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Production of high nutritional value crackers from some processed vegetables

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Abstract

Vegetables are critical to good health, and certainly good for all age categories as it forms an important portion of a healthy diet. Nutritional, chemical composition, physical properties and sensory quality characteristics of vegetables crackers made by mixing wheat flour and fresh, puree and dried for carrot, beetroots and turnip leaves were studied. Wheat flour and puree of turnip leaves, carrot and beet and their powder were mixed in the ratio of 100:00, 90:10 and 80:20 individually. The results showed a significant increase in the antioxidant activity in carrots, beets and fresh turnip leaves, and its decrease after processing (puree and dried). It was noted through this study that the total flavonoids were higher in the puree samples than the fresh ones. Turnip leaf showed a significant increase in phenols and total flavonoids in the case of pureed and dried samples. There were slight significant changes in the betalains and carotenoids pigment in beets and carrot after boiling and drying, respectively and the changes were not noticeable in the state of chlorophyll after boiling and drying in turnip leaves. The content of protein and fiber were significantly increased in samples containing turnip leaves, as well as iron, zinc, phosphorous and calcium in samples containing beets and turnip leaves. These crackers meet a large percentage of the daily needs of these minerals for children from 4 to 8 years old. We conclude from the results of sensory tests that replacing wheat flour with different percentages of dried turnip leaves improved the sensory properties of crackers compared to boiled turnip leaves, while boiled carrots and beet roots were better in sensory evaluation than dry ones.

Key words: beet roots, carrot, turnip leaves, crackers, physical properties, pigments
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Introduction

Plant-based food contains significant amounts of bioactive compounds, which provide desirable health benefits beyond basic nutrition. Epidemiological evidence suggest that consumption of a diet rich in vegetables has positive implications for human health. In last decades, special attention has been paid towards edible plants especially those are rich in secondary metabolites called phytochemicals. **(Joanne and Beate 2012)**. Beetroots (*Beta vulgaris* L) is a crop belonging to the Chenopodiaceae family having bright crimson color. It

is famous for its juice value and medical properties as reported by **Liliana and Oana-Viorela (2020).** Today, beetroot is grown in many countries worldwide, regularly consumed as part of the normal diet, and commonly as part of the normal diet, and commonly used in manufacturing as a food coloring **(Clifford *et al*., 2015)** are a rich source of potent antioxidant and minerals including magnesium, potassium and iron, the molecule beta line which is considered and antioxidant composite is important for cardiovascular health, they can be eaten raw, boiled, steamed and roasted. Beetroot contains a lot of antioxidants, vitamins (A, C, B) fiber and natural dyes. Red beet roots also rich in phenol compounds, which have antioxidant properties. Also, Red beet extract could be a good natural colorant (betalains pigment) in food industries as candy products (jellies, ice sherbets, and gelatin/gellan based gummy candy), processed meat products and bakery products (biscuits fortified with red beetroot powder as reported by **Amnah, (2013)**. Carrot (*Daucus carota* l.) is the most important crop of family Apiaceae. Also ,good source of antioxidants vitamins and minerals because of the huge amount of beta carotene included in the roots which gives the lovely orange color. It's an inexpensive yet highly nutritious as it contains appreciable amount of B_1, B_2, B_6, and B_{12} besides being rich in carotene and fiber **(Haq and Prasad 2015).** Carrot is a root vegetable with carotenoids, flavonoids, polyacetylenes, vitamins, and minerals, all of which possess numerous nutritional and health benefits .A rapid rise in the popularity of orange carrots was observed with the recognition of its high pro vitamin A content (**Sule and Abu 2017**). Like many other colored vegetables, carrot is a gold mine of antioxidants. Carotenoids widely distributed in orange carrots are potent antioxidants, which can neutralize the effect of free radicals. They have been shown to have inhibition mutagenesis activity contributing to decrease risk of some cancers. The crops of leafy vegetables considered the important crops because these contain amounts of vitamins and minerals for people. Low intake of leafy vegetables leads to a lack of vitamins and minerals especially iron as reported by **Pallavi and Beena, (2010)**. Also, vegetables and vegetables wastes have got important constituents of the diet and provide qualities of nutrients, especially vitamins, minerals and fiber. Since low consumption of green leafy vegetables in diet is one of the major factors, which leads to deficiency of vitamins A and iron**.** Turnip (*Brassica rapa*) the dark-green leafy tops of the turnip plant (*brassi carapa*) are known as turnip greens. In terms of vitamins, minerals, and health promoting antioxidants, the greens have higher nutritional profile than the tuber itself. As they provide sufficient quantities of vitamins and minerals to humans, green leafy

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vegetables occupy a significant position among food crops. They are a rich source of vitamins such as carotene, ascorbic acid, folic acid, riboflavin, and calcium, iron and phosphorous **(Palafox-Carlos *et al.*, 2011)**. Being rich in nutrients, it's possible to use vegetables leaves to enrich inferior/ deficient nutritional goods. **(Tripathi and Yadav, 2021).** Make a great addition to the vegetables garden both the root and tops, turnip greens, can be eaten. While turnip and turnip greens are not as common as many other vegetables , they are one of the oldest known vegetables ,they were used in middle ages for their nutritional value and even as treatment for health conditions. Green leafy vegetables occupy an important place among the food crops as these provide adequate amounts of many vitamins and minerals for human. They are rich source of carotene, vitamins and minerals like calcium, iron and phosphorous increase the per casita availability of foods. In this work, beet roots, carrot and turnip leaves powders and puree individually were used in fortification of crackers formula, with the aim of benefiting from agricultural turnip wastes, and some vegetables are rich with natural color and also to develop crackers with good acceptability and to evaluate the effects of fortification of beet roots, carrot and turnip leaf powder and their puree on the physical, chemical and sensory properties of the crackers.

