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Research Article

Effect of black carrot (*Daucus carota* L.) pomace in cake and cookie formulations as a functional ingredient on sensory analysis

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ABSTRACT

In this study, it was aimed to determine the properties of the black carrot pomace and its use in pastries. For this purpose, black carrot pomace was dried at 150ºC by using drum drier. Dietary fiber (64.93 %), total sugar (1.16 %), fat (1.60 %), protein (8.82 %), anthocyanins (0.21 mg/g) and total phenolic substances (2.30 mg/g) of the black carrot pomace were determined. The functional properties of the carrot pomace such as water retention capacity (1.53 g/g), swelling (1.59 mL/g), alcohol insoluble residue (737.5 g/kg) and emulsion capacity (30.64 mL/g) were calculated. Dried pomace was used at three different levels in modified cookie and cake formulations. Ranking test was applied for the sensory evaluation of each derived formulations. The results of the sensory analysis showed that the use of black carrot pomace in cookie formulations was more suitable and more preferred.

Keywords: *Daucus carota*, Anthocyanin, Total phenolic substances, Functional food

Introduction

The fruit and vegetable processing industry produces significant volume of by-products, which could cause problems in their disposal. Despite considerable improvements in processing techniques including the use of depolymerizing enzymes, mash heating, and decanter technology, approximately one third of the raw material remains as pomace. Food industry wastes might be recycled using new washing, drying and fermentation techniques. Usually, these products are used in animal feeding. However, the high amount of dietary fiber content could permit the use of these products in developing new natural ingredients for the food industry. The conditions that are used in pomace processing industry could be effective on the chemical and physical characteristics and this might be important for the utilization purpose of the pomace (Constenla et al., 2002; Pagan et al., 2001; Schieber et al., 2001). The composition of the dietary fibers of various plant-originated pomaces was discussed in many literatures. The health benefits of dietary fiber have led to increased consumption of fiber-rich products and a search for new sources of fiber as food ingredients. In order to take advantage of the dietary and functional properties of fiber, some high dietary fiber formulated foods are currently being developed (Figuerola et al., 2005).

Dietary fibers are not only desirable for their nutritional properties, but also for their functional and technological properties and because of those they can also be used to upgrade agricultural products and by-products for use as food ingredients (Schieber et al., 2001; Figuerola et al., 2005). Thus, the functional properties, such as particle size, water retention, swelling, alcohol insoluble residue, emulsion capacity, emulsion stability, water and oil absorbtion, dietary fiber etc., which have been more useful for understanding the physiological effects of dietary fiber should be studied, than the chemical composition alone (Figuerola et al., 2005; Robertson et al., 2000).

Black carrot (*Daucus carota L.*) is cultivated in the southern regions of Turkey. The extracts of the roots are used in a traditional drink "Şalgam" also, it is known as a rich anthocyanin source (Keskin et al., 2021). The anthocyanin pigment composition of black carrot (*Daucus carota L.*) was detected as cy-3-rut-glu-gal acylated with one cinnamic acid (Akhtar et al., 2017; Giusti et al., 2003). Nawirska (2005) reported that carrot pomace contains mainly cellulose (% 51.6) and comparatively high amounts of lignin (32.2 %) also pectin (% 3.88) and hemicellulose (12.3 %). Chau et al. (2004) has revealed that carrot pomace was rich in insoluble fiber-rich fraction 56.3 g/100 g of pomace, which was mainly composed of pectic polysaccharides, hemicellulose, and cellulose. This insoluble fiber-rich fraction was found to have desirable physicochemical properties and in vitro hypoglycemic properties as compared with cellulose. Various attempts were made at utilizing carrot pomace in food such as milk, bread, cake, dressing and pickles, and for the production of functional drinks (Stoll et al., 2003; Pandey et al., 2021).

In this study, it was aimed to investigate the proximate composition and the functional properties of the black carrot pomace to be used as a potential fiber rich source in the enrichment of cereal products and to produce dietary cakes and cookies. For this purpose, total dietary fiber, water retention capacity, swelling, emulsion capacity, total phenolic content and anthocyanin content of black carrot pomace were determined; hence this pomace was used in three different cake and cookie formulations.

