Journal of Home Economics
Volume 28, Number (3), 2018

Journal of Home Economics

http://homeEcon.menofia.edu.eg
ISSN 1110-2578

Chemical Composition, Physical and Sensory Evaluation of BiscuitsMixed with Some Vegetable Powders

Hend M. Ali* ,Zeinabsayedahmedahmed*

[*] Home Economics Department, Faculty of Specific Education, Assiut University

Abstract

Thisstudy aimstodetermine the chemical composition ,caloric value and mineral contents, physical and sensory evaluation of biscuits supplemented with some vegetable powders of carrot (CF), sweet potato (SPF), spinach (SF) and Beetroot (BRF). Biscuits were formulated by replacing wheat flour in biscuits formula by some vegetable powders at 5, 10and 15% levels. On adry weight basis, the data revealed that the gross chemical composition for spinach recorded the highest ratio in protein (28.08%) while, carrot recorded the highest ratio in crude fiber (19.82%) followed by beetroot (15.09%). The sweet potato was the highest in total carbohydrates (84.31%). Mineral contents in samples under study were found as P, 310.23 – 342.65; K, 50.47 – 282.08; Ca, 151.20 – 971.20; Fe, 12.64 – 39.43; Mg, 93.90 – 1419.71 and Zn, 2.05 – 7.05 mg/100g D.W.The data showed that biscuits supplemented with 10% and 15% SF recorded a high ratio in protein and crude fiber. While supplemented biscuits with CF, SPF and PRF recorded the highest ratio in total carbohydrates. Data also indicated more significant differences,observed in mineral contents between biscuits supplemented with different vegetable powders, also sensory evaluation scores revealed that samples with 5% of SPF and CF were most acceptable among the panelists due to their sweet taste as compared with control. The results of the current study showed that vegetable powders can be considered as a good source of Ca, Mg, P, K, Fe, protein and crude fiber. Consequently, it is recommended to utilize the four studied vegetable powders for raising the nutritional value of products.

Keywords : Chemical composition, biscuits,carrot, sweet potato, spinach, beetroot.

Introduction

Diets rich in fruits and vegetables can be associated with a delay in the aging process and a decreased risk ofdeveloping lifestyle-related diseases such as cardiovascular diseases, cancer,diabetes, cognitive function disorders, and neurological diseases, because fruits and vegetables have anti-inflammatory, anti-carcinogenic and anti-oxidative effects (**Wallace**, **2011** and **Pojer *et al*., 2013**).

Vegetable generally is a source of substances of high biological and nutritional value. Carrot is important in human nutrition. Itis also a rich source of chemo protective compounds that protect the body against many diseases (**Bystricka *et al*., 2015).**

Carrots are rich sources of carotene, ascorbic acid and are known as vitamin C food with moisture, protein, fat, carbohydrates, sugars and fiber in the range of 84 to 95%, 0.6 to 2.0%, 0.2 to 0.7, 9.58 to 10.6%, 5.4 to 7.5% and 0.6 to 2.9%; respectively (**Hashimoto** and **Nagayama 2004**).

The carrot powder contains moisture 8.78%, protein 6.16%, fat 2.43% and crude fiber 24.66% (**Gazalli *et al*.**,**2013**).

Carrots are also a good source of minerals and vitamins like Ca, Fe, Na, K, Mg, Cu, Zn, carotenes, thiamine, riboflavin, niacin, vitamin C (**Arscot**&**Tanumihardioi2010** and**Sharma *et al*.**, **2012**).

The sweet potato, (*Ipomoea batatas,L.*), is a major staple crop, ranking third in the tuber roots andseventeenthin total cropproduction (**FAO**,**2015).**Thesweetpotato is commerciallyimportant because of its easy adaptability to a tropical climate and its minimal growth requirements, and it isgaininginterestduetoitsnutritional value (**Anbuselvi *et al*.,2012**).

Sweet potato (*Ipomeabatatas*, *L.*) is very important vegetable crop food in many countries including Egypt. It is a member of the family *Convolvulaceae,* in which there are over 400 Ipomea species distributed throughout the tropics, but sweet potato is the only one of economic importance. Beta-carotene-rich sweet potato (also known as orange - fleshed sweet potato) is one of a few new crops, which is both an excellent source of energy and important nutritive substances that can contribute to improve the nutrient status of the community (**Burri**, **2011**).

Sweet potatois a good source of fiber which plays a favorable role in reducing blood cholesterol level (**Woolfe**, **1992**).

Sweet potato flour can serve as a source of energy and nutrients (carbohydrate, β–carotene, pro vitamin A), minerals (Ca, P, Fe, K, and Z) and can add natural sweetness, color, flavor and dietary fiber to processed food products (**VanJaarsveld *et al*.,2005**).

Spinach (*Spinaciaoleracea,L.*) is an important leafy green vegetable that contains large quantities of bioactive compounds andnutrients, such as p-coumaric acid derivatives that exhibit strongantioxidant activity, and glucuronic acid derivatives of flavonoids(e.g. patuletin and spinacetin) that are not common to mostother vegetables (**Bergman *et al*.,2001**; **Edenharder *et al*.,2001**and **Pandjaitan *et al*.,2005**).

Spinach leaf is eaten by people mainly for its characteristic green colour, nutritional content such as carotenes, vitamin C and minerals such as calcium and iron. Bioavailability of minerals such as calcium and iron from green leafy vegetables were assessed and found to be > 25% (**Sheetal *et al*.,2006**).

