Food Technology Research Journal, Vol. 2, issue 1, 50-63, 2023

FTRJ

Effect of Adding Veggies Powdered on Physico-Chemical and Sensory Properties of Cookies

***Nada, A. Shatat, Mona, M. Khalil & Rania, E El-Gammal**

Food Industries Department, Faculty of Agriculture, Mansoura University, Egypt

Original Article

Article information

Received 2/8/2023
Revised 17/8/2023
Accepted 20/8/2023
Published 30/8/2023
Available online 1/9/2023

Keywords:
Biscuits, Veggies Powdered, Nutrient composition, TPA and Acceptability score.

ABSTRACT

The present work aimed to study the effect of adding powdered carrot, pumpkin, spinach, and chard on cookies in terms of physical, chemical and sensory properties. Adding powdered veggie to cookies enhanced the amount of protein, ash, crude fiber, minerals and dietary fibers, and decreased carbohydrates and calories compared to control cookies. Texture profile of cookies showed that adding carrot, pumpkin, spinach and chard powder positively influence on some texture parameters. Cookies with 10% carrot or pumpkin powder showed the highest ($p \geq 0.05$) acceptability than the control cookies, followed 10% of spinach or chard powder. This study recommend using powdered veggie as a value -add in food based cereals.

1.Introduction

Veggies are readily available and affordable food characterized in low calories (Kumar and Brooks, 2018). Veggies fibers are of superior quality compared to those obtained through processing cereal, because they contain more soluble dietary fiber, have greater water-holding abilities, and contain less phytic acid (Sagar et al., 2018). In addition to this, veggies have also included a variety of bioactive chemicals such carotenoids, polyphenols and antioxidants which may offer additional health benefits (Das et al., 2020; Arfaoui, 2021).

The nutritional value of bakery goods is improved by partially replacing wheat flour with non-wheat flour, which also satisfies consumer demands for wholesome food and a variety of dietary options (Franco et al., 2020).The process of drying fruits and vegetables works to preserve it and reduce its size and weight, which makes storage and transportation less expensive (Guo et al., 2021). Drying is a common way of preserving fruit and vegetable powders used in the preparation of quick food. Powders from dried fruits and vegetables are essential ingredients of many products, including instant cakes, soups, cookies, healthy snacks and course ready-to-eat powdered drinks. (Khoza et al., 2021 and Li et al., 2023).

Dietary fiber is an indigestible, complex carbohy rate that is present in the structural elements of plants (Pérez-Corría et al., 2019). The health advantages of eating a fiber-rich diet are numerous, including the avoidance of constipation, blood sugar regulation, heart disease, the reduction of excessive cholesterol, and the prevention of several malignancies. They cannot be absorbed by the body and so have no calorific value (Yegin et al., 2020). Dietary fibers are appealing not only for their nutritional advantages but also for their technological and functional qualities, and they can be used as food additives (Das et al., 2020). Cookies are the most popular bakery product consumed Cookies are the most popular bakery product consumed worldwide as a snack food on a big scale in poor nations where protein energy malnutrition is common because they are ready to eat, inexpensive, nutritionally dense, readily available, and have a longer shelf life (Abi et al., 2021).

Cookies are a type of flat confectionery baked food product that typically has a low moisture amount and contains oil, flour, and sugar. They often have a greater size and a smooth chewing texture compared to biscuits (Ayo -Omogie, 2023). Carrot (*Daucus Carota*) belongs to the family Apiaceae.

***Corresponding Author**

Email: nadashatat7@gmail.com

Carrot (*Daucus Carota*) belongs to the family Apiaceae. Carrot powder adding to the recipe enriches the product with natural vitamins, because of the concentration of the coloring pigment carotene (Salehi and Aghajanzadeh, 2020). Moreover, dried carrots could be ground into flour and introduced into different dishes due to its natural antioxidant capabilities and the anticancer properties of carotene, which is a precursor to vitamin A and mineral content (Abdo et al., 2021).

Pumpkin (*Cucurbita moschata*) belongs to the family of Cucubitaceae is extensively grown in tropical and subtropical countries. Pumpkin contains a lot of beta-carotene, the pigment that gives its yellow or orange color. It also has a lot of nutrients and carbs. The principal source of vitamin A in plants, beta-carotene has a distinct yellow-orange hue (Kaur et al., 2020 and Hussain et al., 2022). It can be used to make pumpkin flour, which has a longer shelf life. Pumpkin flour is a well-liked ingredient due to its flavor, sweetness, and brilliant yellow-orange color. According to reports, it is added to cereal flours in bakery goods such cakes, cookies, bread, soups, sauces, and instant noodles as well as utilized as a natural coloring agent in pasta and flour mixtures (Hussain et al., 2023).