Materials and Methods

Raw materials

Wheat flour (72% extraction rate), carrot, beet roots, turnip leaves, skimmed milk and the other ingredients (salt, ground cumin, sodium bicarbonate, starch and oil) required for the preparation of crackers were obtained from the local market, Giza, Egypt. All chemicals and reagents utilized during this study were analytical grade and purchased from El-Gomhouria Co. for Chemical, Giza, Egypt.

Preparation of raw materials

Carrot, beet roots and turnip leaves (waste) were washed under running tap water to eliminate dust and other foreign particles then cut into small pieces. These slices were boiled in a small amount of water until they become soft and chopped using kitchen machine (Braun, Combi Max 700) to get a smooth puree. Carrot, beet roots vegetables and turnip leaves (waste) were washed then cut thin slices and dried at 50˚C in an air oven for 24 hours. Dry slices (carrot and beet) and turnip leaves were pulverized using domestic grinder and sifted

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through sieve of 72 (210 µm) mesh and packed in airtight polypropylene jar and stored in cool and dry place.

Preparation of crackers blends

Crackers were prepared according to the method of by **Kuchtova *et al.*, (2016)**. Substitution of refined wheat flour with carrot, beet and turnip leaves powder and puree were done at different levels *viz.* 5%, 10%, 15%, 20%, 25% and 30%. The best proportions in terms of sensory evaluation were 10 and 20%. First, wheat flour (w/w), starch (5gm), salt (2gm), sodium bicarbonate (2gm), ground cumin as flavor (1gm) and skimmed milk (5gm) were mixed, then added water and sunflower oil (10gm). Leavening agents were added to the blend and mixed manually for 3 min. It mixture was added to the tested puree or powder (as individually) and added an amount of water as needed and kneaded for 5 min. The dough was sheeted and stamped out in a circular shape having a thickness of few mm and around 20 mm diameter using a biscuit cutter. The cut mass was transferred to a greased baking tray and baked in the oven (Binder, ED23, Germany) at 180ºC for 20 min and crackers were cooled

Nutritional composition

The Moisture content, protein content, ash content, fat content, crude fiber in raw, puree and dried of carrot, beet roots, turnip leaves and in different crackers samples were determined as per standard methods **(AOAC, 2016)**. Total carbohydrates value was obtained by subtracting total of moisture, protein, fat, crude fiber and ash content from 100.Total carbohydrate was calculated by difference. Total calories were determined as mentioned by **James (1995)** according to the equation

Total calories= 4 (%protein + %carbohydrates) + 9 (% fat).Mineral contents (iron (Fe), zinc (Zn), calcium (Ca), and phosphorus (P) were determined using by Agilent Technologies (model 4210 MP-AES), atomic absorption spectrophotometer instrument as described by the **AOAC. (2019)** method. Relative percentage of daily requirement for minerals in 100 gm of crackers on dry weight compare with **Recommended Dietary Allowances (2011)** for children age, 4-8 years

Physical properties of prepared crackers

The following physical properties were carried out according to the methods of **AACC (2004)**:-

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1- Weight was recorded by using sensitive balance (0.1 gm).

2- Weight was determined by rape seeds displacement method.

3- Specific weight was calculated by using the following equation

$$\text{Specific weight} = \frac{\text{Weight (cm3)}}{\text{Weight (gm)}}$$

Shear force was measured using A matek universal testing machine Model LRK3339-3(NTS technology CO., LTD.) equipped with LRK desktop microcomputer (a65-500 series).Each sample was sheared five time and the sample was cut with a special cutter (1.0 mm thickness and 6.5 mm wide), **(El-Akel,1993**).

Determination of total phenols

Total phenols content decided using folin consistent with the tactic described by **Cosmulescu and Trandafir (2012)**.Absorbance was detected with a spectrophotometer at 765 nm. Results were compared to gallic acid standard and expressed as mg gallic acid equivalents/100 gm sample.

Determination of total flavonoids

Total flavonoids for the tested materials were determined using the aluminium nitrate colorimetric method described by **Cosmulescu*et al.* (2015).** Absorbance was measured at 510 nm against a blank and results were compared to a catechin standard and expressed as mg of catechin equivalents/100 gm sample.

Determination of antioxidant

The antioxidant action of the tested samples (carrot, beet roots and turnip leaves for fresh, puree and dried, individually) were examined on the basis of the scavenging effect on the stable DPPH radical activity. This method consistent with **Braca*et al.* (2002),** it had been supported the reduction of alcoholic DPPH solutions within the presence of a hydrogen

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donating antioxidant that displays a robust optical absorption band at 517 nm and deep violet color appears.

Determination of chlorophyll content

Total chlorophyll was appreciated from turnip leaves (fresh, puree and dried) and their crackers by multiple solvents and measured by using spectrophotometric method as given by **Gogoi and Basumatary, (2018).**

Determination of total betalains

The betalains was extracted from red beet (fresh, puree and dried) and their crackers by diluted with distilled water and measurements were carried out at wavelength of 535 nm and the quantification was expressed as mg betalains/ 100g using the following equation as determined by **Castellar *et al*., (2003)**. Total betalains content (mg/100g) = A× DF× MW×1000/€L. Where: A=Absorption value at 535 nm density, DF=Dilution volume, MW=Molecular weight of betalain (550g/mol), L=Path length of cuvette and €= The extinction coefficient for betalain 60000 L/mol.

Determination of total carotene

Total carotene content of fresh, puree and dried carrot and their crackers samples were calculated consistent with the **Nagata and Yamashita, (1992)**, equation**:** β-Carotene (mg /100 gm)= (0.216 x OD 663 - 1.22 x OD 645 - 0.304 x OD 505+ 0.452 x OD 453), OD = absorbance by using spectrophotometer.

