Utilization of Carrot Pomace in Formulating Functional Biscuits and Cakes

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ABSTRACT

Despite applying modern processing methods as depolymerizing enzymes, mash heating and decanter technology in carrot juice extraction, yet a major part of valuable nutritious components mainly dietary fibres and antioxidants are still retained in the pomace. Consequently, in the present study, red carrot pomace (RCP) and yellow carrot pomace (YCP) were chemically analyzed and utilized in formulating functional biscuits and cakes. Total dietary fibres content exhibited values of 51.18% and 52.94%, whereas β-carotene content revealed values of 2.96 and 12.71 mg/100g and anthocyanins content had values of 18.64 and 0.00 mg/100g for RCP and YCP, respectively.

Incorporation of RCP at up to 20% and YCP at up to 15% produced acceptable and comparable biscuits to control. In contrast, the control plain cakes were significantly superior to supplemented cakes with RCP and YCP at levels higher than 5%. However, incorporation level of YCP could be elevated up to 20% in chocolate cakes. It was obvious that incorporation of carrot pomace elevated considerably total dietary fibre, β-carotene contents for YCP and anthocyanins contents for RCP of new biscuits and cakes formulated in the present study.

Keywords: chemical composition, dietary fibre, β-carotene, anthocyanins, plain cake. chocolate cake. functional properties. sensory properties.

INTRODUCTION

Carrot (*Daucus carota L.*) is still an inexpensive and highly nutritious vegetable. It contains appreciable concentrations of B_1, B_2 and B_6 vitamins along with carotenes and dietary fibres (Manjunatha *et al.*, 2003, Bao & Chang, 2006). Consequently, carrot juice and blends are one of the most popular non-alcoholic beverages (Singh *et al.*, 2006). Carrot juices and derived products such as (ATBC) (α-Tocopherol, β-Carotene, vitamin supplement) as well as breakfast drinks represent an emerging market with economic importance (Schieber *et al.*, 2001, Sun *et al.*, 2006).

Despite applying modern processing methods as depolymerizing enzymes, mash heating and decanter technology in carrot juice extraction, yet a major part of valuable nutritious components is retained in the pomace. According to Singh *et al.* (2006) in carrot juice production, the juice yield is only 60-70% and up to 80% of the carotenes may be lost with pomace. Meanwhile, carrot pomace is rich in insoluble fibre content along with high levels of beneficial bioactive compounds with antioxidant activity (Schieber *et al.*, 2001, Bandyopadhyay *et al.*, 2008, Chantaro *et al.*, 2008).

Numerous attempts were made to utilize carrot pomace in food such as bread, cake, dressing and pickles (Ohsawa *et al.*, 1994, 1995). However, consumer acceptance of such products still needs to be demonstrated; especially the sensory quality that may be adversely affected.

Biscuits are the most popularly consumed bakery items overall the world. Some of the reasons behind that are their readability to be eaten fresh, relatively affordable cost or low cost, good nutritional quality, availability in different tastes and long shelf life (Ajila *et al.*, 2008).

Functional foods might be defined as those food that in addition to acting as nutrients may positively affect specific functions, improving health and /or reducing the risk of specific diseases (Bao & Chang, 2006). Meanwhile, functional food can be a natural food, a food from which a deleterious component has been removed, a food where the nature of one or more components has been modified, a food in which the bioavailability of one or more component has been modified, or any combination of these possibilities and have authorized and scientifically based claims (Gibson & Williams, 2000).

Because of competition in the market, and increased demand for healthy, natural and functional products, attempts are being made to improve the nutritive value and functionality of bakery products by modifying their nutritive quality. For instance, increase dietary fibre content and thereby improve prebiotical characteristics of the final product. Hence, development and consumption of such therapeutic bakery products would help to raise the nutritional status of the population (Hooda & Jood, 2005).

The present work was carried out to formulate functional biscuits and cakes by inserting red carrot pomace (RCP) as well as yellow carrot pomace (YCP) in recipes of such bakery products. Moreover, the formulated products versus controls were evaluated from sensorial and physicochemical points of view.

MATERIALS AND METHODS

Materials

Carrots

Yellow and red carrots (*Daucus carota* L.) were purchased from El-Behaira Governorate, Egypt. Carrots were transferred to cooling room (zero °C and RH= 98%) at Faculty of Agriculture, University of Alexandria, Egypt and kept under these conditions until used.

