema denilmektedir. Krema, yağsız sütte süt yağ globüllerinin konsantre bir emülsiyonudur ve sütten spesifik bir proses olarak merkezkaç kuvvetinin etkisi ile ayrılmaktadır. Farklı krema türleri öncelikle yağ içeriklerine (g/100 g) göre çift krema (Double Cream) (%45-50), krema veya tam krema (Cream or Full Cream) (%30-40), tek veya yarım krema (Single or Half Cream) (%15-25), kahve kreması (Coffee Cream) (%15-18) ve light kahve kreması (Light Coffee Cream) (<%10) olarak sınıflandırılmaktadır (Deosarkar ve ark., 2016).

Birleşmiş Milletler Gıda ve Tarım Örgütü'nün (FAO) standartlarına göre ise krema, yağ içeriğine göre aşağıdaki şekilde sınıflandırılmaktadır:

a) Krema (Cream): %18-26 süt yağı
b) Light krema veya kahve kreması (Light Cream or Coffee Cream): >% 10 süt yağı
c) Krem şanti (Whipping Cream): >% 28 süt yağı
d) Yoğun krema (Heavy Cream): >%35 süt yağı
e) Çift krema (Double Cream): >%45 süt yağı

Türk Gıda Kodeksi Krema ve Kaymak Tebliği'nin tanımına göre krema; "sütten fiziksel seperasyon işlemi ile elde edilen süt yağının, yağsız süt içerisindeki yağca zengin emülsiyonudur" şeklinde tanımlanmaktadır (Anonim, 2003). Bu tebliğe göre kremalar içerdikleri süt yağı oranlarına göre;

- Ağırlıkça en az %10 süt yağı içeren krema "az yağlı krema",
- Ağırlıkça en az %18 süt yağı içeren krema "krema",
- Ağırlıkça en az %45 süt yağı içeren krema "tam yağlı krema" adı altında piyasaya sunulur, şeklinde belirtilmektedir.

Çeşitli süt kreması türleri için yağ oranına göre standartlar, ülkelere göre farklılık göstermekte ve kremaları tanımlamak için farklı isimler kullanılmaktadır. Bu nedenle, tek tip bir uluslararası tanım veya kabul edilmiş bir sınıflandırma bulunmamaktadır. Krema ürünleri ayrıca işleme şekillerine göre de; pastörize krema, ultra yüksek sıcaklıkta (UHT) işlenmiş krema, dondurulmuş krema, kurutulmuş krema, kültürlü veya ekşi krema şeklinde de sınıflandırılmaktadır (Özcan ve ark., 2009; Deosarkar ve ark., 2016).

Fermente Krema Üretim Teknolojisi

Birçok ülkede tüketilen ve ekşi krema olarak da bilinen fermente krema, taze kremanın laktik asit bakterileri ile fermente edilmesiyle üretilen, çeşitli kullanım alanları bulunan, besin değeri yüksek ve ayrıca insan sağlığına olumlu etkileri bulunan bir süt ürünüdür. Fermente krema Kuzey Amerika, Meksika, Kuzey ve Doğu Avrupa'da yaygın olarak değerlendirilmektedir (Angelline ve ark., 2018).

Fermente krema, kremalı salata soslarının üretiminde kullanılmasının yanı sıra fırında pişirilen kek, pasta, kurabiye, çörek gibi ürünlerin üretiminde hazırlanan karışımların içinde de yer almakta ve ayrıca bir tatlı olarak meyvelerle birlikte tüketilebilmektedir. Patates cipsi veya krakerin yanında tüketilen bazı sosların hazırlanmasında da fermente krema tercih edilmektedir (Manav ve Yetişmeyen, 2011; Kim ve ark., 2020).

Ekşi krema birçok tüketici tarafından kahvaltılık gıda ürünü olarak tüketilmektedir. Yağ oranı düşürülmüş ekşi kremaya artan talep, sağlık bilincine sahip tüketiciler arasında büyük popülerlik kazanmış, ayrıca peynir, yoğurt ve diğer ürünler için ikame olarak tüketimi de yaygınlaşmıştır. Tüketicilerin bireysel taleplerini karşılamak için çeşitli formülasyonlarda ekşi krema üretilmektedir. Küresel ekşi krema pazarı 2017'de 1.6 milyar ABD doları olarak değerlendirilmiştir. Avrupa 2017'de yaklaşık 304 milyon kg ekşi krema tüketmiş ve en büyük pazar payına Almanya sahip olmuştur. Dünyada, ekşi krema tüketiminde önde gelen ülkeler ABD, Almanya, Polonya, Fransa ve İngiltere olup, bunu Doğu ve Orta Avrupa ülkeleri takip etmektedir. Kuzey Amerika'da ise bu ürünlere talebin arması nedeniyle daha hızlı büyümenin olması beklenmektedir (Şekil 1)(Anonim, 2021a).

Türkiye'de krema genellikle çeşitli tatlıların yapımında kullanılmaktadır. Ancak son zamanlarda sıcak yemekler için kullanılan kremaların da raflarda yer aldığı görülmektedir. TÜİK 2021 yılı Süt ve Süt Ürünleri Üretim Raporu'na göre Türkiye'de Ocak ayında 2800 ton krema üretimi yapılmıştır (Anonim, 2021b). Türkiye'de süt ve krema (ağırlığına göre, yağ içeriği ≤%1 olan, konsantre edilmemiş, şeker veya tatlandırıcı bir madde ilave edilmemiş, net içeriği ≤2 litre olan hazır paketlerde) ürünü üreten işletmelerin sayısı 73 olarak belirtilmiştir (Anonim, 2021c). Türkiye'de ilk fermente krema 2016'da tüketicilere sunulmuştur ve Türkiye'de fermente krema üretimi yapan sadece bir işletme bulunmaktadır.

Olgunlaştırılmış/kültür ilave edilmiş/fermente edilmiş/ekşi (tilmiş) krema; standardize hale getirilmiş, homojenizasyon işlemi uygulanmış ve ısıl işlem görmüş tatlı kremanın laktik

asit bakterilerinin ilavesi ile fermantasyonu sonucunda üretilmektedir. Kremada ayrıca sitrik asit gibi gıda sınıfı asitleştirici ve asitlik düzenleyiciler de kullanılmaktadır (Tamime, 2009).