Sensory evaluation

The method of **Akonor*et al*., (2016)** was carried out by the evaluation of six sensory characteristics (color, flavor, smell, appearance, crispiness and overall acceptability) of the different crackers samples (puree and dried vegetables), where 10 will-trained panelists independently assigned scores for each sensory characteristic on a 10-point category scale.

Statistical analysis

Data of sensorial evaluation was subjected to analysis of variance (ANOVA) followed by Duncan's multiple range tests administered using SPSS statistical (Version 10). Values were

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expressed as mean± SE. P value p< 0.05 was considered significant **(Snedecor and Cochran 1980).**

Results and discussion

The effect of treatments on the phytochemical and chemical composition of selected materials

Flavonoids are natural polyphenols of plant origin. They have antioxidant, antinflammatory and anticarcinogenic properties **(Bonaccorsi *et al.*, 2005)**. The results in Table 1 showed that there were significant differences in antioxidant activity % in all raw materials (carrots - beet roots - turnip leaves). There was a significant increase in the antioxidant activity in the tested materials in the fresh form, while a significant decrease occurred after heat treatments in the case of puree and drying for the same materials. Total flavonoids and phenols there are significant differences between treatments in raw materials. The results in the same Table 1 showed a significant increase in the total flavonoids and phenols of carrots, beets and turnip leaves when they were prepared in puree form, but there was a significant decrease in those phenols after drying for carrot and beet roots. On the contrary, there was a significant increase in total flavonoids and phenols after drying of turnip leaves. The increase in total phenol and flavonoid produced by heat treated and oven dried samples indicate that heat led to decrease in the quantity of antioxidant. The heat processing may have resulted in the formation of monomers during the hydrolysis of Cglycosides bonds. The results from this study are in agreement with those obtained with thermal heating of vegetables containing flavonoids. **(Priecina and Karlina, 2013**).

Table 1. Antioxidant activity and total phytochemical content of fresh, puree and dried materials

Item	% antioxidant activity			Total flavonoid (mg QE/100g)			Total phenolics (mg GAE/100g)		
	Fresh	puree	dried	Fresh	puree	dried	Fresh	puree	Dried
Carrot	75.92 ± 0.245^{a}	72.25± 0.121^{b}	67.16± 0.112^{c}	75.1± 0.14^{b}	178± 0.125^{a}	170± 0.145^{c}	41.56±. 145^{a}	5.26± 0.145^{b}	21.75± 0.125^{c}
Beet roots	120.25± 0.789^{a}	116.23 ±0.125^{b}	99.25± 0.145^{c}	30.0±0. 125^{b}	32.0± 0125^{a}	29.0± 0.125^{c}	198± 0.456^{b}	200± 0.456^{a}	195.0± 0.456^{c}
Turnip leaves	85.20 ±0.865^{a}	83.12±0. 456^{b}	80.15± 0.145^{c}	22.0±0. 456^{c}	23.0±0. 456^{b}	27.5± 0.256^{a}	75.10± 0.126^{c}	77.13± 0.456^{b}	88.50± 0.125^{a}

Each value (average of 3 replicates) within the same column, each value is followed by the standard deviation;

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Beetroots have been reported to contain a high concentration of antioxidant compounds with capabilities for protective effects against DNA damage and oxidative stress (**Vulić*et al.*, 2014**). The potential role for beetroot as an adjuvant in the treatment in some clinical conditions involving oxidative stress and inflammation such as;hypertension, atherosclerosis, type 2 diabetes and dementia has been reported to be beneficial (**Gilchrist *et al.*, 2014**).

Also, **Gorinstein*et al.*, (2008)** have indicated that heating enhances antioxidant activity in fruits and vegetables due to the enhancement of the antioxidant property of the naturally occurring compounds or the formation of novel compounds that have antioxidant activity. **Fidelis and Henrietta (2016)** reported that the beetroot in its natural and processed form is a rich source of antioxidants and free antioxidants scavenging abilities. Flavonoids represent common phenolic compounds in *Brassica*; they possess a lot of biological properties, *e.g*., antioxidant activity, a capillary protective effect, and an inhibitory effect elicited in various stages of tumors **(Cartea *et al.*, 2011)**. They were characterized by numerous subclasses, but the most important in *Brassica.* The natural and harmless pigments are also useful in the food industry **(Esatbeyoglu *et al.*, 2015**). Chart No. 1 shows the pigments contained in the tested materials in their different processing stages. With carotene in carrots, there are significant differences between the treatments, the highest in the puree and the lowest in the fresh. These results agreement with **Sule and Abu (2018)**. Betalains in beet roots, there are significant differences between treatments, the highest in the puree and the lowest in the dry. Beetroot (*Beta vulgaris*) is the main source of natural red dye, known as “beetroot red”. Betanine is the main component of the red colorant extracted from *Beta vulgaris*. Immediately after extraction, betanine is exposed to degradation are known as betalains which include betaxanthin, betacyanin (**Lee *et al.*, 2005**). **Mikołajczyk-Bator and Czapski (2017)** showed that the violet pigments (betanin) of red beet were decreased at the thermal process of the betalain preparation solution expanded alongside rising pH levels. The increase of temperature and pH value of preparation of betalain was connected with expanded damages of betanin (violet pigment). Chlorophyll in turnip leaves has significant differences between the effective treatments in fresh and least in puree. **Porra, (2002)** reported that, chlorophyll concentration in leaves is an indicator of plant health. Determination of chlorophyll content as an indirect method of estimating the productivity also provides a good understanding of the photosynthetic regime of plants; this previous note was by (**Bojovic and Stojanovic 2005).**

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Chart No.1: Total carotene, betalains and chlorophyll of the tested materials.