The spinach powder isrich in essential minerals like calcium (1336 mg/100g), iron (30 mg/100g) and phosphorous (336 mg/100g) (**Galla *et al*., 2017**).

The beetroot species (*Beta vulgaris, L.*) is considered a good source of dietary fibre, minerals (potassium, sodium, iron, copper, magnesium, calcium, phosphorus and zinc), vitamins (retinol, ascorbic acid and B-complex), antioxidants, betalains and phenolic compounds, and possesses high nutritional value due to its high glucose content, in the form of sucrose (**Lundberg *et al*., 2008**; **van Velzen *et al*., 2008** and **United States Department of Agriculture 2013**). Several parts of beetroot is used in medicinal system such as anti-oxidant, anti-depressant, anti-microbial, antifungal, anti- inflammatory, diuretic, expectorant and carminative. It is one of the natural food which boosts the energy in athletes as it has one of the highest nitrates and sugar contents plant. (**Yadav, *et al*. 2016**).

Kale *et al*., (2018) showed that moisture content in beetroot was 87.4%, carbohydrate 7.59%, Protein 1.35%, fat 0.3%.

The red beetroot (*Beta vulgaris, L.*), largely used for the preparation of fresh and canned foods, contains significant amount of phenolic acids, such as ferulic, protocatechuic, vanillic, p-coumaric, p-hydroxybenzoic and syringic acids (**Kujala *et al*.,2000**).

In several central and eastern Europe countries red beetroot is widely utilised for the production of juice, for direct consumption or as a food colorant (**Janiszewska**, **2014**).

The objective of this work was to determine the chemical composition, minerals,physical and sensory evaluation of biscuits supplemented with some vegetable powders.

Materials and Methods

Materials

Carrot,sweet potato, spinach leaf, beetroot, wheat flour (72% extraction rate), sugar powder, margarine and baking powder were obtained from Assiut local markets, Egypt.

Sodium chloride, sodium carbonate, ammonium bicarbonate were purchased from El-Jomhouria Company of Drugs in Assiut.

Preparation of Samples

Raw (carrot,sweet potato, spinach leaf, and beetroot) were washed, remove dirt and soil. They were peeled, cut into slices and dried in an oven at 55^{o}C for 8 hours. Then the dried carrot,sweet potato, spinach leaf and beetroot were milled into flour. Samples were stored in airtight containers at 4^{o}C in the refrigerator until uses.

Technological Process

Biscuit formula and ingredients

Control biscuit dough was prepared according to the formula presented in Table (1),**(Sayed**, **2011**) . The supplemented biscuits with (carrot, sweet potato, Spinach and beetroot) powders were prepared using the same formula except for adding of 5%, 10% and 15% of four studied vegetable powders on the expense of wheat flour.

Dough preparation

Powdered sugar and margarine were creamed in Braun Mixer with a flat beater for 2 minutes. Water containing sodium chloride, sodium carbonate, ammonium bicarbonate and were added to the cream and mixed for 5 minutes to obtain a homogenous cream. Baking powder was added slowly to the flour and was mixed for 2 minutes to obtain biscuit dough (**Sayed**, **2011**).

Table (1) Biscuit formula

Ingredients	Types of biscuits (g)												
	Control	CF			SPF			SF			BRF		
		5%	10%	15%	5%	10%	15%	5%	10%	15%	5%	10%	15%
Wheat flour (g)(72% extraction)	100	95	90	85	95	90	85	95	90	85	95	90	85
Vegetable powders (g)	--	5	10	15	5	10	15	5	10	15	5	10	15
Sugar powder (g)	30	30	30	30	30	30	30	30	30	30	30	30	30
Margarine (g)	20	20	20	20	20	20	20	20	20	20	20	20	20
Sodium chloride (g)	1	1	1	1	1	1	1	1	1	1	1	1	1
Sodium carbonate (g)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Ammonium bicarbonate (g)	1	1	1	1	1	1	1	1	1	1	1	1	1
Baking powder (g)	3	3	3	3	3	3	3	3	3	3	3	3	3
Water (ml)	16	16	16	16	16	16	16	16	16	16	16	16	16

Preparation of biscuit

The dough was sheeted to a thickness of about 3 mm using Atlas Brand rolling machine. The sheeted dough was cut into round shape using a 45 mm diameter cutter and baked on an aluminium tray in an electric oven at 180°C for 6 minutes. The biscuit was cooled for 30 minutes, packed in polyethylene bags, stored under desiccation (**Vatsala** and **Haridas1991**; **Manohar** and **Rao1997**).

Preparation of different blends of biscuits

Blends of biscuits were prepared using wheat flour 72% extraction rate as control and that substituted with 5%, 10% and 15% of (carrot, sweet potato, spinach and beetroot) powders.

Methods

Physical evaluation of biscuits

Biscuits were evaluated for height (cm^3), width (cm^3), spread ratio and spread factor. Three biscuits were used for the evaluations from each of the three studied biscuits and averages were recorded. The spread ratio and spread factor were calculated according to(**Manohar** and **Rao1997**)using the following equations:

$$\text{Spread ratio} = \frac{\text{Width}}{\text{Height}}$$

$$\text{Spread factor} = \frac{\text{Spread ratio of sample}}{\text{Spread ratio of control}} \times 100$$

Sensory evaluation of biscuits

Sensory evaluation for the color, texture, taste, odor and overall acceptability were done in order to determine consumer acceptability. A numerical hedonic scale ranging from 1 to 10 (1 is very bad and 10 for excellent) was used for sensory evaluation(**Larmond**, **1977**). Ten experienced personstest the suggested biscuits.