ABD Gıda ve İlaç Dairesi ve ABD Tarım Bakanlığı tarafından belirtilen tanımı ile fermente krema, pastörize kremanın laktik asit oluşturan bakteriler tarafından fermente edilmesi sonucu üretilen, en az %18 süt yağı içeren ve laktik asit cinsinden titre edilebilir asitliği %0.5'ten az olmayan süt ürünü olarak bildirilmiştir (Anonim, 2000; Anonim, 2020). Türk Gıda Kodeksi Krema ve Kaymak Tebliği'nde ise fermente krema; krema, rekonstitüe krema ve/veya re-kombine kremanın uygun mikroorganizmalarla fermantasyonu sonucu pH değeri düşürülmüş, koagüle olan veya olmayan krema olarak tanımlanmıştır. Ayrıca fermente ve ekşitilmiş kremaların titrasyon asitliğinin; laktik asit cinsinden %0.225'ten az ve %0.67'den fazla olamayacağı bildirilmiştir (Anonim, 2003). Farklı yağ oranlarına göre sınıflandırılan ekşi kremaların bileşimi Tablo 1'de belirtilmiştir.

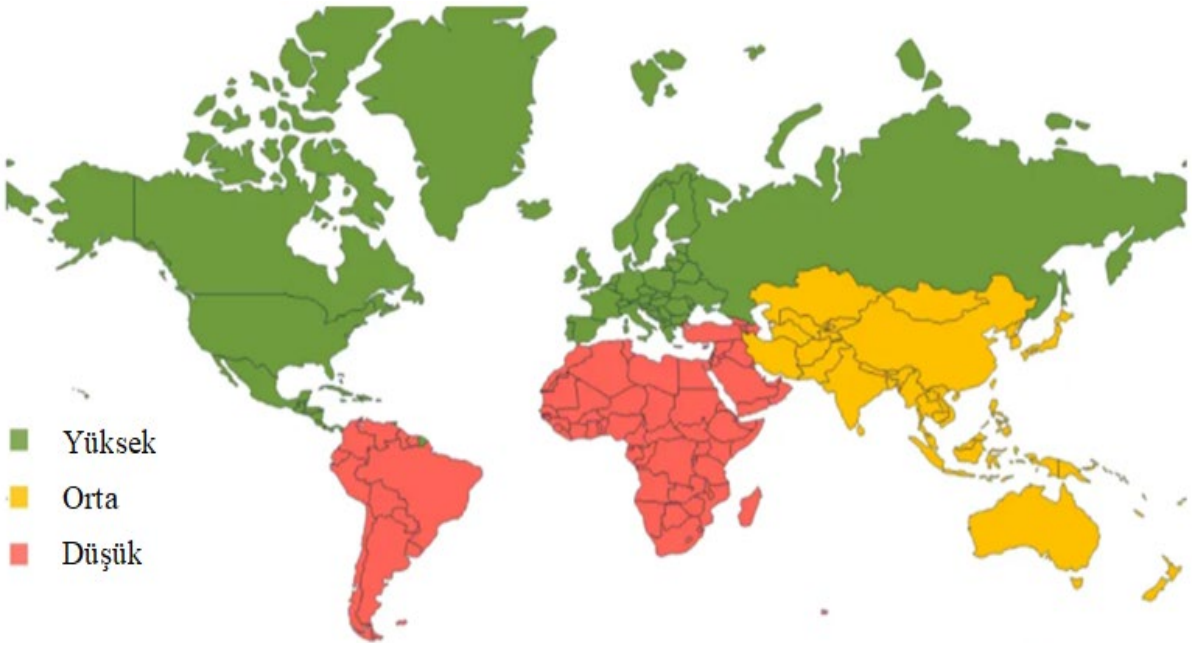


Figure 1. Fermented/ Sour cream market, market size by region (Anonim, 2019).

Tablo 1. Ekşi kremanın bileşimi (Anonim, 2011)

Table 1. Composition of sour cream (Anonim, 2011)

100 g'ye göre	Tam yağlı	Az yağlı	Yağsız
Yağ	20.10 g	10.60 g	0.00 g
Protein	3.10 g	3.50 g	3.10 g
Karbonhidrat	4.30 g	7.10 g	15.60 g
Şeker	0.16 g	0.22 g	0.39 g
Kalsiyum	116 mg	141 mg	125 mg

Fermente krema yüksek oranda kalsiyum içermektedir. Bir öğünde yer alan fermente krema, günlük önerilen kalsiyum ihtiyacının %13'ünü sağlamaktadır. Kemik sağlığına faydalarının yanı sıra, kremadaki kalsiyum sinir, kas ve kalp fonksiyonları için de hayati önem taşımaktadır. Bir öğünde yer alan fermente krema ayrıca, B_2 vitamini olarak da bilinen günlük önerilen riboflavin alımının %12'sini, günlük gereken fosforun %13'ünü karşılamaktadır (Katke ve ark., 2019). Ayrıca yapılan çalışmalarda, ekşi/fermente krema gibi yağ oranı yüksek süt ürünlerinin tüketiminin sfingolipitler ve fosfolipit içeriğinden dolayı kolon kanserine ek olarak, özellikle insan yumurtalık kanseri hücre hatlarına karşı anti-proliferatif aktivite gösterdiği saptanmıştır (Larsson ve ark., 2006; Castro-Gómez ve ark. 2016).