Spinach (*Spinacia oleracea*) is a dark green leafy vegetable that belongs to the Chenopodiaceae family and is widely consumed due to its unique nutritional profile (Li et al., 2019). Spinach is one of the naturally enriched vegetables that contain a variety of phytonutrients and bioactive components with beneficial biological features, such as carotene, lutein, zeaxanthin, ascorbic acid, flavonoids, and polyphenols (Salehi et al., 2019 and Manzoor et al., 2020). Swiss chard (*Beta vulgaris*) is a glycophytic belonging to the Chenopodiaceae family, is aherbaceous biennial leafy vegetable grown in many regions of the world, low cost, and used in a variety of traditional cuisines (Mzoughi et al., 2019). The stems are frequently sliced and cooked like celery, and the leaves can be eaten in salads or cooked like spinach. Unlike spinach and celery, the plant is more resilient and easier to grow. The leaves of chard include considerable amounts of vitamins A, C, and B, as well as a variety of minerals such as calcium, iron and phosphorus (Libutti et al., 2023).

Therefore, this study aims to determine how well carrot, pumpkin, spinach and chard powder replaced with wheat flour in terms of physical, chemical and sensory properties. Considering the chemical composition, energy value, mineral contents, dietary fibers and texture profile analysis (TPA).

Materials and Methods

Materials

Carrot, pumpkin, spinach and chard were obtained from local market in El- Mansoura city, El-Dakahlia Governorate, Egypt.

Other ingredients

All purpose wheat flour (72% extraction rate), instant active dry yeast (yeast, monostearate sorbitan, ascorbic acid, and vegetarian oil), butter (80% fat), sugar, table salt, vanilla essence and baking powder. All baking materials were obtained from local market, El-Mansoura city, El-Dakahlia Governorate, Egypt.

Methods

Preparation of Carrot, Pumpkin, Spinach and Chard powder

Fresh carrot was washed with running tap water to remove dirt and other field damaged portion, then peeled using a domestic vegetable peeler and sliced to a thickness of 5 mm. Carrots slices were blanched at 100˚C in boiled water for 2 min as mentioned by (Anitha et al., 2020). Blanched carrots were kept in a tray dryer for drying. Carrot was dried for 3-4 hrs at 65˚C in air circulation dryer (GARBUIO - Treviso., Italy) at Food Industries Dept., Fac. of Agric., Mansoura. University. After drying process, it was grounded into powder using a mixer grinder (MOULINEX- France), to pass through sieved (120 mesh) to remove any large particles, and then stored in sealed polyethylene bags at refrigerator (3-5˚C) until needed.

Fresh pumpkin was washed with running tap water to remove dirt and other parts that had been damaged in the field, then peeled and the fibrous matter and seeds were removed.

Pumpkin was cut into 5 mm slices and blanched at 100˚C for 5 min in boiled water. The blanched sliced pumpkin was placed in a tray dryer to dry. Pumpkin was dried for 7-8 hrs at 65˚C as mentioned by (Anitha et al., 2020) in air circulation dryer (GARBUIO - Treviso., Italy) at Food Industries Dept., Fac. of Agric., Mansoura. University. After drying process, it was grounded into powder using a mixer grinder (MOULINEX- France), to pass through sieved (120 mesh) to remove any large particles, and then stored in sealed polyethylene bags at refrigerator (3-5˚C) until needed.

Fresh leaves of spinach and chard were subjected to preliminary operations such as sorting, grading, washing with running tap water and dirt removal for pretreatments. Then blanching at temperature 100 ˚C in boiled water for 5 sec as mentioned by (Galla et al., 2017). Leaves of spinach and chard were placed in a tray dryer to dry. Leaves were dried for 3-4 hrs at 65 ˚C using air circulation dryer (GARBUIO - Treviso., Italy) at Food Industries Dept., Fac. of Agric., Mansoura. University. After drying process, it was grounded into powder using a mixer grinder (MOULINEX- France), to pass through sieved (120 mesh) to remove any large particles, and then stored in sealed polyethylene bags at refrigerator (3-5 ˚C) until needed.

Preparation of cookies samples

Different blends of cookies were as mentioned in Table 1. according to Kamaliya and Kamaliya (2001). Wheat flour and (carrot, pumpkin, spinach and chard) powder were used to standardize the cookies. The mixture was in two steps, firstly butter and sugar is creamed together and then the dried ingredients (wheat flour, powdered carrot, pumpkin, spinach and chard) in addition to baking powder and vanilla essence were sieved together and incorporated secondly. . Then dough was handly mixed, rolled out into sheets and then pressed into different shapes using different moulds. Cookies that had been shaped were put on a greased tray with fat and baked at 175˚C for 15 min baked in oven (KIRIAZI -Egypt). After cookies were baked , let cool at room temperature (25±2˚C), then packed in high density polyEthylene bags and stored at refrigerator (3-5 ˚C) for further analyses.

Table 1. Formula of cookies

	Cookies formulas (gm)								
Ingredients	T_0	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8
Wheat Flour72%	100	90	80	90	80	90	80	90	80
Carrot Powder	_	10	20	_	_	_	_	_	_
Pumpkin Powder	_	_	_	10	20	_	_	_	_
Spinach Powder	_	_	_	_	_	10	20	_	_
Chard Powder	_	_	_	_	_	_	_	10	20
Butter	20	20	20	20	20	20	20	20	20
Sugar powder	30	30	30	30	30	30	30	30	30
Vanilla essence (ml)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Backing powder	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Water (ml)	22	22	22	22	22	22	22	22	22

Chemical analysis

Moisture, crude protein, fat, ash, crude fibers, total carbohydrates and minerals in raw materials cookies samples were decided on the basis of the method described in (Robinson et al., 2014) at Laboratory of soil fertility tests and monitoring of fertilizer quality, Central laboratory, Faculty of Agriculture, Mansoura University.