Determination of chemicalcomposition

Moisture, crude protein, crude oil, crude fiber and ash contents were determined according to the procedures described in the(**AOAC**,**2000**). The total carbohydrates were calculated by difference according to(**Howard** and **Leonard1963**). The Caloric value was calculated using values of 4 k cal/g. of protein, 4 k cal/g. of carbohydrate and 9 k cal/g. of fat according to(**Livesy**, **1995**;**Osborne** and **Voogt1978**) .

Determination of mineral contents

The samples were wet acid-digested using a nitric acid and perchloric acid mixture (HNO_3; $HCSO_4$; 2: 1 v/v). The amounts of iron and zincin the digested sample were determined using a GBC Atomic Absorption 906 A, as described in (**AOAC**, **1990**). Potassium was determined by a flame photometer 410, calcium and magnesium contents in the samples were determined by iCAP6200 (ICP-OES) was Inductively Coupled Plasma Emission Spectrometry (**Isaac** and **Johnson1985**). Phosphorus, was determined according to the methods described by(**AOAC**, **1990**).

Statistical analysis

The data were subjected to statistical analysis of variance and treatment means were compared for significant differences using the Duncan's Multiple Range Test significant differences at p = 0.05 according to the MSTAT-C Statistical software (**Russell**, **1993**). Computer program was used to perform all the analysis of variance in agreement with the procedure outlined by (**Duncan**, **1995**).

Results and discussion

Chemical composition of raw materials

The data of chemical composition of four raw materials (Carrot, Sweet potato, spinach and beetroot) are presented in Table (2). The data revealed that there was a significant difference in moisture content(63.28%WW – 89.41% DW). While, protein content ranged from (5.25% to 28.08%) DW; (0.70% to2.97%) WW,likewise the highest protein content was recorded for spinach DW. The low level of crude oil were recorded in (carrot and sweet potato) (1.71% - 2.41%) DW; (0.21% - 0.75%) WW while, the crude fiber was significantly high (15.09% - 19.82%) DW in raw (beetroot and carrot); (2.48% - 2.15%) WW in raw (carrot and sweet potato). Ash content were (2.55%, 11.54%, 12.16% and 15.35%) DW; (0.94%, 1.53%, 1.52% and 1.63%) WW in raw (sweet potato, beetroot, carrot and spinach); respectively.The total carbohydrates content in sweet potato was high(84.31%) DW. The caloric values of raw (carrot, sweet potato, spinach and beetroot) were (280.63, 376.60, 313.94 and 305.53)and (35.05, 138.27, 33.21, 40.52)Kcal/100 g dry and wet weight matter; respectively.

Table (2):Chemical composition of raw materials on dry and wet weight basis*

Parameters	Carrot		Sweet potato		Spinach		Beet root	
	WW	DW	WW	DW	WW	DW	WW	DW
Moisture (%)	87.50	87.50	63.28	63.28	89.41	89.41	86.74	86.74
Protein (%)	0.70	5.56	1.93	5.25	2.97	28.08	1.08	8.12
Crude oil (%)	0.21	1.71	0.75	2.04	0.25	2.38	0.32	2.41
Crude fiber (%)	2.48	19.82	2.15	5.85	0.97	9.14	2.00	15.09
Ash (%)	1.52	12.16	0.94	2.55	1.63	15.35	1.53	11.54
Total Carbohydrate (%)	7.59	60.75	30.95	84.31	4.77	45.05	8.33	62.84
Caloric value (Kcal/100g)	35.05	280.63	138.27	376.60	33.21	313.94	40.52	305.53

* Mean of three replicates.
WW = Wet weight , DW = Dry weight.

Mineral contentsof raw materials

The mineral contents of four raw materials are outlined in Table (3). The results revealed that a significant differences between the four materials. As shown there were the contents of P and K in beetroot were 342.65 and 282.08 mg/100g; respectively. However,Ca and Fe content was the highest (971.20 -39.43) mg/100g in raw dry spinach. While, the lowest values of Zn and Mg were noted in carrot and sweet potato (2.05 – 93.90); respectively.

Table (3): Mineral contents ofraw materials (mg/100g) on dry weight basis*

Parameters	P	K	Ca	Fe	Mg	Zn
Carrot	335.36	50.47	151.20	17.06	117.60	2.05
Sweet potato	310.23	167.41	223.31	12.64	93.90	2.20
Spinach	339.21	195.63	971.20	39.43	1419.71	5.93
Beetroot	342.65	282.08	154.14	16.10	167.34	7.05

* Mean of three replicates.

Chemical and mineral contents of carrot powder (DW) are showed in Table (2) and (3) revealed that moisture content was 87.50%, protein 5.56%, crude oil 1.71%, crude fiber 19.82%, ash 12.16% and carbohydrates 60.75%; respectively. Mineral contents recorded the highest values in phosphor, calcium, iron and magnesium. This data is in agreement with **(Raees-ul**and **Prasad, 2015)**.

Results given in Table (2) revealed that there was an increase in moisture and carbohydrates content of raw sweet potatoDW (63.28 – 376.60%) and a decrease in the protein, crude oil and crude fiber (5.25, 2.04 and 5.85%). This data is close agreement with (**Alloush**, **2015**). The mineral contents of raw sweet potatoof phosphor, potassium, calcium, iron,magnesium and zinc were(310.23, 167.41, 223.31, 12.64, 93.90 2.20) mg/100g.