Biscuit and cake ingredients

Wheat flour (72% extraction ratio) and the other ingredients used in the biscuits and cakes making, were purchased from a supermarket in Alexandria, Egypt.

Methods

Extraction of carrot pomace

Both yellow and red carrots were "topped" and "tailed" using a sharp knife, thoroughly washed with tap water, trimmed and peeled using a hand peeler (Approximately 0.65-1.00 mm of the periderm was removed by peeling and 2cm of both the tip and the top were also removed by trimming), and were cut into sticks by sharp knife (1×3×1cm). The sticks were then blanched for 15min in boiling water with a ratio of carrot to water 1:1 (w/v). The sticks along with the blanching water were blended in a household extractor at a maximum velocity for 6min to get fine pastes. Finally, the pomace was filtered through cheesecloth.

Carrot- pomace powder

After extraction of juice from carrots (*Daucus carota L.*) belonging to both yellow and red varieties, the pomace was dried in an air-oven at 60°C for 6hr until reaching the final moisture content of 10.79% for yellow - carrot pomace (YCP) and 8.81% for red- carrot pomace (RCP). The dehydrated pomaces were milled using hammer mill and sieved through 121 pores/cm^2 sieve, then packed into air tight glass jars and kept at room temperature until use.

Preparation of biscuits

Biscuits were made from wheat flour only (control) along with wheat flour blends with YCP or RCP at 5%, 10%, 15% and 20% substitution levels (w/w). Mary biscuits recipe was used as follows: One hundred g of wheat flour (72% extraction ratio) or blend, 47.5g sugar, 23.5g shortening, 50g liquid milk, 2.0g salt, 2.5g baking ammonia and 0.25g vanillin (Smith, 1972).

All the aforementioned ingredients were mixed in Hobart dough mixer (Model N-50G, 470 rpm, Hz 50) for 7 min. The dough was flattened using sheeting roll machine, shaped to round pieces with 3 mm thickness and 5 cm diameter. Baking was performed at 190°C for 12 min. Biscuits were allowed to cool and kept in polyethylene bags at room temperature until used for analysis.

Preparation of cakes

Cakes were made from wheat flour only (control) along with wheat flour blends with YCP or RCP at 5, 10, 15 and 20% substitution levels (w/w). The formula consisted of 100 g wheat flour (or blend), 137.5g sugar, 100g whole egg, 104g liquid milk, 25 g shortening, 0.5g baking powder and 1.5g salt (Bennion & Bamford, 1973). As for chocolate cake, 10 g of cacao powder were added to the aforementioned formula and thereby considerable amounts of pomace were readjusted to maintain the given substitution levels.

Creaming method as described by Bennion & Bamford (1973) was used to prepare cakes, where shortening was first creamed with sugar then eggs were beaten into the creamed mixture, flour (sifted with baking powder and salt) was added alternately with milk. Cake batter was poured into an aluminum foil pan and baked at 180°C for 30 min, then the temperature was reduced to 160°C and continued for 30 min. Cakes were cooled to room temperature and packed in polyethylene bags.

Sensory evaluation

Biscuit samples along with the control (no pomace was inserted) were subjected to sensory evaluation. Ten trained panelists from Food Science and Technology, Department, Faculty of Agriculture, University of Alexandria were asked to evaluate the samples using hedonic scale consisting of 9 points from 1 (Extremely dislike) to 9 (Extremely like). Colour, consistency, flavour, appearance and overall acceptability were evaluated (Hooda & Jood, 2005).

Cake samples along with the control sample were subjectively judged by panelists as previously mentioned for biscuits. The quality attributes evaluated were crust colour, crumb colour, crumb grain, texture, flavour, and overall acceptability.

Analytical methods

Gross chemical composition

Moisture content was determined by drying the sample in a vacuum oven at 70°C to a constant weight (AOAC, 2000, method No. 945.43).

Ash was determined by incineration the sample at 550°C in an electrical Muffle furnace (AOAC, 2000, method No. 923.03). Meanwhile, total dietary fibre (TDF) content was determined by enzymatic- gravimetric method (AOAC, 2000).

Crude protein (N×6.25) was determined according to the AOAC (2000) (method No. 2001.11). Fat content was determined according to Folch *et al.* (1957) using a mixture of chloroform and methanol (2:1 v/v). Carbohydrate content was calculated by difference.