Materials and Methods

The black carrot pomace used in the study was supplied in 5 kg plastic bottles from a local fruit and vegetable processing facility, Etap Tarım ve Gıda Ürünleri Ambalaj San. Ve Tic. A.Ş. Mersin, Turkey. The supplied black carrot pomace was dried in drum drier (VDS 430) at Ege University Vocational Training School Pilot Plant with drum speed: 6 rpm, vapor pressure: 75 psi, drying temperature: 150 ºC. The dried pomace was blended in Warring blender. The dried pomace, which has the particle size varying between 425-850 µm, was used in different cake and cookie formulations.

Production of Cakes and Cookies:

As a result of the preliminary research on the chemical and the functional properties of carrot pomace, three cookie and three cake formulations were derived in which dried carrot pomace to be used as an ingredient. The three formulations modified to involve 3%, 5% and 7% dried pomace, respectively (Table 1 and Table 2).

Chemical Analysis and Functional Properties of the Black Carrot Pomace

Moisture content of the dried pomace was determined in vacuum oven at 80ºC and 600-800 mbar. The ash content was estimated according to AOAC-1995 method 942.05, total sugar was determined by Lane Eynon Method (AOAC-1990 method 923.09). Fat content was determined by Soxhelet Method (Food and Agriculture Organization, 1986). Protein content (AOAC-1990 method 920.53) and dietary fiber content of the dried pomace was calculated (AOAC-1994 method 991.43).

Total phenolic content was measured by using the Folin–Ciocalteu method (Vinson et al., 1995) and the results were expressed as mg gallic acid equivalents (GAE) per gram of sample (mg GAE/g). Total anthocyanins were determined by using a pH differential method (Fuleki and Francis, 1968) and the results were expressed as miligram of cyanidin-3-glucoside equivalents per gram of sample.

Water retention capacity (WRC) 1 g of pomace was hydrated in 30 mL distilled water in a centrifuge tube at room temperature. After equilibration (18 h), the samples were centrifuged (3,000*g*; 20 min), the supernatant was decanted and the sample was transferred into a weighed sinter to drain. Sample fresh weight was recorded prior to drying. WRC was calculated as the amount of water retained by the pellet (g/g dry weight) after transferring to the sinter and the WRC was used to measure the water retained by the insoluble matrix (Robertson et al., 2000).

Swelling the sample (~0,1g) was hydrated in 10 mL of distilled water, in a calibrated cylinder (1.5 cm diameter) at room temperature. After equilibration (18 h), the bed volume was recorded and expressed as volume/g original substrate dry weight (Robertson et al., 2000).

Alcohol insoluble residues (AIR) AIR were prepared to characterize the relative contribution of polymeric material from each test substrate. Samples (~1 g dry weight) were extracted (x3) in boiling ethanol (30 mL; 5 min; 80-85% v/v). Alcohol-insoluble material from each extraction step was recovered by extraction step was recovered from filtration. Ethanolic supernatants were discarded and the ethanol insoluble material was dried by solvent exchange through absolute ethanol (x2) and acetone (x2) to yield a dry powder (Robertson et al., 2000).

Emulsion capacity one gram of each sample was mixed with 34 mL 1% NaCl solution in a Waring micro blender for 3 second. While continuing blending, 30 mL vegetable oil was added at a rate of 10 mL / min. Blending was continued for an additional 30 sec. Each sample was transferred to a 50 mL graduated centrifuge tube, kept in water bath at 80 ºC for 1 min, and then centrifuged at 3000 g for 40 min. The volume of oil separated from each sample after centrifugation was read directly from the tube. Emulsion capacity was expressed as the amount of oil emulsified and held per gram of sample (Okezie and Bello, 1988).

Water and oil absorbtion one gram of sample was dispersed in 50 mL of distilled water for water absorbtion and in 50 mL vegetable oil for oil absorbtion. Then the samples were centrifuged at 5000g for 30 mins. The volume of water and oil was measured to calculate the amount of water/oil absorbed by the sample. The results were reported as mL water/oil absorbed per g of sample.