Chemical and mineral contents of raw spinach powder are presented in Table (2) and (3). Spinach powder possessed good quantities of protein 28.08%, fiber 9.14% along with minerals such as calcium 971.20 mg/100g, iron 39.43 mg/100g and phosphorus 339.21 mg/100g. Additionof spinach (5, 10, 15%) increased the amounts of protein, minerals and fiber in biscuits when compared to control. The data is in agreement with (**Filip** and **Vidrih**, **2015**).

Results in Table (2) indicated that moisture content was 86.74%, crude oil 2.41%, protein 8.12%, carbohydrates 62.84%, crude fiber 15.09% and ash 11.54% in dry raw beetroot.The mineral contents of beetroot were analyzed and results revealed that phosphor was 342.65, potassium 282.08, calcium 154.14, iron 16.10, magnesium 167.34 and zinc 7.05 (mg/100g); respectively. Results reported are disagreement with (**Odoh** and **Okoro2013**; **Kale*et al.*, 2018**).

Table (4): Chemical composition of supplemented biscuits on dry weight basis*

Samples	Moisture	Protein	Crude oil	Crude fiber	Ash	Total Carbohydrate	Caloric value (K call/100g)
Control	6.57±0.13[c]	7.35±0.03[c]	17.16±0.12[e]	1.64±0.07[g]	2.43±0.06[d]	71.42±2.04[a]	469.52±12.89[b]
5% CF	7.60±0.16[b]	6.13±0.03[g]	17.67±0.03[c]	2.20±0.01[d]	3.01±0.02[b]	70.99±5.06[a]	467.51±15.89[c]
10% CF	6.89±0.18[c]	6.38±0.05[e]	17.32±0.04[d]	2.36±0.05[c]	3.24±0.03[b]	70.70±4.23[a]	464.20±14.87[d]
15% CF	7.37±0.11[b]	6.42±0.07[e]	18.21±0.02[a]	2.71±0.06[b]	3.36±0.04[a]	69.30±4.90[b]	466.77±12.78[e]
5% SPF	6.74±0.17[c]	6.25±0.03[f]	18.25±0.01[a]	2.00±0.01[e]	2.51±0.02[d]	70.99±3.89[a]	473.21±7.56[a]
10% SPF	8.17±0.23[a]	6.39±0.02[e]	18.31±0.02[a]	2.06±0.03[e]	2.49±0.01[d]	70.75±6.09[a]	473.35±10.56[a]
15% SPF	8.30±0.27[a]	6.51±0.04[e]	18.30±0.04[a]	2.29±0.01[c]	2.52±0.02[d]	70.38±4.23[a]	472.26±16.56[a]
5% SF	5.20±0.16[e]	7.03±0.03[d]	18.23±0.10[a]	2.17±0.04[cd]	3.01±0.02[b]	69.56±4.87[b]	470.43±14.67[b]
10% SF	4.91±0.11[f]	8.56±0.02[b]	18.28±0.02[a]	2.83±0.03[b]	3.20±0.03[b]	67.13±4.23[c]	467.28±16.45[c]
15% SF	4.93±0.09[f]	9.03±0.08[a]	18.34±0.02[a]	3.68±0.05[a]	3.71±0.02[a]	65.24±4.13[d]	462.14±14.55[e]
5% BRF	5.78±0.06[e]	6.01±0.01[g]	17.92±0.03[b]	2.36±0.02[e]	2.81±0.02[c]	70.90±5.45[a]	468.92±13.49[b]
10% BRF	6.21±0.13[d]	6.39±0.02[e]	17.36±0.02[d]	2.59±0.06[bc]	2.99±0.04[c]	70.67±3.67[a]	464.48±5.15[d]
15% BRF	5.54±0.07[e]	6.93±0.03[d]	17.69±0.02[c]	2.17±0.02[cd]	3.16±0.03[b]	70.05±4.56[a]	467.13±6.89[c]

* Mean of three replicates.

Means followed by the same small letter, within the same column, do not significantly different at 0.05 level of probability.

The chemical composition of wheat biscuits and supplemented biscuits with the four vegetable powders are presented in Table (4). The data showed that there were significant differences in moisture, protein, crude oil, crude fiber, ash, total carbohydrates and caloric values. The protein content in 5%, 10%, 15% SF was significantly ($p<0.05$) higher than all other supplemented biscuits, this results could be due to higher content of protein in SF compared to other samples, so the addition of the other three vegetable powders to biscuits led to reduction of protein content.Thecrude fiber content in supplemented biscuits with 15% SF was significantly ($p<0.05$) higher when compared with control. The data revealed that all supplemented biscuits with four vegetable powders were decreased in total carbohydrates compared with the control.

Mineral contents of supplemented biscuits

The mineral contents of wheat biscuits and supplemented biscuits with four vegetable powders are outlined in Table (5). The data indicated that there was significant varietal effect on P, K, Ca, Fe, Mg and Zn. The abundant minerals in the studied samples were P and Ca with values ranging from 319.25 – 372.01 and 71.76 – 210.58 mg/100g; respectively. Followed by K and Mg 58.24 – 181.63 and 49.20 – 150.31 mg/100g while Fe and Zn were ranged from 41.34 to 55.08 and 1.75 to 2.89 mg/100g.