Fermente ya da ekşi krema, çok sayıda ülkede uzun yıllardır kullanılan viskoz formda bir üründür. Kuzey Avrupa'da geleneksel bir ürün olarak nitelendirilen fermente krema, "gräddfil" (İsveç), "crème fraîche" (Fransa) ve "kermapiimä" (Finlandiya) gibi isimlerle adlandırılmaktadır. Fermente krema için yasal gereklilikler ise ülkelere göre değişiklik göstermektedir. Fermente krema kıvamlı, yüksek asitli (%0.6 laktik asit), sade bir aroma ve pürüzsüz bir tekstüre sahip bulunmaktadır. Bu krema çeşidi, 40°C'nin altındaki saklama sıcaklıklarında newtonian olmayan bir davranış göstermektedir. Fermente krema beyazdan sarımsıya, hafif kremsi, homojen ve parlak bir görünüme sahip olmalıdır. Hafif asidik, peynirimsi/tereyağımsı bir aromaya, ferahlatıcı, ekşi ve lezzet bileşenlerince yeterli tada sahip olan fermente bir kremada serum ayrılması gözlenmemelidir (Scott ve ark., 2003; Meunier-Goddik, 2012; Deosarkar ve ark., 2016). Fermente kremalarda baskın olan organik asit laktik asittir, ardından asetik ve sitrik asitler de bulunmaktadır. Fermente kremalardaki yüksek aromalı uçucu bileşikler ise 2,3-butanedion, asetik asit, butirik asit, oktanal, 2-metil3-furantiyol, 1-okten-3-on ve asetaldehit olarak belirtilmiştir (Shepard ve ark., 2013).

Tüketicilerin özellikle yağ içeriği azaltılmış gıdalara yönelmesi son yıllarda düşük yağlı fermente kremaya olan talebi ve bu ürünün marketlerdeki payını da gün geçtikçe arttırmaktadır. Bununla birlikte ekşi krema, maya ve küf gelişimi nedeniyle sınırlı bir raf ömrüne sahiptir (Anonim, 2011). Fermente kremalardaki farklı yağ oranları kremanın toplam küfmaya sayısı ve toplam bakteri sayısı ile birlikte kuru maddesi, sertliği, diasetil içeriği ve titrasyon asitliği gibi fizikokimyasal özellikleri üzerinde de etkili olmaktadır (Özdemir, 2002). Fermente kremada hissedilen margarinimsi-yağlı tat, asetik tat/ekşi tat, diasetil aroması, asetaldehit aroması, ekşi koku/aroma, peynir aroması ve acı tat ekşi kremanın saklama süresiyle ve kullanılan starter kültür ile bağlantılı olarak ortaya çıkabilmektedir (Folkenberg ve Skriver, 2001).

Fermente kremanın tekstürel özellikleri ve tadı, çiğ sütün bileşimi, özellikle de kremanın olgunlaşması ve depolanması sırasında meydana gelen mikrobiyolojik ve biyokimyasal tepkimeler, yağ ve starter kültürlerin oranı gibi faktörlerden etkilenmektedir (Danylenko ve ark., 2020) .

Kremanın fizikokimyasal özellikleri, lipit globüllerinin ve süt lipit globül membranının yapısı, lipid globüllerinin konsantrasyonu, kremadaki yağsız kuru madde bileşenlerinin çeşidi ve konsantrasyonu (örn. proteinler, tuzlar ve eklenen emülgatör ve stabilizatörler), kremanın sıcaklığı ve globüllerin parçalanmasına veya aglomerasyonuna (kümeleşmesine) neden olan kremanın fiziksel olarak işlenme teknikleri (örneğin, pompalama, havalandırma, olgunlaştırma, kristalizasyon ve yayıklama) gibi çeşitli faktörlerden etkilenmektedir (Deosarkar ve ark., 2016; Ceylan ve Ozcan, 2020).

Serum ayrılması, taneli kıvam, jöle benzeri yapı, çok ince veya çok kalın, çok kıvamlı ve topaklı veya homojen olmama gibi çeşitli kalite sorunları ekşi kremanın duyusal özelliklerini etkilemektedir. Bu kalite değişimleri; kremanın yağ içeriği, homojenizasyon ve ısıl işlem arasındaki sinerjik reaksiyonlar, kullanılan starter kültürün çeşidi, fermantasyon şartları ve süresi, fermantasyon sonrası kültür ilave edilmiş kremanın işleme koşulları, soğutma işlemi ve son olarak kültür ilave edilmiş kremanın depolanması ve dağıtılması gibi nedenlerden kaynaklanmaktadır (Narvhus ve ark., 2019).

Ekşi kremada, tekstürü iyileştirmek ve ekşi kremanın peynir altı suyu sızması problemini engellemek için süt proteinleri ve süt kaynaklı olmayan stabilizatörlerin kullanılabileceği araştırmacılar tarafından belirtilmiştir (Hassan ve ark., 2017). Stabilizatörler ürünün viskozitesini arttırmaktadır. Ancak kıvam arttırıcıların ve stabilizatörlerin ürünün bileşimine katılması, geleneksel yapıda ve duyusal özelliklerde, özellikle de kremsi tat ve spesifik kokularda azaltmaya yol açmaktadır (Danlylenko ve ark., 2020). Kremada yaygın olarak kullanılan stabilizatörler, bitki polisakkaritleri grubunda karragenanlar, guar gamlar, modifiye nişasta ve selüloz türevleridir. Polisakkaritler, su moleküllerine bağlanmanın yanı sıra süt proteinleri ile de etkileşime girerek suyun hareketini sınırlayan ve viskoziteyi artıran bir ağ örgüsü oluşturmaktadır. Kullanılan stabilizatör çeşidi ve miktarı, yağ içeriğine, starter kültür çeşidine ve son üründe istenen duyusal özelliklere bağlı olarak büyük ölçüde değişmektedir (Meunier-Goddik, 2012). Ekşi kremada kullanılan stabilizatör karışımlarının türleri ve miktarları Tablo 2'de özetlenmiştir.