Functional properties

Functional properties of carrot pomace were evaluated according to Eim *et al.* (2008). Water retention capacity (WRC), swelling capacity (SWC) and oil holding capacity (OHC) were evaluated.

The WRC was expressed as the amount of water obtained by the sample (g/g dry weight). The SWC was expressed as g/g of the original pomace sample (dry weight).The OHC as percentage of absorbed oil by pomace.

β-Carotene:

Carotenoids were extracted from samples with 80% acetone (1: 50 w/v). Absorbance of the extract was measured at 480 nm using Spekol Spetrocolorimeter (Spekol 11, Carl Zeiss Jena, Germany). The β-carotene concentration was figured out by using the extinction coefficient ($E_{1cm}^{1\%}$) of 2273 (Jensen, 1978, Ben-Amotz & Avorn, 1983).

Anthocyanins

Anthocyanins were extracted with 1 % conc. HCl in 95% methanol (v/v) (1g sample: 50 ml solvent w/v). The micro molar concentration of anthocyanins in the extracts was obtained by multiplying the absorbance at 530 nm by 33.3 based on the molar extinction coefficient (1.0 cm light path) of cyanidin chloride being 30000 (Halaweish & Dougall, 1990). Anthocyanin content was calculated as mg cyanidin chloride/g sample.

Statistical analysis

Data were subjected to analysis of variance (ANOVA) and Duncan's multiple range tests, to separate the treatment means (Steel & Torrie, 1980). The analysis was computed using the SAS program.

RESULTS AND DISCUSSION

Compositional properties of carrot pomace

The results presented in Table (1) reveal that the pomace belonging to yellow carrot (YCP) exhibited higher moisture content (10.79%) than its counterpart for red carrot (RCP) being 8.81%.

Meanwhile, YCP exhibited four times more β-carotene than that of RCP. In contrast, the latter had anthocyanins content amounted to 18.64 mg/100g versus the absence of anthocyanins in YCP. These data are in general agreement with the published data by Chau *et al.* (2004) and Bandyopadhyay *et al.* (2008).

The data given in Table (1) obviously indicate that carrot pomace is considered as a potential source for dietary fibre (more than 50%) along with β-carotene in case of YCP (12.71mg/100g) and anthocyanins (18.64 mg/100g) in case of RCP. The latter two components are considered as dietary antioxidants. Recently, the interest in such components has prompted research in the field of functional components (Molina *et al.*, 2009). Consequently, carrot pomace is rich in bioactive components, and thereby it can be utilized as a functional ingredient in formulating functional foods. It is worth to mention that carrot pomace is currently produced under numerous trade names as a vitamin and mineral rich co-product of the juicing industry (Schieber *et al.*, 2001). Few efforts have been made in utilizing carrot pomace in foods such as bread, cake, dressing and pickles and for the production of functional drinks. Meanwhile, carrot peels could be utilized to produce high dietary fibre powder (Chantaro *et al.*, 2008).

Table (1) shows that the swelling capacity was almost comparable for both types of pomace ,being around 13 g/g. Water retention capacity of YCP (9.35) was lower than that of RCP (12.09). As for oil holding capacity, YCP had slightly higher value (1.44) than that of RCP (1.20). Water retention capacity was found to be 18.6g water /g, while oil holding capacity was 5.5 g oil/g of carrot dietary fibre (Eim *et al.*, 2008).

Sensory properties of biscuits

Table (2) shows that biscuits supplemented with RCP at up to 20% were significantly acceptable as the control. This was also true regarding biscuits supplemented with YCP but at a lower level (15%). Generally, addition of RCP to biscuits was more acceptable than YCP. Accordingly, carrot pomace can be recommended in biscuits formula at levels up to 20% and 15% of RCP and YCP, respectively. Biscuits containing these two levels of supplementation were subjected for further study.

Chemical composition of biscuits

The results presented in Table (3) show that biscuits supplemented with 20% RCP and that supplemented with 15% YCP exhibited lower moisture content than that of the control. On the other hand, Table (3) shows almost similarity in terms of crude protein, fat and carbohydrate and contents for supplemented and the control biscuits.

Total dietary fiber content increased considerably from 4.79% for the control biscuits to 9.67 and 9.28% for biscuits supplemented with RCP and YCP, respectively (Table 3). On the other hand the biscuits supplemented with RCP exhibited almost comparable β-carotene content (0.52 mg/ 100g) to the control (0.54 mg/ 100g), whereas the biscuits supplemented with 15% YCP exhibited higher β-carotene content than the control being 0.89 mg/100g. On the contrary to biscuits supplemented with YCP that did not contain any detectable amount of anthocyanins, the biscuits supplemented with RCP had appreciable amount of anthocyanins being 2.20 mg /100g (Table 3).