Total carbohydrate was determined by difference 100 – (%moisture + %ash + %protein + %fat).

Energy value was calculated according to the following equation:

E (caloric value) = 4 (carbohydrate %+ protein %) + 9 (fat %).

Determination of Dietary fibers

Total dietary fibers Soluble and insoluble dietary fibers in raw materials and cookies samples were determined according to method described by (Prosky et al., 1988) at Food Tech. Res. Institute, Agric. Res. Center, El-Giza, Egypt.

Texture profile analysis of cookies (TPA)

Texture measurements of cookies samples were investigated with universal testing machine (Cometech, B type, Taiwan) provided with software. Back extrusion cell with 35 mm diameter compression disc was used. Two cycles were applied, at a constant crosshead velocity of 1 mm/s, to 30% of sample depth, and then returned. From the resulting force–time curve, the values for texture attributes, i.e. Hardness(N), adhesiveness(mj), resilience and fracturability(N) were calculated from the TPA graphic according to (Wani et al., 2015) at Food Tech. Res. Institute, Agric. Res. Center, EL-Giza, Egypt.

Sensory evaluation of cookies samples

Cookies produced were evaluated according to the way described by (Khouryieh and Aramouni 2012), using ten panelists in food Industries Department, Faculty of Agriculture, El-Mansoura University. A hedonic scale rating test was used on a scale of 10 points from “like extremely” to “dislike extremely”. The panelists were given an evaluation form which listed various sensory parameters and score the cookies for surface cracking pattern, surface color, crumb color, texture, aroma, flavor, and overall acceptability.

Statistical analysis

The producer of the SAS software system programme was used to do a statistical analysis of the data that was collected (SAS, 2010). Analysis of variance was conducted using General Liner Model (GLM) procedure (Snedecor and Cochran, 1980). Means were separated using Duncan's test at a degree of significance ($P \leq 0.05$).

Results and Discussions

Chemical composition and energy value of raw materials

Proximate chemical composition of wheat flour, carrot powder, pumpkin powder spinach powder and chard powder are presented in Table 2. The obtained results showed that wheat flour recorded the highest moisture content being 12.60%, while spinach powder had lower moisture content being 6.45%. Meanwhile, the highest value of crude protein was recorded for chard powder 33.06% followed by spinach powder 27.87%. However, pumpkin powder and wheat flour had the lowest crude protein value being 11.37 and 11.25%, respectively. While, spinach powder had the highest fat content being 5.04 % as compared to wheat flour, pumpkin, carrot and chard powder were 1.48%, 1.36%, 0.91 and 0.42%, respectively. On the other side, spinach and chard powder contained the highest ash content 17.10 and 15.76% respectively. While, wheat flour had the lowest ash and crude fibers content being 0.63 and 0.64 % respectively. However, carrot powder had the highest crude fibers followed by pumpkin, spinach and chard powder being 13.94%, 9.37%, 8.33% and 7.76%, respectively. The obtained results are in the line with those reported by (Mala, et al., 2018) declared that pumpkin powder contained 8.9 % crude fibers. While, (Assenova et al., 2021) found that carrot powder contains 8.55% fibers.

Wheat flour and carrot powder recorded the highest value of total carbohydrates being 74.04% and 70.98%, respectively. While, spinach powder had the lowest total carbohydrates content being 43.54%. Wheat flour recorded the highest caloric value content being 354.48(cal/100g), while chard powder had lowest caloric value content being 310.42 (cal/100g). The obtained results are in the line with those reported by (Sakr et al., 2012) stated that wheat flour were 10.35%, 1.05%, 0.47%, 0.49% and 87.64% for crude protein, fat, crude fibers, ash and total carbohydrates, respectively. (Hussein, et al., 2013) who found that carrot powder contained 9.20 % crude protein, 7.16% crude fibers, 6.83 % ash and 65.26 % total carbohydrates. (Galla et al., 2017) stated that spinach powder were 8.60%, 27.8%, 5.69%, 18.81% and 8.82 for moisture, crude protein, fat, ash and crude fibers, respectively. Also, (Anitha et al., 2020) who found that pumpkin powder contained 14.37 % crude protein, 1.32% fat, 5.6 % ash and 72.70 % total carbohydrates. (El-Sayed, 2020) who found that spinach powder contained 6.35%, 31.15%, 17.97% and 16.40% for moisture, crude protein, ash and total carbohydrates, respectively.