Tablo 2. Ekşi kremada kullanılan stabilizatörler (Meunier-Goddik, 2012)
Table 2. Stabilizers used in sour cream (Meunier-Goddik, 2012)

Ürün	Stabilizatör	Kullanım Limiti
Ekşi Krema	Modifiye gıda nişastası, peynir altı suyu, sodyum fosfat, guar gam, sodyum sitrat, kalsiyum sülfat, karregenan, keçiboynuzu gamı	%1.5-3.0
Hafif Ekşi Krema	Modifiye gıda nişastası, peynir altı suyu, sodyum fosfat, guar gam, sodyum sitrat, kalsiyum sülfat, karregenan, keçiboynuzu gamı	%1.75-3.5
Yağsız Ekşi Krema	Modifiye gıda nişastası, mikro kristalize selüloz, propilen glikol mono ester, akasya gamı, selüloz gamı	%3.5-6.5

Fermente krema üretimi için temel aşamalar, sütten taze kremanın ayrılması, istenen yağ içeriğini elde etmek için standardizasyon, ürün özelliklerini iyileştirmek için homojenizasyon, kremanın raf ömrünü uzatmak için ısıtma ve laktik asit bakterileri ile fermantasyon, soğutma ve depolama aşamalarıdır (Şekil 2).

Homojenizasyon

Homojenizasyonun temel işlevi, kremadaki yağ fazını stabilize etmek ve "kaymak" olarak bilinen yağ fraksiyonunun yüzeye çıkmasını engellemektir. Homojenizasyonun etkinliği, prosesin bir sonucu olarak yağ globüllerinin boyutunun küçültülmesi olarak tanımlanabilmektedir (Narvhus ve ark., 2019).

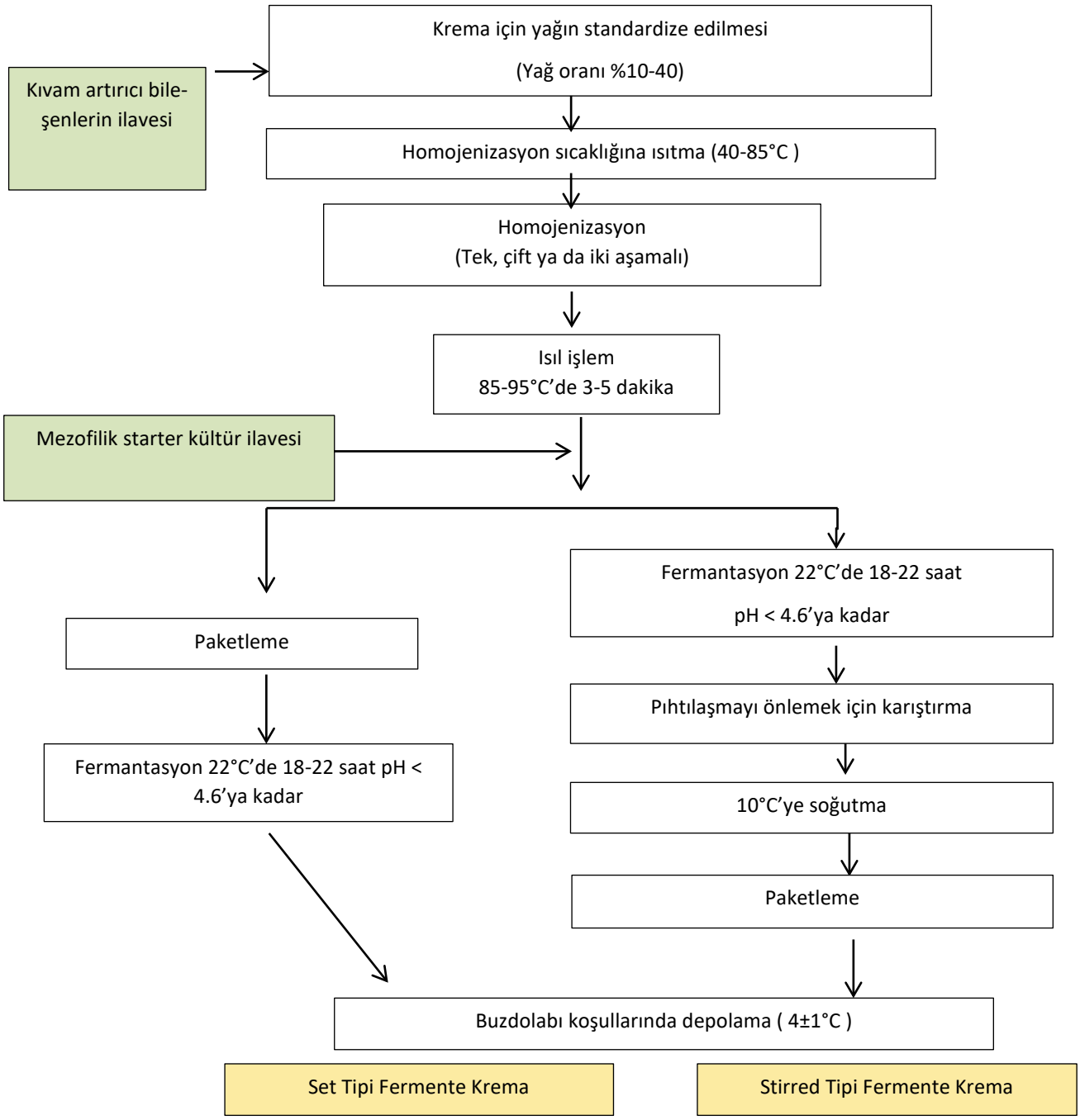
Fermente/kültürlü/ekşi krema üretimi için kremanın homojenize edilmesinin ana nedenlerinden bir diğeri, peynir altı suyu ayrılmadan ürünün uygun kıvam ve viskozitesini sağlamaktır (Aryana ve Olson, 2017).

Homojenizasyon yağ globüllerinin toplam yüzey alanında %5-10 oranında bir artışa yol açmaktadır. Homojenizasyonun etkinliği ve globüllerin boyutlarının küçültme derecesi homojenizasyon basıncına bağlı olarak ortaya çıkmaktadır. Homojenizasyon sırasında, küçük yağ globülleri, büyük globüllere göre parçalanmaya karşı daha dirençlidir. Bazı çok küçük yağ globülleri homojenizatörden geçebilmekte ve orijinal yağ globül membranı bozulmadan kalabilmektedir. Bozulmayan globüllerin boyutu, homojenizasyon basıncından etkilenmekte ve homojenizasyon basıncındaki bir artış, giderek daha küçük olan yağ globüllerinin bozulmasına yol açmaktadır (Michalski ve ark., 2002). Homojenizasyon uygulama parametrelerinin kremanın yağ içeriğine ve de ürünün istenen özelliklerine göre değiştirilmesi mümkün olabilmektedir.