Data presented here are in accordance with the results reported by Vitali, *et al.* (2009) who found that incorporation of integral raw materials and dietary fibre resulted in considerable improvement of selected nutritional and functional properties of biscuits. According to Elleuch *et al.* (2010), increment of dietary fibre results in healthy food products, low in cholesterol, fat and calories. Notwithstanding, fibre can offer physiological functionalities for numerous technological properties such as hydration properties, oil holding capacity as well as antioxidant capacity.

Sensory properties of cakes

It was obvious that plain cakes supplemented with RCP at level higher than 10% and with YCP at a level higher than 5%, respectively were significantly different from the control as judged by the

Table 1: Chemical composition (on dry weight basis) and functional properties of red and yellow carrot pomace

Composition properties \ Sample	Red carrot pomace	Yellow carrot pomace
Moisture %	8.81±0.06	10.79±0.11
Ash %	5.97±0.03	7.14±0.01
Crude fibres%	17.30±0.33	20.83±0.29
Total dietary fibre %	51.18±1.004	52.94±2.65
β-carotene (mg/100g)	2.96±0.0001	12.71±0.19
Anthocyanins (mg/100 g)	18.64±0.18	0
Functional properties		
Swelling Capacity (g/g)	13.07±0.09	13.51±0.13
Water Retention Capacity (g/g)	12.09±0.09	9.35±0.62
Oil Holding Capacity (%)	1.20±0.12	1.44±0.07

Eatch value is expressed as mean of triplicates ± standard deviations.

Table 2: Sensory evaluation of biscuits supplemented with red and yellow carrot at different levels

Type of pomace	Substitution level	Organoleptic properties				
		Colour	Consistency	Flavour	Appearance	Overall acceptability
Red-carrot pomace	0%	6.80[a]	7.30[a]	7.00[a]	6.90[a]	7.20[a]
	5%	5.25[a]	6.35[a]	6.40[a]	5.85[a]	6.80[a]
	10%	5.50[a]	6.55[a]	7.05[a]	6.60[a]	6.65[a]
	15%	6.45[a]	6.30[a]	7.05[a]	6.80[a]	6.85[a]
	20%	6.35[a]	6.40[a]	7.00[a]	5.85[a]	7.10[a]
Yellow-carrot pomace	0%	7.30[a]	6.40[a]	7.00[a]	6.90[a]	6.75[a]
	5%	6.15[a]	6.25[a]	6.25[a]	5.85[a]	6.05[a]
	10%	6.40[a]	6.85[a]	6.85[a]	6.60[a]	6.25[a]
	15%	6.35[a]	6.45[a]	6.45[a]	6.80[a]	6.45[a]
	20%	6.85[a]	6.65[a]	6.45[a]	5.85[a]	5.80[b]

Means in a column belonging to the same type of cake not sharing the same superscript are significantly different at $P < 0.05$.

Table 3: Chemical composition (on dry weight basis) of control and biscuits supplemented with red and yellow carrot pomace

Composition	Biscuits		
	Control	Supplemented with 20%red carrot pomace	Supplemented with 15%yellow carrot pomace
Moisture %	6.97±0.02	2.23±0.04	5.32±0.06
Crude protein%	7.65±0.12	6.34±0.20	7.19±0.001
Fat %	13.04±0.32	12.89±0.24	13.32±0.33
Ash %	0.72±0.001	1.36±0.20	1.003±0.05
Carbohydrates %	78.59	79.41	78.48
Total dietary fibre %	4.79±0.82	9.67±0.53	9.28±0.22
β-carotene (mg/100g)	0.54±0.02	0.52±0.01	0.89±0.01
Anthocyanins (mg/100 g)	0	2.20±0.06	0

Results are expressed as mean values ± standard deviations.

panelists (Table 4). This result could be attributed mainly to the unaceptable colour of cakes supplemented with high levels of red carrot pomace.

Chocolate cake was formulated by inserting cacao powder in the cake recipe as a trial to improve the unacceptable colour of the cakes supplemented with carrot pomace. Such a solution resulted in elevating the supplementation level of YCP to 20% without any significant deteriorative effects on quality attributes of cakes. Unfortunately, incorporation of cacao in recipe of cakes supplemented with RCP at levels higher than 5% was unacceptable by the panelists.