The results showed in Table (2) that there were significant differences between the raw materials used (carrots, beet roots and turnip leaves) in the different cases, fresh, puree and dry. The puree was the most moisture and least dry. As for the protein, there are significant differences in carrots and turnip leaves, the most active protein in the dry and the least the puree. As for the beet roots, there are no significant differences between them. There are no significant differences in fiber in beetroot and turnip leaves, but in carrots, there are significant differences, the highest in dry. Fat and ash there were no significant differences between the treatments. Carbohydrates are significant differences in all the materials used and treatments, the highest in the dry treatment and the lowest in the puree. These results agreement with **Javed*et al.*, (2019)** reported that there are various varieties of turnips, the leaves of (*Brassica Rapus L.*) have a great nutritional value and considered one of the cheapest locally available nutrients as they contain a high levels of dietary fiber, minerals and bioactive components such as flavonoids. On the other hand, **Joanne and Beate (2012)** reported that the cooking, in general, may even increase the fiber content of a product if water is driven out in the cooking process. Baking or other heat treatments used in food processing will also increase the fiber content of the product. The results

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showed in Table (3) that there were no significant differences between the processed samples of boiled carrots, beets roots and turnip leaves, while the processed sample of twenty percent carrot (F3) was the least in moisture. While the protein increased in the sample containing boiled turnip leaves (F2), and the results also showed a significant difference in the protein between the samples, The reason is due to the high protein content of turnip leaves. The data of the fat showed significant differences between the samples, and the control sample had the highest value, while the fat decreased in the other manufactured samples. Also, the results in Table (3) showed that the ash and fiber showed a significant difference between the samples, and the lowest value was the control sample. On the other hand, there was a slight significant difference between the samples in the percentage of carbohydrates, and we find that it induced a convergence in the value of total carbohydrates in the samples containing boiled beets with the control sample. The reason is due to the high sugar content of beets. The results of Table 3 showed slight significant differences in the calorie values between the manufactured samples, and sample F 5 was similar to the control sample in the calorie value. Previous results agreed with the scientists **Joanne and Beate (2012)** who reported that the vegetables include a diverse group of plant foods that vary greatly in content of energy and nutrients. Additionally, fruits and vegetables supply dietary fiber, and fiber intake is linked to lower incidence of cardiovascular disease and obesity. Vegetables, also supply vitamins and minerals to the diet and are sources of phytochemicals that function as antioxidants, phytoestrogens, and anti-inflammatory agents and through other protective.

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Table 2. Chemical composition of fresh materials and their treatments as g/100g sample

Materials	Moisture			Protein			Crude fiber			Fat			Ash			Carbohydrate		
	Fresh	Puree	Dried	Fresh	Puree	Dried	Fresh	Puree	Dried	Fresh	Puree	Dried	Fresh	Puree	Dried	Fresh	Puree	Dried
Carrot	87.0± 1.102^{b}	90.12± 0.695^{a}	10.20± 0.896^{c}	0.91± 0.019^{b}	0.59± 0.09^{c}	1.15± 0.115^{a}	0.96± 0.589^{c}	1.20± 0.89 ^{b}	1.82± 0.425^{a}	0.20± 0.112^{a}	0.25± 0.89 ^{a}	0.28± 0.147^{a}	1.12± 0.89^{a}	1.35± 0.879 ^{a}	1.56± 0.519^{a}	9.81± 0.892^{b}	6.49± 0.819 ^{c}	84.99± 0.89^{a}
Beet roots	88.15± 0.953^{b}	89.25± 0.125^{a}	7.50± 0.123^{c}	1.61± 0.025^{b}	1.75± 0.19^{ab}	1.98± 0.156^{a}	2.80± 0.89^{b}	2.85± 0.89 ^{b}	3.10± 0.894^{a}	0.17± 0.89 ^{a}	0.17± 0.879^{a}	0.18± 0.589^{a}	1.75± 0.119^{a}	1.76± 0.89^{a}	1.85± 0.478^{a}	5.52± 0.789^{b}	4.22± 0.356c	85.39± 0.749^{a}
Turnip leaves	75.45± 0.856^{b}	77.30± 1.025^{a}	2.29± 0.89^{c}	16.44± 0.115^{ab}	15.26± 0.819^{b}	17.0± 0.789^{a}	4.60± 0.89^{ab}	4.80± 0.89^{ab}	5.10± 0.89 ^{a}	0.056± 0.145^{b}	0.061±0 .89 ^{a}	0.065± 0.852^{a}	2.30± 0.89 ^{a}	2.31± 0.125^{a}	2.41± 0.845^{a}	1.15± 0.89 ^{b}	0.27± 0.881^{c}	73.14± 0.88^{a}

Each value (average of 3 replicates) within the same column, each value is followed by the standard deviation;

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Table (3): Chemical composition of crackers made from puree vegetables as g/100g sample on fresh weight.

Formula	%Moisture	%Protein	%Fat	%Ash	% Crude fiber	%Total carbohydrate	Caloric value(kal/100gm)
Control	8.11±1.55^{ab}	11.15±0.26^{a}	9.68±1.21^{a}	0.75±1.26^{d}	0.47±1.06^{d}	77.95±1.14^{b}	443.52a±1.06^{a}
F1	9.05±1.26^{a}	11.61±1.78^{a}	8.73±1.14^{b}	2.6±1.262^{bc}	0.81±1.47^{b}	76.24±1.20^{b}	429.97±1.36^{b}
F2	9.30±1.06^{a}	12.01±2.26^{a}	8.18±1.55^{b}	4.48±1.26^{a}	1.16±2.85^{a}	74.14±1.15^{c}	418.34±2.26^{bc}
F3	7.98±1.26^{b}	9.57±1.456^{c}	6.20±1.89^{d}	2.88±1.89^{bc}	0.85±1.55^{c}	80.50±1.26^{a}	416.08±1.26^{bc}
F4	9.27±1.16^{a}	9.37±2.26^{c}	8.10±1.89^{b}	1.55c±1.90^{c}	0.89±2.89^{b}	80.09±1.45^{a}	430.74±1.16^{b}
F5	8.86±1.26^{ab}	9.61±1.26^{c}	6.48±1.26^{d}	3.70b±1.48^{b}	0.65±1.47^{c}	79.56±2.267^{a}	415.01±1.78^{c}
F6	8.82±1.45^{ab}	10.30±1.26^{b}	7.4±1.263^{c}	4.41±2.26^{a}	0.85±1.12^{b}	77.04±2.15^{b}	416.05±1.45^{bc}
LSD	1.16	1.16	0.88	1.01	1.15	0.805	0.958