Kremada Uygulanan Homojenizasyon Yöntemleri;

- Tekli/Tek Aşamalı (Single): Süt veya kremanın tek valfli bir homojenizatörden bir kez geçirilmesidir.
- Çiftli/İki Aşamalı (Double): Süt veya kremanın bir kez homojenizatörden geçirildikten sonra, ardından aynı veya ikinci bir homojenizatörde bir kez daha homojen hale getirilmesidir.
- İki Aşamalı (Two-Stage): Süt veya kremanın, aynı ekipman biriminde iki homojenizasyon valfli bir homojenizatörden geçirilmesi şeklinde uygulanmaktadır (Narvhus ve ark., 2019).

Araştırmalara göre, tekli homojenizasyon, yoğun bir kıvama sahip fermente krema üretimi için yeterli olmaktadır (Narvhus ve ark., 2019). Bununla birlikte, daha katı ve pürüzsüz fermente krema elde etmek için aynı basıncın iki kere kullanılmasıyla çift uygulama ile de homojenizasyon yapabilmektedir (Vasiljevicve ve Shah, 2008). Fermente krema ürünlerinde kullanılan kremanın homojenizasyon işlemi 40-85°C arasındaki sıcaklıklarda, 100-205 bar basınç arasında uygulanmaktadır. Homojenizasyon sıcaklığının 75°C'nin üzerine çıkarılması kremanın yağ fraksiyonunun viskozitesinde daha fazla azalmaya ve peynir altı suyu proteinlerinin denatürasyonuna neden olabilmektedir (Narvhus ve ark., 2019). Kremanın yağ içeriğine göre homojenizasyon basınçları, %10 yağlı krema için 150-200 bar, %18 yağlı krema için 120-170 bar ve %38 yağlı krema için 30-50 bar olarak belirtilmiştir. Homojenizasyon basıncında meydana gelen bir azalma ise daha büyük yağ globüllerinde daha küçük boyutta azalma ile sonuçlanmaktadır (Lyck ve ark., 2006).



Şekil 2. Kültür ilave edilmiş fermente krema için üretim akış şeması (Narvhus ve ark., 2019)

Figure 2. Process flow chart for cultured cream (Narvhus et al., 2019)

Homojenizasyon, genellikle homojenizatörden kaynaklanabilecek bakteriyel kontaminasyon riskini azaltmak için ısıl işlemden önce uygulanmakta, ancak krema ısıl işlemden sonra da aseptik homojenizatörlerde bakteri gelişiminin önlendiği bir sıcaklıkta aseptik olarak da homojenize edilebilmektedir (Lyck ve ark., 2006; Walstra ve ark., 2006; Narvhus ve ark., 2019).

Isıl İşlem

Kremaya enzimleri ve mikroorganizmaları inaktive etmek amacıyla ısıl işlem uygulanmakta ve böylece kremanın raf ömrü uzatılmaktadır. Bu uygulama ile krema tüketici için güvenilirliği yüksek bir ürün haline gelmektedir. Isıl işlem genellikle 85°C'de 30 dakika veya 90-95°C'de 3-5 dakika olarak uygulanmaktadır. İşlenmiş süt veya kremanın kısa bir sürede fermente edilmesi veya fermantasyona kadar 4°C'de tutulması mikrobiyel korumayı arttırmaktadır (Lyck ve ark., 2006; Walstra ve ark., 2006; Vasiljevicve ve Shah, 2008; Deosarkar ve ark., 2016; Narvhus ve ark., 2019).

Süt veya kremanın pıhtılaştığı pH, kısmen kullanılan ısıl işlemin şiddetine bağlı olmaktadır. Peynir altı suyu proteinlerinin denatürasyonuna neden olacak kadar yüksek olan ısıl işlem, ß-laktoglobulin ve κ-kazein interaksiyonu nedeni ile jelleşme pH'sını 5.0'dan 5.3'e yükseltebilmekte, bu da, kazein: peynir altı suyu proteini kümeleşmesini daha yüksek bir izoelektrik noktada gerçekleştirmektedir. Belirtilen nedenlerden, yüksek sıcaklıkta ısıl işlem görmüş sütlerde jelleşme süresi azalmaktadır (Lucey, 2004).

Fermantasyon

Krema ısıl işlemden sonra 20-24°C'lik (genellikle 22°C) inokülasyon sıcaklığına kadar soğutulmakta ve %1-2 oranındaki mezofilik laktik asit bakterilerinin ilavesi ile fermantasyon gerçekleştirilmektedir. Starter kültür ilavesinden sonra uygulanacak karıştırma işlemi kremanın yoğunluğu nedeni ile starterin iyi bir şekilde dağılması için homojen bir şekilde gerçekleştirilmelidir. Fermantasyon genellikle 14-24 saat sürmektedir. Kremanın istenilen asitliğine ulaşıldığında (~ pH 4.5 veya titre edilebilir asitlik yaklaşık %0.7-0.8), kremanın 4-5°C'ye hızla soğutulmasıyla fermantasyon sonlandırılmaktadır. İnkübasyon sonunda fermente krema 4 ±1°C sıcaklıkta depolanmaktadır (Smiddy ve ark., 2009; Meunier-Goddik, 2012; Shepard, 2012; Narvhus ve ark., 2019).

Starter kültür olarak tercih edilirken mikroorganizmaların; farklı üretim koşullarına uyum sağlama, fermantasyon sırasında hızlı asit üretimi, depolama ve dağıtım aşamalarında minimum asit üretimi, fermente süt ürününün raf ömrü boyunca canlılığını koruma ve karakteristik tat, aroma ve tekstür oluşturma özellikleri ile fermente krema üretiminde önem taşımaktadır. Genelde fermente krema üretiminde asit ve aroma oluşturma yeteneğindeki laktik asit bakterileri (LAB) kullanılmaktadır. Asit oluşturan LAB arasında *Lactococcus lactis* ssp. *lactis, Lactococcus lactis* ssp. *cremoris, Lactococcus lactis* ssp. *lactis* biovar. *diacetylactis* yer alırken, *Leuconostoc mesenteroides* ssp. *cremoris* ise fermente krema üretiminde yaygın olarak kullanılan aroma oluşturan bakterilerdir. Bu bakterilerin yanı sıra *Lactobacillus acidophilus, Lactobacillus rhamnosus, Bifidobacterium animalis* subsp. *lactis* gibi ve *Bifidobacterium bifidum* probiyotik bakterileri de kullanılmaktadır (Smiddy ve ark., 2009; Meunier-Goddik, 2012, Yilmaz-Ersan ve ark., 2016).