Table 2. Chemical composition and energy value of raw materials (% on dry weight basis)

Raw materials	Chemical composition (%)						
	Moisture	Crude	Fat	Ash	Crude	Total	Energy Value
Wheat flour	12.60 [a]	11.25 [d]	1.48 [b]	0.63 [c]	0.64 [c]	74.04 [a]	354.48 [a]
Carrot powder	7.22 [c]	13.56 [c]	0.91 [cd]	7.33 [b]	13.94 [a]	70.98 [a]	346.35 [b]
Pumpkin powder	8.02 [b]	11.37 [d]	1.36 [c]	9.36 [b]	9.37 [b]	69.89 [b]	337.28 [c]
Spinach powder	6.45 [c]	27.87 [b]	5.04 [a]	17.10 [a]	8.33 [b]	43.54 [c]	331.00 [c]
Chard powder	7.16 [c]	33.06 [a]	0.42 [d]	15.76 [a]	7.76 [b]	43.60 [c]	310.42 [d]

*a, b, c = Means followed by different letters in the same column are significantly different by Duncan's multiple test ($p<0.05$).

Minerals content of raw materials used in cookies preparing

Minerals are important for certain physicochemical processes which are essential to human life. Per day, greater than 100 mg of the macro-minerals (Na, Mg, K, Ca and P) and less than 100 mg of micro-minerals (Fe, Cu and Zn) are required (Soetan et al., 2010). Minerals content of raw materials are presented in Table 3. These results indicated that spinach powder proved to be of the highest content of K, Ca, Mg, Na, P and Zn compared with chard powder, pumpkin powder, carrot powder and wheat flour. It was recorded (5161.42, 2110.33, 761.80, 177.16, 370.41 and 6.43mg/100g), respectively. Obtained results are in the line with those reported by (El-Sayed, 2020) that spinach powder had (3334, 2988,1428,26.69 and 0.718 mg/100g) for K, Ca, Mg, Fe and cu, respectively, while, carrot powder had the lowest content of K, Ca, Mg, Na and Fe compared with chard powder, pumpkin powder and spinach powder. It was recorded (3224.30, 198.61, 163.81, 71.18 and 3.82mg/100g), respectively. (Assenova et al., 2021) who found that carrot powder contains (78.0, 94.5, 610.0, 0.65, 1.06 and 0.98 mg/100g) for Ca, Mg, P, Fe, Zn and Cu, respectively. (Anitha et al., 2020) who found that pumpkin powder contained (12.0 mg) for Fe and (100 mg) for Ca. However, wheat flour (72% ext.) had the lowest minerals content being (153.90, 11.51, 34.92, 42.63, 90.72, 0.95, 0.48 and 0.19 mg/100g), for K, Ca, Mg, Na, P, Fe, Zn and Cn respectively.

Table 3. Minerals of raw materials used in cookies preparation (mg/100g on dry weight basis)

Raw materials	Minerals (mg/100g)							
	(K)	(Ca)	(Mg)	(Na)	(P)	(Fe)	(Zn)	(Cu)
Wheat flour (72% ext.)	153.90 [c]	11.51 [f]	34.92 [d]	42.63 [d]	90.72 [d]	0.95 [d]	0.48 [d]	0.19 [c]
Carrot powder	3224.30 [b]	198.61 [d]	163.81[c]	71.18 [c]	731.21 [a]	3.82 [d]	4.11 [b]	0.96 [a]
Pumpkin powder	3286.41[b]	291.80 [c]	426.33 [b]	98.43 [b]	391.90 [b]	64.63 [a]	2.22 [c]	0.81 [a]
Spinach powder	5161.42 [a]	2110.33 [a]	761.80 [a]	177.16 [a]	370.41 [b]	31.12[b]	6.43 [a]	0.75 [b]
Chard powder	3312.81 [b]	486.22 [b]	661.11 [a]	183.21 [a]	312.60 [c]	17.15 [c]	4.30 [b]	0.61[b]

*a, b, c = Means followed by different letters in the same column are significantly different by Duncan's multiple test ($p<0.05$).

Total, soluble, and insoluble dietary fibers of raw materials used in cookies preparing

Dietary fiber, a group of plant carbohydrate polymers, includes both oligosaccharides and polysaccharides which may be associated with lignin and other non- carbohydrate components such as polyphenols, saponins and waxes. Dietary fibers have been categorized into two major groups called insoluble dietary fiber (IDF) and soluble dietary fiber (SDF) based on their water solubility (Elleuch et al., 2011). Total dietary fibers (TDF), soluble dietary fibers (SDF) and insoluble dietary fibers (IDF) of wheat flour, carrot powder, pumpkin powder spinach powder and chard powder were analyzed and the results are presented in Table 4. Concerning the dietary fibers content, the results showed that, carrot powder contained the highest percentage of TDF, SDF and IDF, which amounted in 64.19, 21.03 and 43.16 %, respectively. These results are in accordance with those obtained by (Kohajdová et al., 2012) who found that the total dietary fibers of carrot powder were 55.70%. While, there was no significant difference between each of the pumpkin powder, spinach powder and chard powder in their total dietary fibers content. (Lokuge et al., 2018) who found that the total dietary fibers of pumpkin powder ranged from 26.5 to 29.7%. Meanwhile, wheat flour had the lowest percentage of TDF, SDF and IDF, which being 4.52, 1.57 and 2.95% for wheat flour, respectively. Alshehry, (2020) observed that, wheat flour contained 3.09% TDF, 1.07% SDF, and 2.02% IDF (on dry weight basis).