The increase in P, Ca, K and Mg contents in blended biscuits may be a result of blending different levels of vegetable powders.

Table (5): Mineral contents of supplemented biscuits on dry weight basis*

Samples	P	K	Ca	Fe	Mg	Zn
Control	330.26±2.10[e]	61.76±1.51[g]	153.59±7.40[f]	55.08±2.67[a]	58.70±1.92[f]	2.92±0.02[c]
5% CF	340.14±2.45[d]	58.24±2.40[h]	71.76±2.78[l]	46.07±1.34[e]	49.20±1.93[h]	5.02±0.01[b]
10% CF	357.10±1.89[b]	60.92±0.6[g]	80.26±3.54[h]	47.36±1.23[d]	52.14±1.43[g]	5.21±0.01[a]
15% CF	372.01±2.78[a]	63.10±1.06[g]	91.13±4.52[f]	49.67±1.94[b]	56.05±2.31[f]	5.29±0.05[a]
5% SPF	339.36±2.54[d]	114.61±1.78[e]	147.85±5.47[g]	46.91±1.38[e]	49.90±1.04[h]	5.07±0.02[b]
10% SPF	346.21±1.65[c]	119.68±2.65[d]	159.64±3.78[e]	47.21±1.74[d]	53.21±2.09[g]	5.19±0.03[a]
15% SPF	351.02±2.75[b]	127.25±4.76[d]	166.24±4.65[d]	48.36±2.81[c]	57.64±1.94[f]	5.24±0.02[a]
5% SF	342.10±1.89[d]	90.04±5.23[f]	173.16±4.56[c]	41.78±0.03[j]	127.63±4.56[b]	2.40±0.01[e]
10% SF	349.14±2.62[c]	110.24±4.09[e]	189.36±4.56[b]	43.10±1.76[h]	130.14±4.45[b]	2.73±0.03[d]
15% SF	355.92±1.45[b]	119.39±6.34[d]	210.58±4.07[a]	44.90±1.97[g]	150.31±4.84[a]	2.89±0.04[c]
5% BRF	319.25±2.82[f]	160.71±2.97[c]	76.68±3.05[l]	41.34±1.67[j]	69.74±2.07[e]	1.75±0.03[g]
10% BRF	330.12±1.81[e]	172.20±2.78[b]	82.40±2.97[h]	42.67±1.31[l]	75.24±3.93[d]	1.91±0.02[f]
15% BRF	339.67±2.29[d]	181.63±3.05[a]	89.08±4.23[f]	43.10±1.58[g]	79.96±2.34[c]	2.01±0.02[f]

* Mean of three replicates.

Means followed by the same small letter, within the same column, do not significantly different at 0.05 level of probability.

Sensory evaluation of supplemented biscuits

Table (6) show the sensory evaluation result of the biscuit 100% (control sample) and samples supplemented with four vegetable powders at different levels (5, 10 and 15%). The score for sensory attributes, color, texture, taste, odor and overall acceptability of biscuits differed significantly ($p<0.05$) between the samples. These variations are actually related to the amount of vegetable powders added. As shown in Table (6) the biscuits made from 5% of SPF, CF recorded higher acceptability with scores 34.20 and 33.80; respectively.

Table (6): Sensory evaluation of supplemented biscuits

Samples	Color (10)	Texture (10)	Taste (10)	Odor (10)	Overall acceptability (40)
Control	9.30±0.06[a]	9.20±0.04[a]	9.50±0.89[a]	9.20±0.04[a]	37.20±2.09[a]
5% CF	8.60±0.03[b]	8.50±0.04[c]	8.70±0.65[c]	8.00±0.03[c]	33.80±1.06[c]
10% CF	8.40±0.03[d]	8.30±0.03[f]	8.40±0.39[f]	7.90±0.05[d]	33.00±2.05[d]
15% CF	8.00±0.03[g]	8.00±0.70[g]	8.30±0.38[g]	7.80±0.06[e]	32.10±0.12[f]
5% SPF	8.70±0.03[b]	8.60±0.45[b]	8.80±0.45[b]	8.10±0.04[b]	34.20±1.32[b]
10% SPF	8.50±0.02[c]	8.50±0.34[c]	8.50±0.38[e]	8.00±0.07[c]	33.50±2.65[c]
15% SPF	8.10±0.04[f]	8.40±0.42[d]	8.40±0.56[f]	8.00±0.06[c]	32.90±2.04[d]
5% SF	8.00±0.03[g]	7.50±0.72[i]	7.90±0.58[h]	7.80±0.05[e]	31.20±2.41[g]
10% SF	8.10±0.02[f]	7.30±0.48[j]	7.80±0.73[i]	7.60±0.05[f]	30.80±2.06[h]
15% SF	8.30±0.04[e]	7.00±0.51[k]	7.60±0.37[i]	7.40±0.05[f]	30.30±1.34[i]
5% BRF	8.10±0.02[f]	8.40±0.34[d]	8.50±0.61[e]	7.90±0.03[d]	32.90±2.28[d]
10% BRF	8.40±0.06[d]	7.90±0.78[h]	8.60±0.74[d]	7.70±0.24[g]	32.60±1.96[e]
15% BRF	8.60±0.03[b]	7.70±0.23[i]	8.40±0.82[f]	7.10±0.12[h]	31.80±2.04[f]

Means followed by the same small letter, within the same column, do not significantly different at 0.05 level of probability.