İnsan vücudundaki metabolik işlevleri veya sistemleri etkileyen, enerji ve besin maddesi içeriğinin ötesinde sağlık yararları sağlayan, fonksiyonel gıdalar pazarı giderek büyümektedir. Bu büyüme, teknolojik yenilikler, yeni ürünlerin geliştirilmesi ve yaşam kalitesini iyileştiren ürünlerle ilgilenen sağlık bilincine sahip tüketicilerin sayısının artmasıyla desteklenmektedir (Granato ve ark., 2010). Sağlığı ve yaşam kalitesini iyileştiren gıdalara olan ilginin artması, dünya çapında probiyotik bakterilere olan ilgiyi de artırmaktadır. Dünya Sağlık Örgütü, probiyotikleri "yeterli miktarlarda uygulandığında konağa sağlık yararı sağlayan canlı mikroorganizmalar" olarak tanımlamaktadır (Anonim, 2002). Probiyotik mikroorganizmaların insan sağlığına katkıda bulunduğu en önemli etkileri, laktoz intoleransı ve kabızlık semptomlarının hafifletilmesi, kan kolestrol seviyesinin düşürülmesi, çocuklarda alerjik reaksiyonların ortaya çıkışının geciktirtilmesi, farklı tip diyarelerin önlenmesi ve tedavisi, immün sistemin uyarılması, anti-tümör ve anti-kanserojen etkiler olarak sayılabilmektedir (Kerry ve ark., 2018)

Başarılı probiyotik ürünlerin geliştirilmesi, insan tüketimi için uygun probiyotik suşların seçimine, suşun üretim ve depolama boyunca canlılığının korunmasına ve tüketim anında terapötik bir etkinin sağlanmasına bağlı bulunmaktadır. Süt ürünlerinin, probiyotik fermantasyonu için uygun bir matriks olduğu kanıtlanmıştır. Süt ürünleri için probiyotik ürünlere olan talebin artması, fermente süt ürünlerinin biyoaktif bileşiklere sahip olması, laktoz intoleransının önlenmesi ve probiyotik bakterilerin sağlığı geliştirici etkilerinden kaynaklanmaktadır (Homayouni ve ark., 2012; Nahaisi ve ark., 2014; Kim ve ark., 2020).

Gelişmekte olan ülkelerde en çok görülen sağlık sorunlarının bağırsak sağlığı ile ilgili olduğu düşünüldüğünde, probiyotik ürünlerin geliştirilmesi metabolizma için ilave faydalar sağlamaktadır. Probiyotikler bağırsak sağlığını iyileştirme, bağışıklık sisteminin modülasyonu, anti-bakteriyel, anti-viral ve psikobiyotik koruyucu mekanizmaları ile yararlı etkiler oluşturmaktadır (Gill ve ark., 2000; Lim ve ark., 2018; Ozyurek ve Ozcan, 2020).

Probiyotik bakterilerin fermente kremada orta zincirli ve çoklu doymamış yağ asidi içeriğindeki artışa neden olduğu ve kremanın yağ asidi profilini değiştirdiği Yilmaz-Ersan (2013) tarafından belirtilmiştir. Yağ asidi içeriğinin kromatografik analizi, depolama sırasında *B. lactis* ile fermente edilen probiyotik kremada kontrol krema örneğine göre linoleik ve α-linolenik asit miktarının arttığını göstermiştir. Fermente kremada orta zincirli ve çoklu doymamış yağ asidi içeriğindeki artış probiyotik bakterilerin türü ile ilişkilendirilmiştir. En yüksek miktarda doymuş yağ asidi *L. acidophilus* ile fermente edilmiş kremada belirlenirken, en yüksek miktarlarda tekli doymamış ve çoklu doymamış yağ asitleri ise *B. lactis* ile fermente edilmiş kremada saptanmıştır.

Yine, Yilmaz-Ersan ve ark. (2016) *L. acidophilus, L. rhamnosus* ve *B. animalis* subsp. *lactis* bakterileri ile ürettikleri probiyotik kremalarda kremanın biyokimyasal özelliklerinin kullanılan kültürün çeşidinden etkilendiğini belirtmişlerdir. 22 günlük depolama süresince kremadaki probiyotik bakterilerin sayısı zamanla azalma gösterse de tüketim anında kremada bulunması gereken minimum probiyotik miktarından (6 log cfu g^{-1}) daha az olmadığı saptanmıştır.

Ekinci ve ark. (2008), *L. acidophilus*, *B. bifidum*, *S. thermophilus* ve *L. bulgaricus*, *P. thoenii (jensenii*) *P126*, *P. jensenii B1264* ve karışık bir kültürü (*L. acidophilus, B. bifidum, S. thermophilus* ve *L. bulgaricus* karışımı) %2 oranında kullanarak ürettikleri kremalarda en yüksek konjuge linoleik asit (KLA) içeriğini (0.73 mg KLA/g yağ) *B. bifidum* fermantasyonu ile üretilen kremalarda tespit etmişlerdir.