Table 4. Total, soluble, and insoluble dietary fibers of raw materials used in cookies preparation (% on dry weight basis)

Raw materials	Dietary fibers (%)		
	TDF	SDF	IDF
Wheat flour (72% ex.)	4.52 [c]	1.57 [c]	2.95 [d]
Carrot powder	64.19 [a]	21.03 [a]	43.16 [a]
Pumpkin powder	28.39 [b]	7.16 [b]	21.23 [b]
Spinach powder	24.99 [b]	8.81 [b]	16.18 [bc]
Chard powder	20.24 [b]	6.43 [b]	13.81 [c]

*a, b, c = Means followed by different letters in the same column are significantly different by Duncan's multiple test ($p<0.05$).
TDF: total dietary fibers
SDF: soluble dietary fibers
IDF: insoluble dietary fibers

Chemical composition and energy value of cookies samples

Effect of addition different raw material (carrot, pumpkin, spinach and chard powder) on proximate analysis composition of processed cookies samples was tested and the results are introduced in Table 5. From the obtained data, moisture content was gradually increased in all cookies samples as amount of substitution with (carrot, pumpkin, spinach and chard) powder increased which reached to (5.87 %) for blend (T2), (6.11%) for blend (T4), (5.28%) for blend (T6) and (4.61%) for blend (T8), respectively in compared with control sample (4.26%), respectively. As for crude protein, ash and crude fibers contents, the gradual increase in substitution amounts of wheat flour by (carrot, pumpkin, spinach and chard) powder resulted in parallel increase in crude protein, ash and crude fibers contents in all cookies samples which reached to (9.53, 2.45 and 6.84 %) for blend (T2), (8.71, 4.26 and 4.63 %) for blend (T4), (9.78, 7.33 and 1.29 %) for blend (T6) and (10.81, 5.52 and 2.18 %) for blend (T8), respectively in compared with control sample (8.54, 0.96 and 0.36 %), respectively. The reason of this result may be attributed to the high protein, ash and crude fibers contents of (carrot, pumpkin, spinach and

and chard) powder, Table 2. While, fat content was highest in spinach powder samples in compared with other samples which reached to (14.18 and 14.36%) for blends (T5 and T6), respectively. The reason of this result due to the higher fat content in spinach powder, Table 2. On the other hand, total carbohydrates were decreased progressively in all cookies samples when the (carrot, pumpkin, spinach and chard) powder ratios increased which reached to (71.54%) for blend (T2), (69.39 %) for blend (T4), (63.24 %) for blend (T6) and (69.10 %) for blend (T8) as compared to (74.36 %) for the control sample. Also, caloric value were decreased when adding (carrot, pumpkin, spinach and chard) powder in cookies compared to control sample which being 438.52 (cal/100g). These results are approximately similar to those obtained by, (Galla et al., 2017) reported that the substitution of wheat flour with spinach powder resulted in increase the crude protein, crude fibers, ash and moisture content of produced biscuits samples except with decrease in the total carbohydrate and energy contents.

Table 5. Chemical composition and energy value of cookies samples (% on dry weight basis)

Cookies samples	Chemical composition (%)						
	Moisture	Crude protein	Fat	Ash	Crude fibers	Total carbohydrates	Energy Value (cal/100g)
T0	4.26 [e]	8.54 [g]	11.88 [b]	0.96 [f]	0.36 [f]	74.36 [a]	438.52 [a]
T1	5.36 [c]	8.96 [e]	10.12 [de]	2.38 [de]	6.73 [a]	73.18 [b]	419.64 [c]
T2	5.87 [b]	9.53 [d]	10.61 [cd]	2.45 [de]	6.84 [a]	71.54 [b]	419.77 [c]
T3	6.05 [ab]	8.86 [ef]	11.16 [bc]	4.22 [cd]	4.36 [b]	69.70 [c]	414.68 [e]
T4	6.11 [a]	8.71 [fg]	11.53 [b]	4.26 [cd]	4.63 [b]	69.39 [c]	416.171[d]
T5	5.18 [c]	9.54 [cd]	14.18 [a]	6.68 [b]	3.21 [c]	64.42 [cd]	423.46 [b]
T6	5.28 [c]	9.78 [c]	14.36 [a]	7.33 [a]	3.29 [c]	63.24 [d]	321.32 [b]
T7	4.53 [d]	10.32 [b]	9.64 [e]	4.48 [cd]	2.98 [d]	71.03 [b]	412.16 [e]
T8	4.61 [d]	10.81 [a]	9.96 [de]	5.52 [c]	2.18 [d]	69.10 [c]	409.28 [f]

*a, b, c = Means followed by different letters in the same column are significantly different by Duncan's multiple test ($p<0.05$).
**Carbohydrates were determined by the difference.
* T0: control cookies with 100% wheat flour, T1: cookies with 10% carrot powder, T2: cookies with 20% carrot powder, T3: cookies with 10% pumpkin powder, T4: cookies with 20% pumpkin powder, T5: cookies with 10% spinach powder, T6: cookies with 20% spinach powder, T7: cookies with 10% chard powder, T8: cookies with 20% chard powder.