Each value (average of 3 replicates) within the same column, each value is followed by the standard deviation;F1= 10%turnip leaves puree ,F2=20% turnip leaves puree ,F3=10% carrot puree ,F4=20% carrot puree ,F5=10% beet roots puree and F6=20%
beet roots puree

It is clear from Table (4) the chemical composition of crackers made from the dried turnip leaves, dried carrots and dried beets. Moisture results showed that there were no significant differences between the tested samples and some of them, but there were a significant difference between the samples in protein, ash, fat, total carbohydrates and calories. Sample F8 was characterized by a high value of protein, fat, ash and fiber.

Table (4): Chemical composition of crackers made from dried vegetables on dry weight

Formula	%Moisture	%Protein	%Fat	%Ash	% Crude fiber	%Total carbohydrate	Caloric value(kal/100g)
control	8.11±1.55^{a}	11.15±1.22^{a}	9.68±1.55^{bc}	0.75±1.58^{d}	0.47±1.12^{d}	77.95±1.05	443.52±1.45^{a}
F7	8.26±1.85^{a}	11.85±0.55^{a}	10.11±1.36^{a}	3.77±1.33^{a}	0.83±1.12^{b}	73.44±1.12	432.12±1.59^{b}
F8	9.21±1.15^{a}	12.25±1.45^{a}	10.17±1.54^{bc}	4.90±1.75^{b}	1.18±1.12^{a}	71.50±1.46	426.53±1.75^{c}
F9	8.49±1.16^{a}	9.43±1.25^{b}	6.23±1.250^{e}	2.1±1.25^{b}	0.66±1.12^{c}	81.58±1.45	420.11±1.46^{f}
F10	8.98±1.45^{a}	10.28±1.15^{c}	8.36±1.581^{c}	3.71±1.58^{c}	0.88±1.12^{b}	76.77±1.55	423.44±1.78^{e}
F11	8.67±1.45^{a}	9.98±1.55^{b}	7.82±1.75^{d}	3.053±1.50^{a}	0.66±1.12^{c}	78.48±1.65	424.22±1.34^{d}
F12	8.67±1.76^{a}	10.80±1.56^{c}	8.22±1.25^{b}	4.50±1.59^{b}	0.88±1.12^{b}	75.60±1.58	419.58±1.45^{g}
LSD	1.26	1.16	0.88	1.01	1.10	0.805	0.885

Each value (average of 3 replicates) within the same column, each value is followed by the standard deviation; F7= 10% dried turnip leaves, F8=20% dried turnip leaves, F9=10% dried carrot, F10=20% dried carrot,F11=10% dried beet roots and F12=20% dried beet roots

This results agreement with **Ktenioudaki, (2013)** who reported that the baked products have been widely used for incorporating healthy compounds and different plant fiber products are added to various baked food products in order to increase

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their fiber content. **Biondi *et al.*, (2012)** who reported that the turnip *(Brassica)* vegetables are a good source of many phytochemical compounds that exert positive effects on the final consumer's health.

Mineral content in crackers made from puree and dried materials

Table 5 shows the content of crackers made of mashed turnip leaf, carrots and beets on some of the important minerals for the growth of children in the study stage, such as zinc, iron, calcium and phosphorous, estimated in mg/100 gram sample and calculating the daily needs of these elements for children from 4 to 8 years old.

Table 5. Minerals salts profile (mg/100g on dry weight basis) and estimated of contribution to RDA for children (age 4-8 years) of the crackers made from boiled materials

Formula	Zn (mg/100gm)	% RDA	Fe (mg/100gm)	%RDA	Ca (mg/100gm)	%RDA	P (mg/100gm)	%RDA
Control	0.97±0.145^{d}	19.4	1.98±0.298^{d}	19.80	340.99±0.256^{d}	34.1	52.55±0.215^{d}	10.51
F1	2.27±0.125^{a}	45.4	6.44±0.253^{b}	64.40	391.31±0.256^{ab}	39.1	61.54±0.825^{ab}	12.30
F2	2.30±0.33a	46.0	6.97±0.456^{b}	69.7	395.69±0.251 ^{a}	39.6	62.50±1.212^{a}	12.50
F3	1.21±0.289^{c}	24.2	4.48±0.251^{c}	44.80	348.05±0.145^{cd}	34.8	58.32±0.236^{c}	11.66
F4	1.32±1.21^{c}	26.4	4.91±1.25^{c}	49.10	355.17±1.145^{c}	35.5	59.43±1.25^{c}	11.88
F5	1.39±0.155^{b}	27.8	7.13±1.245^{a}	71.30	372.61±1.11^{b}	37.2	61.17±0.121^{ab}	12.23
F6	1.48±1.45^{b}	29.6	7.48±0.112^{a}	74.80	376.28±0.298^{b}	37.6	62.49±0.251^{a}	12.49
LSD	1.16		1.22		1.18		1.01	
contributin to RDA for children 4- 8 years(mg/day	5		10		1000		500	

Each value (average of 3 replicates) within the same column, each value is followed by the standard deviation; F1= 10% turnip leaves puree, F2=20% turnip leaves puree, F3=10% carrot puree, F4=20% carrot puree, F5=10% beet roots puree and F6=20% beet roots puree

There were significant differences between the samples in zinc and phosphorous content, and the samples containing,10 (F1) and 20% (F2) of boiled turnip leaves and covered by 45.4% and 12.30% and 46.0% and 12,50% of the daily needs of zinc and phosphorous for the mentioned age group. Also, the samples containing puree carrots covered the daily needs from 24.2to 26.4% for samples F3 and F4 respectively.