Sensory Analysis

Sensory evaluation was conducted in an air conditioned sensory test laboratory equipped with individual booths. Cakes and cookies were served at room temperature to involve 3 cakes and 3 cookies on white plastic plates coded by using randomly selected 3 digit numbers. Panelists' sensitivity to major tastes and odors were tested according to ISO-3972:2011. Ranking test (Altuğ and Elmacı, 2005) was applied to evaluate the preference of trained panelists for appearance, texture, flavor and overall impression of cake and cookie formulations. 7 panelists attended the evaluation of the cookies while 10 panelists attended the evaluation of the cakes. The ranking test forms used for the evaluation of cake and cookie samples are given in Figure 1 and 2.

Name:............... Product:Cake Date:......................

Evaluate and rank the cake samples by assigning sample code of the most like/preferred sample to "1" and the least liked/preferred sample to "3" for appearance, texture, flavor and overall impression.

	Appearance		Texture		Flavor		O. Impression
Most preferred	1	Tender	1	Most preferred	1	Most preferred	1
	2		2		2		2
Least preferred	3	Tough	3	Least preferred	3	Least preferred	3

Figure 1. Ranking test form for the cake samples

Name:............... Product: Cookie Date:......................

Evaluate and rank the cookie samples by assigning sample code of the most like/preferred sample to "1" and the least liked/preferred sample to "3" for appearance, texture, flavor and overall impression.

	Appearance		Texture		Flavor		O. Impression
Most preferred	1	Tough	1	Most preferred	1	Most preferred	1
	2		2		2		2
Least preferred	3	Tender	3	Least preferred	3	Least preferred	3

Figure 2. Ranking test form for the cookie samples

Results and Discussion

The results of the chemical analyses applied to the black carrot pomace after drying were shown in Table 3. Since the aim was to produce dietary cake and cookies, it can be concluded that the low levels of lipid and sugar content is an advantage. Total phenolic content of the dried pomace was detected to be 2.30 mg/g dw and the anthocyanin content was calculated as 0.21 mg/g dw. Kamiloğlu et al. (2017) used black carrot pomace for enhancing the nutritional value of cake in addition they investigated the digestive stability of polyphenols from black carrot pomace and traced the changes in antioxidant capacity by using a standardized static *in vitro* digestion model. They reported a dose-dependent increase in anthocyanins (72–267 µg/g dw), phenolic acids (49–148 µg/g dw), total phenolics (54–202 mg GAE/100 g dw) and total antioxidant capacity (21–129 to 153–478 mg TE/100 g dw).

In our study the dietary fiber content of the sample was calculated as (64.93 g/100g dw). According to the study performed by Figuerola et al. (2005) the dietary fiber contents were found as: grapefruit (44.2-62.6 %), lemon pomace (60.1-68.3 %), orange pomace (64.3-78,2 %) and apple pomace (60.2-89.8 %) and also Nawirska et al. (2005) calculated the dietary fiber contents of apple pomace as 98.74 % and carrot pomace as 54.2 %. In addition, Chau et al. (2004) reported the dietary fiber of carrot pomace within the ranges 50.1-67.4 %. It can be deducted that black carrot pomace can be used in dietary cake formulations due to its high dietary fiber content.

The dried black carrot pomace used in this study has the water retention capacity of 1.53 g/g and the swelling was determined to be 1.59. Figuerola et al. (2005) detected the water retention capacity of grapefruit (2.09-2.26 g/g), lemon pomace (1.74-1.85 g/g), orange pomace (1.65 g/g) and apple pomace (1.62-1.87 g/g) and the swelling values of grapefruit (6.69-8.02), lemon pomace (7.32-9.19), orange pomace (6.11) and apple pomace (6.29-8.27) (Figuerola et al.. 2005). As seen in the above figures the water retention and swelling values of the black carrot pomace was found to be lower than the fruit pomaces analyzed in other studies. This difference is assumed to originate from the difference between the dietary fiber composition of vegetables and the fruits.

Oil adsorption capacity depends on surface properties, overall charge density, thickness, and hydrophobic nature of the fiber particle. In this study the oil absorbtion of the black carrot pomace was calculated as 2.77 mL/g. Likewise the oil absorbtion capacities of grapefruit (1.20-1.52 g/g), lemon pomace (1.30-1.48 g/g), orange pomace (1.81 g/g) and apple pomace (0.60-1.45 g/g) (Figuerola et al.. 2005). The oil absorbtion value of the black carrot pomace, which was found to be higher than the fruit pomaces in the literature, must be taken into consideration in the fat containing food formulations.