Chemical composition of cakes

Table (5) shows the chemical composition of plain and chocolate cakes. Moisture content of plain cakes varied from 31.61 to 34.16%, whereas it ranged from 27.71 to 37.04% for chocolate cakes. Crude protein possessed lower content (5.64-6.74%) for plain cakes than chocolate cakes (7.62–9.07%). Meanwhile, the former exhibited carbohydrate content varied from 74.89 to 79.89% versus 77.54–78.91% for chocolate cakes. Fat content ranged from 8.37 to 12.44% and from 9.87 to 11.38% for plain and chocolate cakes, respectively.

Table 4: Sensory evaluation of plain and chocolate cakes supplemented with carrot pomace (red and yellow) at different levels

Type of cake	Type and level of pomace		Organoleptic properties					
			Crust colour	Crumb colour	Crumb grain	Consistency	Flavour	Overall acceptability
Plain cakes	Red-carrot pomace	0%	8.30^{a}	8.30^{a}	8.50^{a}	7.70^{a}	6.45^{b}	6.90^{a}
		5%	7.70^{a}	7.90^{a}	7.90^{a}	7.50^{a}	8.50^{a}	7.50^{a}
		10%	5.90^{b}	6.10^{b}	7.30^{a}	6.70^{ab}	8.10^{a}	7.30^{a}
		15%	4.50^{b}	4.70^{b}	5.30^{b}	5.30^{c}	7.70^{ab}	4,70^{b}
		20%	5.10^{b}	5.10^{b}	5.10^{b}	5.70^{bc}	6.50^{b}	4.10^{b}
	Yellow-carrot pomace	0%	8.11^{ab}	7.90^{ab}	8.30	8.10	5.90	8.30^{a}
		5%	9.10^{a}	8.70^{a}	8.30	7.50	7.50	8.50^{a}
		10%	7.90^{ab}	7.50^{b}	7.70	7.30	7.10	6.51^{b}
		15%	7.90^{ab}	7.90^{ab}	7.90	7.90	6.30	6.90^{b}
		20%	7.30^{b}	7.90^{ab}	7.30	7.10	6.30	7.10^{b}
Chocolate cakes	Red-carrot pomace	0%	8.50^{a}	8.70^{a}	8.30^{a}	7.90^{a}	6.50^{b}	7.90^{ab}
		5%	8.70^{a}	8.70^{a}	8.70^{a}	8.50^{a}	8.30^{a}	8.50^{a}
		10%	7.90^{ab}	7.50^{ab}	7.30^{a}	7.30^{ab}	8.70^{a}	7.59^{ab}
		15%	7.30^{ab}	6.90^{b}	7.90^{a}	8.10^{a}	7.50^{ab}	6.70^{b}
		20%	7.05^{b}	5,30^{c}	5.65^{b}	6,25^{b}	7.40^{a}	7.40^{ab}
	Yellow-carrot pomace	0%	7.50^{a}	6.90^{a}	7.15^{a}	7.10^{a}	6.50^{ab}	6.95^{a}
		5%	6.75^{ab}	2.70^{b}	4.10^{b}	4.90^{b}	7.55^{a}	3.50^{b}
		10%	6.60^{ab}	2.10^{b}	3.50^{b}	4.30^{b}	7.15^{a}	3.30^{b}
		15%	6.10^{ab}	1.50^{b}	4.10^{b}	3.90^{b}	4.90^{b}	3.10^{b}
		20%	5.10^{b}	1.70^{b}	3.50^{b}	3.90^{b}	5.45^{b}	3.90^{b}

Means in a column belonging to the same type of cake not sharing the same superscript are significantly different at $P < 0.05$.

However, ash content was found to be almost comparable for the control and the two forms of cakes, since it ranged from 2.26% to 2.75% (Table 5).

Data presented in Table (5), reveal pronounced elevation of total dietary fibres as a result of incorporating carrot pomace. It increased from 10.19% for the control to be 15.53% for plain cakes supplemented with 5% YCP. On the other hand, total dietary fibres content increased from 10.65% for the control to 17.01% for chocolate cake supplemented with 20% YCP.

Supplementation of cake with carrot pomace resulted in considerable increment in β-carotene content from 0.55 mg /100g and 0.67mg /100g in control 1.12 and 1.69 mg/100g for plain and chocolate cakes, respectively (Table 5).