While the samples fortified with 10 and 20 % pureed beet covered 27.8% to 29.6% and 12.23% to 12.49%, respectively of the daily requirement of zinc and phosphorous, respectively. The control sample was the least in covering the daily needs of the mentioned mineral elements. The results indicated an increase in iron

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content of F6, followed by F5 in their iron content. Consequently, the percentage of daily needs increased to 74.8% and 71.3%, respectively, followed by F2 and F1, then F4 and F3. On the contrary, the sample F2 and F1 were recorded a significant increase in calcium, followed by F6 and F5, then F4 and F3.These results are in agreement with the scientists **Bakhru, (1993)** who reported that carrot is an excellent source of calcium; which has cholesterol lowering properties and thus helps in reducing the risk of high blood pressure, stroke, heart disease and some type of cancer. Carrots are a good source of dietary fiber and minerals such as calcium, phosphorous, iron, and magnesium (**Sharma *et al.*, 2012**). The data also agreement with (**Clifford *et al.*, 2015)** they reported that the beetroot is grown in many countries worldwide, regularly consumed as part of the normal diet, and commonly as part of the normal diet, and commonly used in manufacturing as a food coloring are a rich source of potent antioxidant and iron, the molecule beta line which is considered and antioxidant composite is important for cardiovascular health.

The results showed in Table 6 that the crackers made from turnip leaves, carrots and beets had a significant increase in the estimated mineral elements, as the drying process led to the concentration of minerals and a high percentage, and therefore the percentage of utilization of them in the recommended daily allowance of all the studied minerals increased compared to the results of the previous Table. The results agreed with **(Straus *et al.*, 2012)** they reported that the beetroot is a rich source nutrients. The minerals content are iron, magnesium, selenium, potassium, calcium, zinc and phosphorus.

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Table 6. Minerals salts profile (mg/100g on dry weight basis) and estimated of contribution to RDA for children (age 4-8 years) of the crackers made from dried materials

Formula	Zn (mg/100gm)	% RDA	Fe (mg/100gm)	% RDA	Ca (mg/100gm)	% RDA	P (mg/100gm)	% RDA
Control	0.97±0.145^{d}	19.4	1.98±0.425^{c}	19.8	340.99±0.125^{e}	34.1	52.55±0.215^{e}	10.51
F7	2.82±0.456^{a}	56.4	7.20±0.568^{a}	72.0	392.11±0.425^{b}	39.21	78.88±0.692^{b}	15.77
F8	2.99±0.251^{a}	59.8	7.57±0.258^{a}	75.7	405.69±0.625^{a}	40.56	82.71±0.251^{a}	16.54
F9	1.47±0.115^{c}	29.4	6.34±0.895^{b}	63.4	375.05±0.328^{d}	37.50	66.37±1.425^{d}	13.27
F10	1.60±0.125^{b}	32.0	6.40±0.225^{b}	64.0	383.12±0.525^{c}	38.31	68.162±0.489^{c}	13.63
F11	1.53±0.165^{c}	30.6	7.55±0.225^{a}	75.5	381.28±0.689^{c}	38.12	65.55±0.256 ^{d}	13.11
F12	1. 74±0.525^{b}	34.8	7.78±0.525^{a}	77.8	392.11±0.525^{b}	39.21	67.56±0.789^{c}	13.51
LSD	1.26		1.16		0.88		1.01	
RDA of 4-8 years (mg/day)	5		10		1000		500	

Each value (average of 3 replicates) within the same column, each value is followed by the standard deviation; F7= 10% dried turnip leaves,F8=20% dried turnip leaves,F9=10% dried carrot,F10=20% dried carrot,F11=10% dried beet roots and F12=20% dried beet roots

Evaluation of the sensory properties of crackers made from puree and dried vegetables

Sensory evaluation is an important indicator. It was done after processing on the basis of color, smell, flavor, appearance, crispness and overall acceptability for all the samples with the help of sensory evaluator from the institute of Food Technology where this study was carried out. Sensory scores of the cookies incorporated with carrot, beetroots and turnip leaves puree are presented in Table 7. The results indicated that the addition of both puree carrot and beetroot had a significant improvement in color, appearance, crispness, and overall acceptability compared to the control and turnip leaves puree samples. While, the sample containing turnip leaves puree (F1 and F2) obtained a score significantly lower in smell and flavor compared to the other manufactured samples. We find that these results are in agreement with **(Tripathi and Yadua, 2021)** and **(Stephen *et al.*, 2019)**. The effect of incorporation of carrot, beet roots and turnip leaves after dried at various levels (10% and 20%) on sensory properties of the crackers is presented in Table 8.

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Table 7. Sensory properties of crackers made from puree vegetables

Formula	Color (10)	Smell (10)	Flavor (10)	Appearance (10)	Crispness (10)	Overall acceptability(10)
Control	6.50 ±1.39 ^{c}	8.50±1.76 ^{a}	8.50±1.39 ^{a}	6.70±1.24^{c}	6.40±1.63^{c}	7.40±1.13^{b}
F1	7.40 ±1.39 ^{b}	7.0±1.76 ^{b}	7.10±1.39 ^{b}	7.30±1.63 ^{ab}	7.40±1.42^{ab}	7.80±1.13^{b}
F2	7.30±1.57 ^{b}	7.9±1.37 ^{ab}	6.90±1.10 ^{c}	6.90±1.44 ^{b}	7.10±0.87 ^{ab}	7.50±0.70 ^{b}
F3	8.30±1.49^{a}	8.50±1.26 ^{a}	8.40±0.96 ^{a}	8.40±1.26 ^{a}	8.20±1.22 ^{a}	8.30±0.94 ^{a}
F4	8.70±1.15 ^{a}	8.60±1.17 ^{a}	8.50±0.70 ^{a}	8.60±1.26 ^{a}	8.3±0.94 ^{a}	8.80±0.78 ^{a}
F5	8.0±1.25 ^{a}	8.2±1.15 ^{ab}	8.7±1.15 ^{a}	8.5±1.17 ^{a}	8.0±1.26 ^{a}	8.10±0.87 ^{a}
F6	8.4±1.26 ^{a}	8.7±1.22 ^{a}	8.9±1.52 ^{a}	8.7±1.26 ^{a}	8.0±1.69 ^{a}	8.40±1.17 ^{a}
LSD	1.16	0.87	0.88	0.85	1.10	0.805