Alcohol insoluble residue was prepared to characterize the relative contribution of polymeric material from the pomace. In this study, it was calculated as 737.5 g/kg. In comparison with the AIR values in Robertson et al. (2000) of pea hull (953.2 g/kg), apple pulp (690.5 g/kg) and citrus pulp (484.8 g/kg), the AIR value of the black carrot pomace is considerably high.

The results of the sensory analysis (Table 5) applied to the cakes showed that the appearance of the 3% carrot pomace containing cakes are superior than the 5 and 7% carrot pomace containing cakes ($p<0.05$). The texture of the 3% carrot pomace containing cakes were ranked to be preferred more than the 5 % and 7% carrot pomace containing cakes ($p<0.05$). There was no significant difference among the 3, 5 and 7% carrot containing cakes in flavor ($p<0.05$). Also no significant difference was detected between the 3 and 5% carrot containing cakes in overall impression and 7% carrot pomace containing cakes were found to be inferior ($p<0.05$).

Table 1. The ingredients of the cake formulations used in sensory analysis

	Amount (%)		
Ingredients	**Formulation No.1**	**Formulation No.2**	**Formulation No.3**
Margarine	9	9	9
Egg	20	20	19
Sugar	14	14	13
Flour	21	20	20
Baking Powder	0.8	0.8	0.8
B.Carrot Pomace	3	5	7

Table 2. The ingredients of the cookie formulations used in sensory analysis

	Amount (%)		
Ingredients (g)	**Formulation No.1**	**Formulation No.2**	**Formulation No.3**
Margarine	9	9	9
Egg	20	20	19
Sugar	14	14	13
Flour	21	20	20
Baking Powder	0.8	0.8	0.8
B.Carrot Pomace	3	5	7
Milk	32	31	30.5

Table 3. Proximate composition of dried black carrot pomace

Property	**Result**
Moisture	6.06 ±0.12 g/100g
Ash	5.65 ±0.08 g/100g dw
Lipid	1.60 ±0.21 g/100g dw
Protein	8.82 ±0.28 g/100g dw
Total sugar	1.16 ±0.03 g/100g dw
Dietary fiber	64.93 ±2.92 g/100g dw
Total Phenolic Compound	2.30 ±0.36 mg/g dw
Anthocyanin	0.21 ±0.03 mg/g dw

Table 4. Functional properties of dried black carrot pomace

Property	Result
Water Retention Capacity	1.53 ±0.52 g/g
Swelling	1.59 ±0.20 mL/g
Alcohol Insoluble Residue	737.5 ±10 g/kg
Emulsion Capacity	30.64 ±0.40 mL/g
Water Absorbtion	7.46 ±0.88 mL/g
Oil Absorbtion	2.77 ±0.31 mL/g

Table 5. The ranking test results of the cakes and cookies

	Cakes			Cookies		
	3%	5%	7%	3%	5%	7%
Appearance	11	22	27	7	14	21
Texture	15	24	21	10	11	21
Flavor	18	19	23	9	14	19
Overall Impression	16	17	27	8	13	21

Similarly the sensory analysis applied to the cookies revealed that the appearance of the 3 % carrot pomace containing cookies were superior ($p<0.05$), also the 7% pomace containing cookies were found to be inferior. No significant difference existed between the texture characteristics of the 3 and 5% carrot pomace containing cookies and these were more preferred to the 7 % carrot pomace containing cookies which were evaluated as inferior ($p<0.05$). The flavor of the 3% carrot pomace containing cookies were found to be superior and 7 % carrot pomace containing cookies found to be inferior among the cookies ($p<0.05$). The general impression of the 3% carrot pomace containing cookies were superior whereas the 7 % was found to be inferior ($p<0.05$).

Baltacıoğlu et al. (2019) used fermented black carrot powder waste (FBCW) to biscuits in various amounts (10, 20 and 30 %). They reported that 30 % FBCW added samples were found to be superior in terms of crust color and softness; control group were chosen as the best in terms of inner biscuit color, pore homogeneity and smell; 10 % FBCW added samples were found to be superior in terms of taste and crispiness and finally 20% FBCW added samples were detected to be superior in terms of greasy feeling in the mouth by the panelists. The authors also reported that 10 % FBCW added samples were superior in terms of general impression.