Mahmood ve Kzaae (2008), 1:1:1 oranında *L. acidophilus, B. bifidum* ve *S. thermophilus* starter kültürlerini kullanılarak ürettikleri probiyotik kremaların 14 günlük depolama sürecinde starter ilavesinden sonra mikrobiyolojik özelliklerinin geliştiğini ve probiyotik starter kullanılan kremalarda laktik asit bakterilerinin sayısının arttığını bildirmişlerdir. Asit oluşturan laktik asit bakterileri homofermentatif bir reaksiyon izleyerek laktozu L-laktat formuna dönüştürmektedir. Böylece sütte laktik asit oranı artmakta ve pH değeri azalmaktadır. Aroma oluşturan bakteriler ise heterofermentatiftir ve laktozu D-laktata dönüştürmenin yanı sıra etil alkol, asetik asit ve CO_2 üretmektedirler. Buna ilaveten sitratı da, fermente kremanın aroma maddelerinden biri olan diasetile dönüştürmektedirler. Diasetil dışında, laktik asit, asetik asit, bütanoik asit, karbonik asit de fermente kremanın sahip olduğu aromadan sorumlu olan diğer bileşenler arasında sayılabilmektedir (Hui ve ark., 2004).

Diasetil fermente kremaya tipik aromasını veren en önemli aroma bileşenidir. *Lactococcus lactis* ssp. *cremoris* (LC) ve *Lactococcus lactis* ssp. *lactis* biovar. *diacetylactis* (LD), diasetil üretmek için aerobik koşullar altında sitratı fermente edebilmektedir. *L. lactis* ssp. *cremoris* kremada daha fazla oranda diasetil oluşturmaktadır. Kremada, iyi bir tat ve aroma oluşumu için ise homofermentatif ve heterofermentatif türlerin metabolik aktivitelerinin birbirleriyle uyum içinde olması gerekmektedir (Hui, 2006, Kim ve ark., 2020).

Bazı *L. lactis* subsp. *cremoris* suşları ayrıca hücre dışı polisakkaritleri (EPS) salgılamaktadır. EPS, pürüzsüzlük, viskozitenin artması ve daha az serum ayrılması şeklinde etki göstermektedir. EPS oluşturan bir kültürün fermente kremanın reolojisi üzerindeki etkisi, ürettiği EPS'nin yapısına, üretilen miktarına, ve ayrıca fermantasyon ve jel oluşumunun mekanizmasına bağlı olarak üretim süresi ile bağlantılı olmaktadır (Duboc ve Mollet, 2001; Lucey, 2004; Narvhus ve ark., 2019). Jel oluşumu ve kremanın reolojik özelliklerinin üretilen EPS'nin miktarından daha çok yapısından etkilendiği belirtilmektedir. Viskozite, jel mukavemeti ve su tutma kapasitesi, yüksek molekül ağırlıklı, sert bir molekül ve az dallanma gösteren EPS oluşumu ile arttırılabilmektedir. Aksine, daha küçük, esnek ve dallanan bir moleküle sahip düşük moleküler ağırlıklı EPS oluşumu ise, belirtilen özellikler için daha düşük değerler vermektedir. Ayrıca, negatif yüklü bir EPS'nin jel oluşum sürecini değiştirdiği ve kazein jelinin esnekliğini arttırdığı belirtilmektedir (Gentès ve ark., 2011).

Salem ve ark. (2015) fermente kremanın kalitesini artırmak ve raf ömrünü uzatmak amacıyla ekşi kremaya 600, 800 ve 1000 ppm konsantrasyonlarda *Moringa oleifera* yaprak ekstresi (MOLE) veya *Moringa oleifera* yağı (MOO) ilave etmişler ve 4 hafta boyunca 5 ±1°C'de depolayarak kimyasal, mikrobiyolojik ve duyusal özelliklerini incelemişlerdir. MOLE seviyesi arttıkça asit içeriği artarken, MOO seviyesi arttıkça azalmıştır. Depolama süresince de kremada asitlik artmıştır. MOLE ve MOO ile zenginleştirilmiş ekşi kremada lipolitik ve proteolitik bakteri, maya ve küf tespit edilmemiştir. Bu fermente kremaların, depolama süresi boyunca kabul edilebilir tat, görünüş ve tekstüre sahip olduğu saptanmıştır.

Depolama

Fermente kremanın raf ömrü yaklaşık 25-45 gün olarak belirtilmiştir. Fermente kremada raf ömrünü belirleyen en önemli faktör kremanın kalitesidir. Krema mükemmel kalitede olmadıkça, fermente kremada hızla istenmeyen tatlar gelişmektedir. Krema kalitesini etkileyen diğer faktörler ise çiğ süt kalitesi ve süte uygulanan ön işlemlerdir (Meunier-Goddik, 2012).

Kremada asidik ve acı tat, fermente aromanın eksikliği, aşırı sıkı ve zayıf yapı gelişimi, serum ayrılması ve yağ sızması duyusal kusurlar olarak belirtilmiştir (Meunier-Goddik, 2012). Folkenberg ve Skriver (2001), depolama süresi boyunca fermente kremanın duyusal özelliklerinin değişimini

değerlendirmişler ve 28 günlük depolamada ekşi koku ve acı tadın oluştuğunu tespit etmişlerdir.

Fermente krema üretiminde, doğrudan asitlendirmede, bakteri fermantasyonu yerine laktik asit gibi organik asitlerle doğrudan asitleştirilerek krema üretilebilmektedir. Asitlendirme sırasındaki ürün sıcaklığı 20-25°C'dir. Daha yüksek sıcaklıklar tanecik ve parçalı bir yapının oluşma olasılığını artırmakta ve daha düşük sıcaklıklar ise jel oluşumu için gereken süreyi uzatmaktadır (Meunier-Goddik, 2012).

Fermente krema üretiminde ayrıca, glukono-δ-lakton (GDL) veya gıdalarda kullanılabilen diğer asitler de kullanılarak kimyasal olarak asitlik gelişimi sağlanabilmektedir. Doğrudan asitlendirme yönteminin, kültür işleme sorunlarını ortadan kaldırması, üretim verimliliği ve kalite kontrol kolaylığı gibi geleneksel kültür uygulamalarına göre avantajları bulunmaktadır. Kimyasal olarak asitliği arttırılmış ekşi kremalar, LAB ile fermente edilmiş kremalara benzer bir görünüme ve tekstüre sahip iken, kültür ilave edilmiş fermente kremalar asitleştirilmiş ekşi kremaya göre daha üstün bir aroma özelliğine sahip olmaktadır (Smiddy ve ark., 2009). Ayrıca laktik kültür ilaveli ekşi krema, asitleştirilmiş kremadan daha fazla organik asit içermekte, ancak biotin, niasin, pantotenik asit, B_6 veya B_{12} vitaminleri açısından ise önemli bir fark görülmemektedir (Kwan ve ark., 1982).