Minerals contents of cookies samples

Mineral content in samples of cookies illustrated in Table 6. The results shown that, the minerals content were gradually increased by the increasing amount of substitution with (10 and 20 %) of carrot powder where K, Ca, Mg, Na, P, Fe, Zn and Cu of blend (T2) being (53.12, 33.16, 17.12, 42.18, 92.34, 2.36, 0.31 and 1.26mg/100g), respectively in compared with control sample (39.16, 12.23,16.39, 41.36, 55.21, 1.66, 0.21 and 0.89 mg/100g), for the same minerals respectively. In addition, the partial substitution of wheat flour with (10 and 20 %) of pumpkin powder increased the minerals content in cookies samples gradually in parallel with increasing the amount of substitution. While K, Ca, Mg, Na, P, Fe, Zn and Cu reached to (68.66, 36.95, 18.15, 43.40, 73.83, 7.18, 0.26 and 1.22 mg/100g) for blend (T4), respectively as compared to control sample. These results are approximately similar to those obtained by (Mala, et al., 2018 and Anitha et al., 2020) who reported that pumpkin powder were a rich source of minerals content. Also, the increasing of substitution amounts by (10 and 20 %) of (spinach and chard) powder was accompanied by gradual increase in minerals content (K, Ca, Mg, Na, P, Fe, Zn and Cu) for all cookies samples which reached to (393.63, 75.24, 27.78, 46.29, 64.51, 3.11, 0.43 and 1.13 mg/100g), for blend (T6) respectively and reached to (143.76, 52.98, 21.65, 44.68, 62.39, 2.96, 0.35 and 0.96 mg/100g), for blend (T8) respectively as compared to control sample. (Galla et al., 2017) who outline that the addition of spinach

spinach powder to biscuits samples raised the important nutrients such as Ca, Fe and P. Also, (Waseem et al., 2021) found that, the proportion of spinach powder increased in the flour blends of bakery products, the mineral contents also increased such as Na, Ca, P, Zn and Fe.

Table 6. Minerals content of cookies samples (mg/100g on dry Weight basis)

Cookies samples	Minerals (mg/100g)							
	(K)	(Ca)	(Mg)	(Na)	(P)	(Fe)	(Zn)	(Cu)
T0	39.16 g	12.23 g	16.39 f	41.36 f	55.21 f	1.66 f	0.21 g	0.89 f
T1	41.54 fg	20.21 f	16.16 f	41.81 ef	83.16 b	1.98 ef	0.27 ef	1.11 bc
T2	53.12 efg	33.16 e	17.12 ef	42.18 de	92.34 a	2.36 de	0.31 cd	1.26 a
T3	58.42 ef	26.87 f	17.26 ef	42.63 d	69.27 d	5.22 b	0.22 g	1.08 cd
T4	68.66 e	36.95 e	18.15 e	43.40 c	73.83 c	7.18 a	0.26 f	1.22 a
T5	368.6 b	61.72 b	23.13 b	45.73 a	63.42 e	2.84 cd	0.33 bc	1.06 d
T6	393.63 a	75.24 a	27.78 a	46.29 a	64.51 e	3.11 c	0.43 a	1.13 b
T7	106.13 d	40.57 d	19.78 d	43.86 c	61.16 e	2.78 cd	0.29 de	0.92 ef
T8	143.76 c	52.98 c	21.65 c	44.68 b	62.39 e	2.96 c	0.35 b	0.96 e

*a, b, c = Means followed by different letters in the same column are significantly different by Duncan's multiple test ($p < 0.05$).
* T0: control cookies with 100% wheat flour, T1: cookies with 10% carrot powder, T2: cookies with 20% carrot powder, T3: cookies with 10% pumpkin powder, T4: cookies with 20% pumpkin powder, T5: cookies with 10% spinach powder, T6: cookies with 20% spinach powder, T7: cookies with 10% chard powder, T8: cookies with 20% chard powder.

Total, soluble, and insoluble dietary fibers of cookies samples

The dietary fibers content including total, soluble and insoluble dietary fibers of cookies samples in Table 7. Obtained results it could be observed that the dietary fibers content of all cookies samples were increased by increasing of substitution amounts by 10 and 20 % of carrot , pumpkin, spinach and chard powder which reached to (4.70, 1.64 and 3.06 %) for blend (T2), (4.14, 1.38 and 2.76 %) for blend (T4), (3.67, 1.26 and 2.41 %) for blend (T6) and (3.47, 1.13 and 2.34 % on dry weight basis) for blend (T8), respectively in compared with control sample (2.84, 0.86 and 1.98 % on dry weight basis), for total, soluble and insoluble fibers respectively. These results are in agreement with (Lokuge et al., 2018) who reported that pumpkin powder is a good source of dietary fibers. Also, (Kohajdová et al., 2012 and Castro et al., 2019) they reported that carrot powder is a good source of dietary fibers.