Most vegetables are commonly cooked before consumption, and the texture and color are considered very important parameters in the cooking quality of vegetables. By cooking, some beneficial effects can be obtained such as an increase in food safety by destroying microorganisms, enhancement of the food digestibility, and formation of desired compounds. However, damaged food quality that causes losses of certain nutrients, formation of undesired compound, and loss of texture can also occur (**Palermo*et al*., 2014**).

Galla*et al*., (**2017**) reported that biscuits were prepared using 5%, 10% and 15% spinach powderand evaluated for their nutritional, textural, sensory quality and sorption behaviors, textural quality revealed that hardness and breaking strengths increased with increased addition of SF. Sensory studied of biscuits showed that 5% supplementation of spinach powder was more acceptable.

Colour parameters varied widely on increasing addition of spinach. Likewise, darkening of products may be due to browning of spinach carbohydrates during baking (**Parul*et al*.**, **2015**).

The addition of red beetrootpomace extracts on antioxidant properties, heat damage and colour of einkorn water biscuits enriched withpseudocereals showed significantly improve some nutritionalcharacteristics of baked products (**Hidalgo *et al*.**, **2018**).

Physical evaluation ofsupplementedbiscuits

The mean values of physical evaluation of wheat biscuits and supplemented wheat biscuits with four vegetable powders are presented in Table (7) and figures 1 – 4. The data recorded a gradual increment of spread ratio of both 10% and 15% supplemented wheat biscuits with four vegetable powders (CF, SPF, SF and BRF) as compared with control. Results given in Table (7) indicated that it increased from (105.17, 105.17, 106.89 and 127.15) for 15% and from (89.05, 90.51, 106.89 and 133.62) for 10%. Supplementedwheat biscuits increased from (103.44, 103.44, 105.17 and 106.89)for 5% with (CF, SPF, SF and BRF) powders; respectively. These variations in baking properties may be due to the changes in the quality and quantity of raw vegetables powders which added to the ingredients.

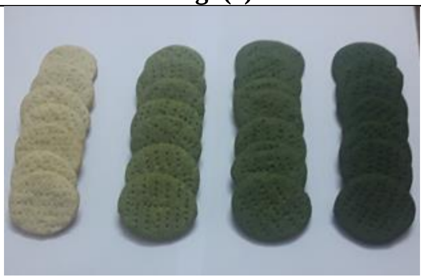
Table (7): Physical evaluation of supplemented biscuits

Physical evaluation	control	Carrot (CF)			Sweet potato (SPF)			Spinach (SF)			Beetroot (BRF)		
		5%	**10%**	**15%**	**5%**	**10%**	**15%**	**5%**	**10%**	**15%**	**5%**	**10%**	**15%**
Width	5.8	6	6.2	6.1	6	6.3	6.1	6.2	6.2	5.9	6.1	6.2	6.2
Thickness	0.5	0.5	0.4	0.5	0.5	8.6	0.5	0.5	0.6	0.4	0.5	0.5	0.5
Spread ratio	11.6	12	15.5	12.2	12	10.5	12.2	12.4	10.33	14.75	12.2	12.4	12.4
Spread factor	100%	103.44	133.62	105.17	103.44	90.51	105.17	106.89	89.05	127.15	105.17	106.89	106.89

Supplemented Biscuits

Control 5% 10% 15%
(CF) (CF) (CF)
Fig. (1)

Control 5% 10% 15%
(SPF) (SPF) (SPF)
Fig. (2)



Control 5% 10% 15%
(SF) (SF) (SF)
Fig. (3)

Control 5% 10% 15%
(BRF)(BRF) (BRF)
Fig. (4)

Control= 100% wheat flour. 72% extraction biscuits.
CF = 5%, 10%, 15% carrot powder supplemented wheat biscuits.
SPF = 5%, 10%, 15% sweet potato powder supplemented wheat biscuits.
SF = 5%, 10%, 15% spinach powder supplemented wheat biscuits.
BRF = 5%, 10%, 15% beetroot powder supplemented wheat biscuits.

Conclusion

The present study revealed that the chemical composition of four vegetable powders (CF, SPF, SF, BRF) recorded the highest values in protein, carbohydrates, dietary fiber and mineral contents such as (P, K, Ca, Fe, Mg, Zn). That may protect the body against free radical scavengers and contribute to the improvement of the nutritional status of the consumers. Sensory evaluation of biscuits blended with different levels (5, 10, 15%) of four vegetable powders (carrot, sweet potato, spinach and beetroot) shows that biscuits blended with5% of SPF and CF were most acceptable among the panelists due to their sweet taste.

References

Alloush, S.A. (2015): Chemical, Physical and Sensory Properties of Sweet Potato Cake, Egypt, J. Agric. Res., 93 (1): 101 – 115.

Anbuselvi, S.; Kumar, M. S.; Selvakumar, S.; Rao, M. R. K. and Dash, A. (2012): A comparative study on biochemical constituents of sweet potatoes from Orissa and Tamilnadu and its curd formation. J. Chem. Pharm. Res., (4): 4879–4882.

AOAC (1990): Official Methods of Analysis. 16th ed. Association of Official Aalysis Chemists. Washington D. C.

AOAC (2000): Association of Official Analytical Chemists. Official Methods 965.33. Official Methods of Analysis,17th Ed., Gaithersburg, MD.