Sonuç

Gıda tedarik zincirinin en büyük ve önemli parçasını oluşturan süt ve süt ürünlerinin en önemli bileşenlerinden birisi süt yağıdır. Süt yağı, kendisine özgü lezzeti ile krema ve tereyağı gibi süt ürünlerinin ana maddesi olmakla beraber beslenme ve teknolojik anlamda da önemli bir bileşendir. Süt yağı, kısa ve orta zincirli yağ asitleri oranının mükemmel uyumu ile kolay sindirilebilir bir özellik ve biyoaktif içeriği ile de kronik hastalıklara karşı koruyucu özellik göstermektedir**.** Yüksek yağ içeriğine sahip süt ürünlerinden birisi de fermente ya da probiyotik kremalardır. Gastronomi alanında dünya çapındaki gelişmeler, son günlerde global anlamda çağımızı tehdit eden Covid-19 pandemisinden korunmak, bağışıklık sisteminin ve bağırsak mikrobiyotasının düzenlenmesi ile ilgili yeni sağlık yaklaşımlarının, fermente kremanın kullanımı ve ticari olarak üretilen krema çeşitliliğini arttırma konusunda bir eğilim göstereceği düşünülmektedir. Ancak günümüzde, ülkelere göre fermente kremaların üretim yöntemleri ve yağ içerikleri çeşitlilik gösterdiği için belli bir standarda göre sınıflandırma yapılamamakta ve yasal gereklilikler değişiklik göstermektedir. Bu anlamda fermente kremanın üretimi ile ilgili literatürdeki bilgiler ve yapılan çalışmalardaki teknolojik veriler yeterli bulunmamaktadır. Bundan dolayı yeni çalışmalar ile bilgilerdeki ve verilerdeki boşluklar giderilmelidir.

Etik Standart ile Uyumluluk

Çıkar çatışması: Yazarlar bu yazı için gerçek, potansiyel veya algılanan çıkar çatışması olmadığını beyan etmişlerdir.

Etik izin: Araştırma niteliği bakımından etik izne tabii değildir.

Finansal destek: -

Teşekkür: -

Açıklama: -

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The APA style calls for three kinds of information to be included in in-text citations. The **author's last name** and the work's **date of publication** must always appear, and these items must match exactly the corresponding entry in the references list. The third kind of information, the page number, appears only in a citation to a direct quotation.

....(Crockatt, 1995).

Direct quote from the text

"The potentially contradictory nature of Moscow's priorities surfaced first in its policies towards East Germany and Yugoslavia," (Crockatt, 1995, p. 1).

Major Citations for a Reference List in Table 2.

Note: All second and third lines in the APA Bibliography should be indented.

REVISIONS

When submitting a revised version of a paper, the author must submit a detailed "Response to the reviewers" that states point by point how each issue raised by the reviewers has been covered and where it can be found (each reviewer's comment, followed by the author's reply and line numbers where the changes have been made) as well as an annotated copy of the main document. Revised manuscripts must be submitted within 30 days from the date of the decision letter. If the revised version of the manuscript is not submitted within the allocated time, the revision option may be cancelled. If the submitting author(s) believe that additional time is required, they should request this extension before the initial 30-day period is over.

Accepted manuscripts are copy-edited for grammar, punctuation, and format. Once the publication process of a manuscript is completed, it is published online on the journal's webpage as an ahead-of-print publication before it is included in its scheduled issue. A PDF proof of the accepted manuscript is sent to the corresponding author and their publication approval is requested within 2 days of their receipt of the proof.

Table 2.

Material Type	Reference List/Bibliography
A book in print	**Baxter, C. (1997).** *Race equality in health care and education.* Philadelphia: Ballière Tindall, p. 110-115, ISBN 4546465465
A book chapter, print version	**Haybron, D.M. (2008).** Philosophy and the science of subjective well-being. In M. Eid & R. J. Larsen (Eds.), *The science of subjective well-being* (p. 17-43). New York, NY: Guilford Press. ISBN 4546469999
An eBook	**Millbower, L. (2003).** *Show biz training: Fun and effective business training techniques from the worlds of stage, screen, and song*. p. 92-90. Retrieved from http://www.amacombooks.org/ (accessed 10.10.2015).
An article in a print journal	**Carter, S., Dunbar-Odom, D. (2009).** The converging literacies center: An integrated model for writing programs. *Kairos: A Journal of Rhetoric, Technology, and Pedagogy,* 14(1), 38-48.
Preview article in a journal with DOI	**Gaudio, J.L., Snowdon, C.T. (2008).** Spatial cues more salient than color cues in cotton-top tamarins (*Saguinus oedipus*) reversal learning. *Journal of Comparative Psychology,* https://doi.org/10.1037/0735-7036.122.4.441
Websites - professional or personal sites	***The World Famous Hot Dog Site.* (1999, July 7).** Retrieved January 5, 2008, from http://www.xroads.com/~tcs/hotdog/hotdog.html (accessed 10.10.2015).
Websites - online government publications	**U.S. Department of Justice. (2006, September 10).** Trends in violent victimization by age, 1973-2005. Retrieved from http://www.ojp.usdoj.gov/bjs/glance/vage.htm (accessed 10.10.2015).
Photograph (from book, magazine or webpage)	**Close, C. (2002).** *Ronald.* [photograph]. Museum of Modern Art, New York, NY. Retrieved from http://www.moma.org/collection/object.php?object_id=108890 (accessed 10.10.2015).
Artwork - from library database	**Clark, L. (c.a. 1960's).** *Man with Baby.* [photograph]. George Eastman House, Rochester, NY. Retrieved from ARTstor.
Artwork - from website	**Close, C. (2002).** *Ronald.* [photograph]. Museum of Modern Art, New York. Retrieved from http://www.moma.org/collection/browse_results.php?object_id=108890 (accessed 10.10.2015).