Table 7. Total, soluble, and insoluble dietary fibers of cookies samples (% on dry weight basis)

Cookies samples	Dietary fibers (%)		
	TDF	SDF	IDF
T0	2.84 f	0.86 g	1.98 f
T1	4.19 b	1.48 b	2.71 b
T2	4.70 a	1.64 a	3.06 a
T3	3.59 cd	1.16 e	2.43 c
T4	4.14 b	1.38 c	2.76 b
T5	3.27 e	0.98 f	2.29 d
T6	3.67 c	1.26 d	2.41 c
T7	3.10 e	0.92 fg	2.18 e
T8	3.47 d	1.13 e	2.34 cd

***a**, b, c = Means followed by different letters in the same column are significantly different by Duncan's multiple test ($p<0.05$).
TDF: total dietary fibers, SDF: soluble dietary fibers, IDF: insoluble dietary fibers, * T0: control cookies with 100% wheat flour, T1: cookies with 10% carrot powder, T2: cookies with 20% carrot powder, T3: cookies with 10% pumpkin powder, T4: cookies with 20% pumpkin powder, T5: cookies with 10% spinach powder, T6: cookies with 20% spinach powder, T7: cookies with 10% chard powder, T8: cookies with 20% chard powder.

Texture profile of cookies

Some physical characteristics namely, cookies texture profile analysis (TPA) are tabulated in Table 8. Hardness was defined as the maximum peak force during the first compression cycle (first bite) indicating the hardness or softness of the product (Nur Huda et al., 2019). Increasing the replacement ratio in all carrot, pumpkin, spinach and chard powder led to a decrease in the hardness ratio, however the highest value of hardness cycle1 detected in cookies sample with spinach powder for blend T5 which reached to (65.33) comparing with the control sample (47.21), while the lowest value of hardness cycle1 detected in cookies sample with pumpkin powder for blend T4 which reached to (23.78) comparing with the control sample.

Adhesiveness was decreased with increasing the replacement ratio in all (carrot, pumpkin, spinach and chard powder), however the highest value of adhesiveness detected in cookies sample with chard powder which were (0.90 and 0.50) for (T7 and T8) comparing with the control sample (0.10) followed by sample with (carrot and spinach powder) which reached to (0.30) for (T1 and T5) comparing with the control sample. Resilience shows how well a sample resists to regain its original position (Bourne, 2002). Resilience was decreased with increasing the replacement ratio in each of (carrot and pumpkin powder) and increased with increasing the replacement ratio in each of (spinach and chard powder). However, the highest value of resilience detected in cookies sample with carrot and pumpkin powder which were 0.08 for (T1 and T3) comparing with the control sample (0.06). Fractur ability was decreased with increasing the replacement ratio in all (carrot, pumpkin, spinach and chard powder), however the highest value of fractur ability detected in cookies sample with spinach powder for T6 which reached to (65.33) comparing with the control sample (47.21), while the lowest value of fracturability detected in cookies sample with pumpkin powder for T4 which reached to (23.78) comparing with the control sample. These results are nearly in accordance with those found by (Salehi et al., 2016) with using carrot powder, (Hosseini et al., 2018) with using pumpkin powder and (Waseem et al., 2021) with using spinach powder.

Table 8. Texture profile for cookies

Cookies samples	Properties			
	Hardness Cycle1	Adhesiveness	Resilience	Fracturability
T0	47.21^{b}	0.10^{d}	0.06^{b}	47.21^{b}
T1	37.34^{d}	0.30^{c}	0.08^{a}	37.34^{d}
T2	25.47^{f}	0.10^{d}	0.05^{b}	25.47^{f}
T3	29.92^{e}	0.20^{c}	0.08^{a}	29.92^{e}
T4	23.78^{f}	0.10^{e}	0.06^{b}	23.78^{f}
T5	65.33^{a}	0.30^{c}	0.02^{c}	65.33^{a}
T6	46.39^{b}	0.10^{d}	0.03^{c}	46.39^{b}
T7	40.61^{c}	0.90^{a}	0.01^{c}	40.61^{c}
T8	40.55^{c}	0.50^{b}	0.02^{c}	40.55^{c}

*a, b, c = Means followed by different letters in the same column are significantly different by Duncan's multiple test ($p<0.05$).

* T0: control cookies with 100% wheat flour, T1: cookies with 10% carrot powder, T2: cookies with 20% carrot powder, T3: cookies with 10% pumpkin powder, T4: cookies with 20% pumpkin powder, T5: cookies with 10% spinach powder, T6: cookies with 20% spinach powder, T7: cookies with 10% chard powder, T8: cookies with 20% chard powder.

Sensory evaluation of cookies

For measuring product liking and preference, the hedonic scale is a unique scale, providing both reliable and valid results (Stone et al., 2020).