Each value (average of 3 replicates) within the same column, each value is followed by the standard deviation;F1= 10% turnip leaves puree ,F2=20% turnip leaves puree ,F3=10% carrotpuree ,F4=20% carrotpuree ,F5=10% beet roots puree and F6=20%
beet roots puree

The data of the table 8 showed that samples F7, F8 and the control sample had a significant increase in smell and flavor compared to the other samples. However, there were a significant decrease in the sensory characteristics (color, smell, flavor, appearance and overall acceptability) shown in the Table in the samples containing dried carrots and beets roots.

Table 8. Sensory properties of crackers made from dried vegetables

Formula	Color (10)	Smell (10)	Flavor (10)	Appearance(10)	Crispness (10)	Overall acceptability(10)
Control	6.50 ±1.39 ^{c}	8.50±1.76 ^{a}	8.50±1.39 ^{a}	6.70±1.2 4 ^{c}	6.40±1.63 ^{b}	7.40±1.13 ^{ab}
F7	8.62±1.57 ^{a}	8.13±1.37 ^{a}	8.63±1.1 0 ^{a}	8.35± 1.36 ^{a}	8.50±1.44 ^{a}	8.40±0.70 ^{a}
F8	8.63±1.49 ^{a}	8.50±1.26 ^{a}	8.90±0.96 ^{a}	8.37±1.26^{a}	8.90±1.26 ^{a}	8.50±0.94 ^{a}
F9	7.63±1.15^{b}	7.50±1.17 ^{b}	7.58±0.70 ^{ab}	7.25±1.77^{ab}	8.37±1.26^{a}	7.30±0.78 ^{ab}
F10	7.75±1.25 ^{b}	6.8±1.15 ^{c}	6.50±1.15 ^{b}	7.25±0.18 ^{ab}	8.60±1.17 ^{a}	6.75±0.87 ^{b}
F11	6.87±1.26 ^{c}	7.5±1.22 ^{b}	6.75±1.5 2 ^{b}	6.20±1.35 ^{c}	8.50±1.26 ^{a}	6.88±1.17 ^{b}
F12	6.00±1.28 ^{c}	6.50±1.22 ^{c}	6.25±1.15^{b}	6.13±1.89^{c}	8.80 ±1.26^{a}	6.0 b±0.87^{c}
LSD	1.16	1.16	0.88	1.01	0.235	0.805

Each value (average of 3 replicates) within the same column, each value is followed by the standard deviation;F7= 10% dried turnip leaves,F8=20% dried turnip leaves,F9=10% dried carrot,F10=20% dried carrot,F11=10% dried beet roots and F12=20% dried beet roots

The addition of dried carrots (F9 and F10), dried beets (F11and F12) and turnip leaves led to a significant improvement in crispness compared to the control sample. We conclude from the results of the previous two Tables 7 and 8 that replacing wheat flour with different percentages of dried turnip leaves improved the sensory properties of crackers than boiled

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turnip leaves, while boiled carrots and beets roots were better in sensory evaluation than dried ones. Beetroot (*Beta vulgaris*) is not a popularly consumed vegetable in Egypt. The samples F11 and F12 made from dried beets showed a significant decrease in color compared to samples made from dried carrots and turnip leaves. These data agreed with **Hussain *et al.* (2018)** stated that the thermal process, betanin can be corrupted by isomerization and evacuation of the carboxyl group which gradually blurs the red shading followed by pale earthy colored shading, at some point. The beet root is peeled, boiled and used in salads to give a reddish color or mixed with other root vegetables and eaten with stew. It is also consumed by juicing the raw beetroots to make beetroot juice or combined with other fruit juices to make a mixed fruit juice as reported by (**Wotton-Beard *et al.*, 2011)**.The *Turnip* (*Brassica rapa L. ssp. rapa*) is a leaf and root vegetable grown and consumed worldwide. The consumption of turnip has been associated with beneficial effects on human health due to their phytochemicals that may control a variety of physiological functions, including antioxidant activity, enzyme regulation, and apoptotic control and the cell cycle as reported by **Dejanovic*et al.*, (2021)**. **Keyimu, (2013)** reported improved scores for appearance with addition of sea weed in noodles up to 3% level. Therefore, it can be concluded from the sensory evaluation that the scores for color, taste, and texture were improved with addition of carrot puree in noodles. Also, **Prerana and Anupama(2019)** found that the carrot puree incorporation in noodles uniformly distributes pigments in dough and improves the color of noodles in comparison with dried vegetable powder. The natural attractive color of carrot improved the overall acceptability of product. Incorporation of carrot puree in instant noodles improved nutritional composition with respect to micronutrients and fiber content compared with control noodles.

We find in Tables 9 and 10 the physical properties of processed crackers. It is clear from the results that there are slight significant differences in the specific weight between the processed samples of carrots, beets and turnip leaves after par boiling.