Arscot, S.A. and Tanumihardio, S.A. (2010): Carrots of many colors provide basic nutrition and bioavailable phytochemicals acting as a functional food. Comprehensive Review in Food Science and Food Safety, 9 (2): 223 – 239.

Bergman, M.; Varshavsky, L.; Gottlieb, H. E. and Grossman, S. (2001): The antioxidantactivity of aqueous spinach extract: chemical identification of active fractions.Phytochemisty, (58): 143–152.

Burri, B. J. (2011): Evaluating sweet potato as an intervention food to prevent vitamin A deficiency. Compr. Rev. Food Sci. Food Safety, (10): 118-130.

Bystricka, J.; Kavalcova, P.; Musilova, J.; Vollmannova, A.; Toth, T. and Lenkova, M. (2015): Carrot (*Daucuscarota*, *L. ssp. Sativus* (Hoffm.) Arcang.) as source of antioxidants, Acta agriculture Slovenica, 105 (2): 303 – 311.

Duncan, B. D. (1995): Multiple ranges and multiple F test. Biometrics (11): 1-42.

Edenharder, R.; Keller, G.; Platt, K. L. and Unger, K. K. (2001): Isolation and characterization of structurally novel antimutagenic flavonoids from spinach (*Spinaciaoleracea*). J. Agric. Food Chem., (49): 2767–2773.

FAO (2015): Statistical Database. Food and Agriculture Organization of the United Nations. Available from: http://www.faostat.fao.org (retrieved 02.02.15).

Filip, S. and Vidrih, R. (2015): Amino acid composition of Food Technol. Biotechnol., 53 (3): 298 – 306.

Galla, N.R.; Pamidighantam, P.R.; Karakala, B.; Gurusiddaiah, M.R. and Akula, S. (2017): Nutritional, textural and sensory quality of biscuits supplemented with spinach (*Spinaciaoleracea L.*), International Journal of Gastronomy and Food Science, (7): 20 - 26.

Gazalli, H.; Malik, A.H.; Jalal, H.; Afshan, S. and Ambreen, M. (2013): Proximate composition of carrot powder and apple pomace powder, Intern. J. Food Nutri. Safety, 3 (1): 25 – 28.

Hashimoto, T. and Nagayama, T. (2004): Chemical composition of ready to eat fresh carrot, J. Food Hygien, Soc. Japan, (39): 324 – 328.

Hidalgo, A.; Brandolini, A.; Canadanovic-Brunet, J.; Cetkovic, G. and Saponjac, V.T. (2018): Microencapsulates and extracts from red beetroot pomace modify antioxidant capacity, heat damage and colour of pseudocereals-enriched einkorn water biscuits, Food Chemistry, (268): 40 – 48.

Howard, O., and Leonard, W. A. (1963): Food Composition and Analysis. Van Nostrond Reinhold Company (VNR). New York.

Isaac, R.A. and Johnson, W.A. (1985): Elemental Analysis of Plant Tissue by Plasma Emission Spectroscopy: Collaborative Study. J. Assoc. Off. Anal. Chem., 68 (3): P499.

Janiszewska, E. (2014): Microencapsulated beetroot juice as a potential source of betalain. Powder Technology, (264): 190–196.

Kale, R.G.; Sawate, A.R.; Kshirsagar, R.B.; Patil, B.M. and Mane, R.P. (2018): Studies on evaluation of physical and chemical composition of beetroot (*Beta vulgaris L.*), International Journal of Chemical Studies, 6 (2): 2977-2979

Kujala, T. S.; Loponen, J. M.; Klika, K. D. and Pihlaja, K. (2000): Phenolics and betacyanins in red beetroot (Beta vulgaris) root: Distribution and effect of cold storage on the content of total phenolics and three individual compounds. Journal of Agricultural and Food Chemistry, (48): 5338–5342.

Larmond, E. (1977): Laboratory Methods for Sensory Evaluation of Food. Canadian Government Publishing Center. Ottawa.

Livesy, G. (1995): Metabolizable energy of macro-nutrients. Am. J. Clin. Nutr., (62) (Suppl.) – 11355 – 11425.

Lundberg, J.O.; Weitzberg, E. and Gladwin, M.T. (2008): The nitrate-nitrite-nitric oxide pathway in physiology and therapeutics. Nature Reviews Drug Discovery, (7):156-167.

Manohar, R. S. and Rao, P. H. (1997): Effect of mixing period and additives on the rheological characteristics of dough and quality of biscuits. J. of Cereal Sci., (25): 197 – 206.

Odoh, U. E. and Okoro, E. C. (2013): Quantitative photochemical, proximate / nutritive composition analysis of Beta vulgaris Linnaeus (*ChenopodiaCeae*). International Journal of Current Research, 5 (12): 3723 – 3728.

Osborne, D. R. and Voogt, P. (1978): The analysis of nutrients in foods. Academic Press. INC. London. GB.

Palermo, M.; Pellegrini, N. and Fogliano, V. (2014): The effect of cooking on the phytochemical content of vegetables, Journal of the Science of Food and Agriculture, 94 (6): 1057 – 1070.

Pandjaitan, N.; Howard, L. R.; Morelock, T. and Gil, M. I. (2005): Antioxidant capacity and phenolic content of spinach as affected by genetics and maturation. J. Agric. Food Chem., (53): 8618–8623.

Parul, S.; Rakhi, S.; Alok, J.; Prasad, R. and Anuj Kumar, G. (2015): Optimization of a process for high fibre and high protein biscuit, J. Food Sci. Technol., 52 (3): 1394 – 1403.