Carson et al. (1994) used dried, powdered unrefined pomace of three apple cultivars as an ingredient in pie filling and oatmeal cookies. Two pie filling or three oatmeal cookies were evaluated by the panelists according to their pomace amounts. Both food products were rated as moderately liked and it was reported that pomace amount did not affect color, cookie size or sensory scores

Canett Romero et al. (2004) made cookies containing four different levels of deseeded grape pomace (0, 5, 7.5 and 10 %). In result, cookies were well accepted by panelists showing no significant differences among the four levels of deseeded grape pomace addition. The addition of deseeded grape pomace imparted a darker color to the cookies indicated by the lower L color value. The researchers reported that deseeded grape pomace is a potential ingredient to some food products.

In many literature studies excessive amounts of pomace were disliked by the panelists since it disrupts some sensory properties i.e. texture, color, size, hardness/softness, mouth feeling, greasy feeling in mouth. Likewise, in our study the 3% carrot pomace containing cakes and cookies were detected superior to 5 and 7 % containing samples in most of the sensory quality attributes.

Conclusion

In this study it was determined that the black carrot pomace is a valuable by-product. The final produced black carrot pomace added cakes and cookies has better functional properties compared to the control groups. The panelists mostly preferred 3% carrot pomace containing carrots and cookies in sensory quality attributes texture, flavor, appearance and overall impression. In the literature lots of studies on the dietary fiber content of apple, peach, grape and citrus pomaces can be accessible, but limited research was carried out on carrot and other vegetable pomaces. As a result due to the compositional and functional properties of the black carrot pomace, which is rich in dietary fiber content, have a potential to be used as an ingredient in dietary products.

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: -

References

Akhtar, S., Rauf, A., Imran, M., Qamar, M. Riaz, M., Mubarak, M. (2017). Black carrot (*Daucus carota* L.), dietary and health promoting perspectives of its polyphenols: A review. *Trends in Food Science & Technology,* 66, 36-47. https://doi.org/10.1016/j.tifs.2017.05.004

Altuğ, T., Elmacı, Y. (2005). *Duyusal test teknikleri,* Sidas Medya, ISBN: 9789944566087.

AOAC International (1990). Invert sugar in sugars and syrups. Lane-eynon (Standard No. 923.09-1923)

AOAC International (1994). Total, soluble, and insoluble dietary fiber (Standard No. 991.43-1994)

AOAC International (1995). Total Kjehldahl Nitrogen Fruits (Standard No. 920.152-1995)

AOAC International (1995). Ash of animal feed (Standard No. 942.05-1995)

Baltacıoğlu H., Baltacıoğlu C., Tangüler H. (2019). Effect of waste fermented carrot powder addition on quality of biscuits. *Turkish Journal of Agriculture-Food Science and Technology*, 7(9), 1237-1244. https://doi.org/10.24925/turjaf.v7i9.1237-1244.2759

Canett Romero, R., Ledesma Osuna, A.I., Robles Sánchez, R.M., Morales Castro, R., Leon-Martinez, L., Leon-Galvez, R. (2004). Characterization of cookies made with deseeded grape pomace. *Archivos Latinoamericanos de Nutrición,* 54(1), 93-99.

Carson, K.J., Collins, J.L., Penfield, M.P. (1994). Unrefined, dried apple pomace as a potential food ingredient. *Journal of Food Science,* 59(6), 1213-1215. https://doi.org/10.1111/j.1365-2621.1994.tb14679.x

Chau, F., Chen, C.H., Lee, M.H. (2004). Comparison of the characteristics, functional properties, and in vitro hypoglycemic effects of various carrot insoluble fiber-rich fractions, *LWT – Food Science and Technology,* 37, 155-160. https://doi.org/10.1016/j.lwt.2003.08.001

Constenla, D., Ponce, A.G., Lozano, J.E. (2002). Effect of Pomace Drying on Apple Pectin. *LWT – Food Science and Technology,* 35, 216-221. https://doi.org/10.1006/fstl.2001.0841

Food and Agriculture Organization (1986). Manuals of Food Quality Control. 7. Food Analysis: General Techniques. Additives, contaminants and composition. FAO Food and Nutrition Paper Rome. 14/7. 212-213. Retrieved from: http://www.fao.org/3/AM808E/AM808E.pdf