Plain cakes supplemented with 5% RCP exhibited anthocyanins of 0.81 mg /100g versus 0.68 mg /100g for chocolate cakes supplemented with 5% RCP. As it is suspected, the controls and cakes supplemented with YCP had no detectable content of anthocyanins (Table 5)

In a conclusion, high quality functional biscuts and cakes were able to be produced by inserting yellow and red carrot pomace. Such products can be considered as one of the most effective and sustainable ways of over coming vitamin A deficiency which is a prevailing problem in developing countries. Meanwhile, the formulated products contain high concentrations of natural antioxidants along with dietary fibres.

Table 5: Chemical composition (on dry weight basis) of plain and chocolate cakes supplemented with red and yellow carrot pomace

Composition \ Product	Plain cakes			Chocolate cakes		
	Control	Supplemented with 5%red carrot pomace	Supplemented with 5%yellow carrot pomace	Control	Supplemented with 5%red carrot pomace	Supplemented with 20%yellow carrot pomace
Moisture %	32.53±0.37	31.61±0.93	34.16±0.04	37.04±0.41	30.71±0.04	27.71±1.3
Crude protein%	6.07±0.02	6.74±0.11	5.64±0.01	9.07±0.01	8.82±0.001	7.62±0.02
Fat %	8.37±0.29	12.44±0.68	11.52±0.03	9.87±0.22	11.38±0.04	10.86±0.4
Ash %	2.75±0.05	2.74±0.05	2. 5±0.01	2.66±0.02	2.26±0.03	2.62±0.03
Carbohydrates %	79.89	74.97	77.44	78.38	77.54	78.91
Total dietary fibre %	10.19±0.16	13.56±0.59	15.53±0.1	10.65±0.35	15. 9±0.1	17.01±0.7
β-carotene (mg/100g)	0.55±0.01	0.78±0.01	1.12±0.01	0.67±0.03	0.74±0.001	1.69±0.01
Anthocyanins (mg/100 g)	0.00	0.81±0.02	0.00	0	0.68±0.02	0

Results are expressed as mean values ± standard deviations.

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استخدام تفل الجزر في تشكيل بسكويت وكيك وظيفيين

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تستخدم الطرق حديثة لاستخلاص عصير الجزر (الإنزيمات المحللة للبوليمرات، الهرس الساخن وتقنية الصب) ورغم ذلك فإن نسبة كبيرة من مكونات ذات قيمة حيوية مثل الألياف الخام ومضادات الأكسدة تظل موجودة بتركيز عال بتفل الجزر. وقد اشتملت الدراسة الحالية على التحليل الكيماوي لكل من تفل الجزر الأحمر وتفل الجزر الأصفر المتبقي بعد استخلاص العصير، وتم استخدامهما كمضافات في بسكويت وكيك وظيفيين. ولقد تبين أن محتوى الألياف الغذائية كان ٥١,١٨، ٥٢,٩٤٪، بينما كان محتوى البيتا-كاروتين ٢,٩٦، ١٢,٧١ ملجم/١٠٠جم، ومحتوى الأنثوسيانين ١٨,٦٤، صفر ملجم/١٠٠جم لكل من تفل الجزر الأحمر وتفل الجزر الأصفر على الترتيب.

أوضحت الدراسة أن إضافة تفل الجزر الأحمر بما لا يزيد عن ٢٠٪ قد نتج عنها بسكويت يضاهي الخواص الحسية للعينة الخالية من الإضافات من حيث التقبل من قبل المحكمين. أما بالنسبة للكيك الخالي من الإضافات فكان أكثر تقبلاً بدرجة معنوية بواسطة المحكمين عن الكيك المضاف إليه أي من نوعي تفل الجزر عند مستويات أعلى من ٥٪، وعلى الرغم من ذلك فلقد أمكن زيادة تقبل الكيك مع زيادة نسبة تفل الجزر الأصفر إلى ما لا يزيد عن ٢٠٪ في خلطة الكيك بالشيكولاته.

أوضحت الدراسة أيضاً أن إضافة تفل الجزر قد أدت إلى حدوث زيادة جوهرية في محتوى البسكويت والكيك من كل من الألياف الغذائية، البيتا-كاروتين (في حالة تفل الجزر الأصفر)، الأنثوسيانين (في حالة تفل الجزر الأحمر).