Pojer, E.; Mattivi, F.; Johnson, D. and Stockley, C. S. (2013): The case for anthocyanin consumption to promote human health: A review. Comprehensive Reviews in Food Science and Food Safety, 12 (5): 483–508.

Raees-ul, H. and Prasad, K. (2015): Nutritional and processing aspects of carrot (*Daucuscarota*) – A review, South Asian J., Food Technol. Environ., 1 (1): 1 – 14.

Russell, D. F. (1993): MSTAT Director crop and soil sciences department, Michigan State University, Version 2.10.

Sayed, A. M. A. (2011): Biochemical and Technological Studies on Barley Talbina. M. Sc. Thesis. Faculty of Agriculture. Assiut university.

Sharma, K.D.; Karki, S.; Thakur, N.S. and Attri, S. (2012): Chemical composition, functional properties and processing of carrot – a review, J. Food Sci. Technol., 49 (1): 22 – 32.

Sheetal, G.; Jyothi, L. and Jamuna, P. (2006): In vitro bioavailability of calcium and iron from selected green leafy vegetables. J. Sci. Food Agric., 86 (13): 2147–2152.

United States Department of Agriculture (2013): USDA National Nutrient Database for Standard Reference [Internet]. Available from: http://ndb.nal.usda.gov/ndb/foods/ list [10 February 2017].

Van Jaarsveld, P.J.; Faber, M.; Tanumihardjo, S.A.; Nestel, P.; Lombard, C.J. and Benadé, A.J.S. (2005): β–carotene-rich orange-fleshed sweet potato improves the vitamin A status of primary school children assessed with the modified-relative-doseresponse test. Am. J. Clin. Nutr., (81): 1080-1087.

van Velzen, A.G.; Sips, A.J.; Schothorst, R.C.; Lambers, A.C. and Meulenbelt, J. (2008): The oral bioavailability of nitrate from nitrate-rich vegetables in humans. Toxicology Letters, (181): 177-181.

Vatsala, C. N., and HaridasRao, P. (1991): Studies on invert sugar for use in biscuits. J. Food Sci. and Techn., (28): 149 – 152.

Wallace, T. C. (2011): Anthocyanins in cardiovascular disease. Advances in Nutrition: An International Review Journal, 2 (1): 1–7.

Woolfe, J.A. (1992): Sweet potato: An Untapped Food Resource. Cambridge University Press, Cambridge, 292 – 389.

Yadav, M.; Chawla, H.; Parle, M. and Sharma, K. (2016): Beetroot: A Health Promoting Functional Food. Inventi Rapid: Nutraceuticals, (1): 1-5.

التركيب الكيميائي والتقييم الفيزيائي والحسي للبسكويت المخلوط بمساحيق بعض الخضروات

هند محمد علي، زينب سيد أحمد أحمد
أستاذ مساعد تغذية وعلوم الأطعمة - كلية التربية النوعية - جامعة أسيوط
مدرس تغذية وعلوم الأطعمة- كلية التربية النوعية - جامعة أسيوط

الملخص العربي

تهدف هذه الدراسةتقدير التركيب الكيميائي والسعراتالحرارية والعناصر المعدنية والتقييم الفيزيائي والحسي للبسكويت المدعم بمساحيق بعض الخضرواتكالجزر والبطاطا والسبانخ والبنجر. ففي عينات البسكويت تم استبدال دقيق القمح بمساحيق بعض الخضروات بنسب 5% و 10% و 15%. وقد أظهرت النتائج أن التركيب الكيميائي العام للسبانخ سجل أعلى نسبة في البروتين (28,08%) بينما سجل الجزر أعلى نسبة في الألياف الخام (19,82%) يليه البنجر (15,09%) كما سجلت البطاطا أعلى نسبة في الكربوهيدرات الكلية (84,31%) على أساس الوزن الجاف. وكان محتوى المعادن في العينات محل الدراسة كالآتي:الفسفور 310,23 - 342,65 والبوتاسيوم 50,47 - 282,08 والكالسيوم 151,20 - 971,20 والحديد 12,64 - 39,43 والماغنسيوم 93,90 - 1419,17 والزنك 2,05 - 7,05 ملجم / 100 جم وزن جاف.

وأظهرت النتائج أن البسكويت المدعم بـ 10% و 15% من مسحوق السبانخ سجل أعلى نسبة في البروتين والألياف الخام بينما البسكويت المدعم بمساحيق الجزر والبطاطا والبنجر سجل أعلى نسبة في الكربوهيدرات الكلية. كما لوحظ وجود اختلافات معنوية في محتوى العناصر المعدنية للبسكويت المدعم بمساحيق بعض الخضروات. وكذلك أظهرت معدلات التقييم الحسي إرتفاعاً معنوياً في البسكويت المدعم بـ 5% من مسحوق البطاطا والجزر عند المقارنة بالعينة الضابطة. وبالتالي أوضحت نتائج الدراسة الحالية أن مساحيق بعض الخضروات تعتبر مصدر هام للكالسيوم والماغنسيوم والفسفور والبوتاسيوم والحديد والبروتين والألياف الخام وبالتبعية فإنه يمكن التوصية بالإستفادة من مساحيق الخضروات الأربعة لرفع القيمة الغذائية للمنتجات.

الكلمات المفتاحية: التركيب الكيميائي - البسكويت - الجزر - البطاطا - السبانخ - البنجر.