Figuerola F., Hurtado M.L., Estevez A.M., Chielle I., Asenjo F. (2005). Fiber concentrates from apple pomace and citrus peel as potential fiber sources for food enrichment. *Food Chemistry*, 91,395-401. https://doi.org/10.1016/j.foodchem.2004.04.036

Fuleki, T., Francis, F.J. (1968). Quantitative methods for anthocyanins. 2- Determination of total anthocyanin and degradation index for cranberry juice, *Journal of Food Science,* 33, 78-83. https://doi.org/10.1111/j.1365-2621.1968.tb00888.x

Giusti, M.M., Wrolstad, R.E. (2003). Acylated anthocyanins from edible sources and their applications in food systems. *Biochemical Engineering Journal,* 14, 217-225. https://doi.org/10.1016/S1369-703X(02)00221-8

International Standards Organisation (2011). Sensory Analysis-Methodology-Method of Investigating Sensitivity of Taste (Standard No. 3972) Retrieved from: https://www.iso.org/standard/50110.html

Kamiloğlu, S., Özkan, G., Işık, H., Horoz, Ö., Van Camp, J., Çapanoğlu, E. (2017). Black carrot pomace as a source of polyphenols for enhancing the nutritional value of cake:

An *in vitro* digestion study with a standardized static model. *LWT – Food Science and Technology,* 77, 475-481. https://doi.org/10.1016/j.lwt.2016.12.002

Keskin, M., Güçlü, G., Şekerli, Y.E., Soysal, Y., Selli, S., Kelebek, H. (2021). Comparative assessment of volatile and phenolic profiles of fresh black carrot (*Daucus carota L.*) and powders prepared by three drying methods. *Scientia Horticulturae,* 287, 110256. https://doi.org/10.1016/j.scienta.2021.110256

Nawirska, A., Kwaśniewska, M. (2005). Dietary fibre fractions from fruit and vegetable processing waste. *Food Chemistry,* 91, 221-225. https://doi.org/10.1016/j.foodchem.2003.10.005

Okezie, B.O., Bello, A.B. (1988). Physicochemical and functional properties of winged bean flour and isolate compared with soy isolate. *Journal of Food Science,* 53(2), 450-454. https://doi.org/10.1111/j.1365-2621.1988.tb07728.x

Pagan, J. Ibarza A., Llorcab, M., Pagan, A., Barbosa-Canovasc, G.V. (2001). Extraction and Characterization of Pectin from Stored Peach Pomace, *Food Research International,* 34, 605-612. https://doi.org/10.1016/S0963-9969(01)00078-3

Pandey, P., Grover, K., Dhillon, T.S., Kaur, A., Javed, M. (2021). Evaluation of polyphenols enriched dairy products developed by incorporating black carrot (*Daucus carota* L.) concentrate. *Heliyon,* 7, e06880. https://doi.org/10.1016/j.heliyon.2021.e06880

Robertson, J.A., De Monredon, F.D., Dysseler, P., Guillon, F., Amado, R., Thibault, J.F. (2000). Hydration properties of dietary fibre and resistant starch: A 110uropean collaborative study. *LWT – Food Science and Technology,* 33, 72-79. https://doi.org/10.1006/fstl.1999.0595

Schieber, A., Stintzig, F.C., Carle, R. (2001). By-products of plant food processing as a source of functional compounds – recent developments, *Trends in Food Science & Technology,* 12, 401-413. https://doi.org/10.1016/S0924-2244(02)00012-2

Stoll, T., Schweiggert, U., Schieber, A., Carle, R. (2003). Process for the recovery of a carotene-rich functional food ingredient from carrot pomace by enzymatic liquefaction. *Innovative Food Science and Emerging Technologies,* 4, 415-423. https://doi.org/10.1016/S1466-8564(03)00060-2

Vinson J.A., Dabbagh Y.A., Mamdouh M.S., Jang J. (1995). Plant flavonoids. Especially tea flavonoids are powerful antioxidants using an in vitro oxidation model for heart disease. *Journal of Agricultural and Food Chemistry*, 43, 2800-2802. https://doi.org/10.1021/jf00059a005