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Table 9: physical properties of crackers made from puree vegetables

Formula	Specific weight	Shear force(g)
Control	1.44±0.116^{b}	23.93±1.456^{d}
F1	1.23±0.456^{c}	34.37±0.456^{a}
F2	1.05±0.434^{c}	30.74±0.433^{c}
F3	1.49±0.456^{ab}	17.94±0.557^{e}
F4	1.51±0.156^{ab}	18.88±0.856^{e}
F5	1.56±0.285^{ab}	31.97±0.956^{b}
F6	1.87±0.416^{a}	30.63±0.456^{c}

Each value (average of 3 replicates) within the same column, LSD each value is followed by the standard deviation;F1= 10% turnip leaves puree ,F2=20% turnip leaves puree ,F3=10% carrot puree ,F4=20%carrot puree ,F5=10% beet roots puree and F6=20% beet roots puree

Table 10: physical properties of crackers made from dried vegetables

Formula	Specific weight	Shear force(g)
Control	1.44±1.456^{a}	23.93±0.856^{e}
F7	0.93±0.011^{b}	17.11±0.366^{g}
F8	0.99±0.356^{b}	18.68±0.156^{f}
F9	1.26±0.258^{ab}	30.35±0.125^{c}
F10	1.32±0.116^{ab}	28.64±0.456^{d}
F11	0.96±0.456^{b}	36.73±0.789^{b}
F12	0.98±0.356^{b}	38.34±0.456^{a}

Each value (average of 3 replicates) within the same column, each value is followed by the standard deviation;F7= 10% dried turnip leaves,F8=20% dried turnip leaves,F9=10% dried carrot,F10=20% dried carrot,F11=10% dried beet roots and F12=20% dried beet roots

It is clear from the Table (9) showed that there are significant differences between the samples in the shear force. The sample F1 had the highest value in the shear force, followed by F5 and F6, then F2 and the control sample, the samples F3 and F4 had low values. Data in Table 10 cleared that there is a significant decrease in the values of the specific weight in samples manufactured from dried turnip leaves (F7 and F8) and dried beets (F11 and F12) compared to the same manufactured samples in Table 9 these results agreement with **El-Akel, (1993)**.

The second chart shows the natural pigments content of the crackers (total carotene, chlorophyll and betalain). A significant increase in the content of the natural pigments total carotene, chlorophyll and betalain were observed in the crackers made from carrot puree, turnip leaves and beetroot, each of the crackers made from the same dried materials, respectively. These results agreement with **Sies and Krinsky, (1995)** reported that the carrot is one of the important vegetables rich in beta carotene, minerals, and dietary fibers. Carotene may prevent cancer and certain chronic diseases. The chlorophyll content increases with leaf development and then decreases with the senescence phenomenon (**Pereyra*et al.*, 2014**). Therefore, we recommend drying or boiling the turnip leaves before the leaves turn yellow to benefit from the chlorophyll dye in some food products as a natural and safe health dye.

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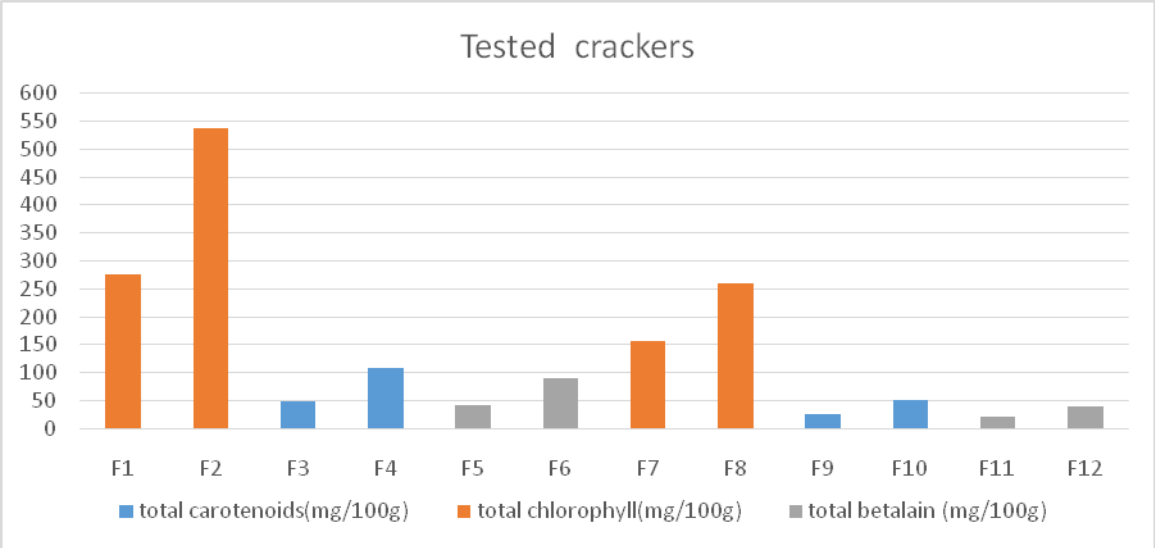

Chart No 2: Total carotene, chlorophyll and betalain of the tested crackers

F1= 10% turnip leaves puree ,F2=20% turnip leaves puree ,F3=10% carrot puree ,F4=20% carrot puree ,F5=10% beet roots puree , F6=20% beet roots puree**,** F7= 10% dried turnip leaves,F8=20% dried turnip leaves,F9=10 % dried carrot,F10=20% dried carrot,F11=10% dried beet roots and F12=20% dried beet roots**.**

Conclusion

Nutritional quality could be defined as the value of the product for the consumer's physical, psychological, or emotional well‐being. The first term of this extended definition concerns the effects of food determined by its phytochemicals, *i.e.*, the sum of all beneficial and harmful compounds and their nutritional (or biological) aspects. Through this study, we recommend the use of carrots, beets roots and turnip leaves in crackers making or other products for school children, as they are materials rich in natural colors and rich in mineral elements that children's body needs in the growth stage, and these materials have attractive natural colors that can be a source of natural colors.

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