The organoleptic properties of cookies produced by using 100% wheat flour as control and cookies samples which by partial substitution of wheat flour by (10 and 20 %) of carrot powder, (10 and 20 %) of

(10 and 20 %) of pumpkin powder, (10 and 20 %) of spinach powder, (10 and 20 %) of chard powder were evaluated to select the best substitution amount for produce high quality cookies. The cookies samples were evaluated by ten panelists for surface color, surface cracking pattern, crumb color, texture, aroma, flavor and overall acceptability as shown in Table 9 and 10. About sensory evaluation of cookies samples by substitution of wheat flour by carrot powder, the results in Table 9. showed that, there were significant differences between the control sample and cookies with carrot powder (10 and 20) in sensory characteristics, except surface cracking pattern, surface color and crumb color had no significant differences. The acceptability of cookies samples decreased with the increasing amount of carrot powder supplementation (20 %). The results of overall acceptability showed that the highest value was found for sample with 10% carrot powder and control sample against the lowest value for cookies blend (20%).

On the other hand, evaluation of cookies by substitution of wheat flour by pumpkin powder, the results in Table 9. showed that, there were significant differences between the control sample and cookies with pumpkin powder (10 and 20) in sensory characteristics, except surface cracking pattern and surface color had no significant differences. The acceptability of cookies samples decreased with the increasing amount of pumpkin powder supplementation (20 %). The obtained results are in the line with those reported by (Anitha et al., 2020) who reported that pumpkin powder could be successfully added to prepare cookies up to 20 % to function as natural nutrient source with remarkable health benefits and increasing consumer acceptance.

Table 9. Sensory evaluation of cookies with carrot and pumpkin powder

Cookies Samples	Sensory properties						
	Surface cracking pattern (10)	Surface Color (10)	Crumb Color (10)	Texture (10)	Aroma (10)	Flavor (10)	Overall acceptability (60)
Carrot powder							
T0	8.90 ±2.76	8.70±2.66	8.75±2.70	9.10±2.79	9.25 ±2.84	8.90 ±2.75	53.60 ±16.24
T1	9.20 ±2.80	9.20±2.80	9.20±2.80	9.00±2.86	9.30 ±2.91	9.50 ±2.91	55.40 ±16.95
T2	8.80 ±0.63	8.70±0.82	8.70±0.82	8.30±0.48	8.70 ±0.48	9.10 ±0.57	52.30 ±2.67
LSD (at 5%)	-	-	-	0.52	0.51	0.49	2.31
Pumpkin powder							
T0	8.80 ±2.68	8.55±2.62	9.05±2.77	8.65±2.70	8.70±2.75	9.00 ±2.80	52.75 ±16.09
T3	8.90 ±2.76	8.70±2.66	8.95±2.80	9.15±2.82	9.35±2.87	9.10 ±2.84	53.75 ±16.42
T4	8.80 ±0.35	8.50±0.53	8.60±0.66	7.85±0.75	8.50±0.53	8.40 ±0.70	50.65 ±2.57
LSD (at 5%)	-	-	0.52	0.59	0.75	0.59	2.31

** Means of ten replicates ± SD.
* T0: control cookies with 100% wheat flour, T1: cookies with 10% carrot powder, T2: cookies with 20% carrot powder, T3: cookies with 10% pumpkin powder, T4: cookies with 20% pumpkin powder.

Concerning to substitution of wheat flour by spinach powder and chard powder, the results in Table (10) showed that, there were significant differences in all sensory attributes between the control sample and cookies blends (10 and 20%). Significant decrease ($p<0.05$) for surface and crumb color in cookies blends (20 %) may be due to the green color of the cookies imparted by the chlorophyll content of spinach and chard powder which affect negatively to consumers acceptability. The decrease for flavor value of cookies samples could be ascribed to herbal flavor of the spinach and chard powder. The acceptability of cookies samples decreased with the increasing amount of spinach and chard powder supplementation. The results of overall acceptability showed that the highest value was found for control sample and cookies blend 10% against the lowest value for cookies blend (20%).

Acceptable quality could be observed by incorporating spinach and chard powder up to 10 %. The obtained results are in the line with those reported by (Waseem et al., 2021) who reported that replacing wheat flour with spinach powder up to 7.5% in baked products could be a viable and adding spinach powder at a rate higher than 10% leads to a significant decrease in sensory characteristics.

Table 10. Sensory evaluation of cookies with spinach and chard powder

Cookies Samples	Sensory properties						
	Surface cracking pattern (10)	Surface Color (10)	Crumb Color (10)	Texture (10)	Aroma (10)	Flavor (10)	Overall acceptability (60)
Spinach powder							
T0	9.10 ±2.82	8.80±2.68	9.15±2.82	9.10 ±2.81	9.25 ±2.84	9.45 ±2.89	54.85 ±16.65
T5	8.60 ±2.64	7.90±2.52	7.90±2.48	8.90 ±2.70	8.55 ±2.68	8.60 ±2.68	50.45 ±15.38
T6	7.10 ±0.57	6.20±0.63	6.20±0.59	8.20 ±0.63	8.00 ±0.67	6.95 ±0.96	42.65 ±1.96
LSD (at 5%)	0.66	0.55	0.50	0.80	0.75	0.62	2.94
Chard powder							
T0	9.05 ±2.81	8.95±2.76	9.00±2.79	9.35 ±2.85	8.95 ±2.83	9.55 ±2.92	54.85 ±16.78
T7	8.90 ±2.76	8.70±2.66	8.75±2.70	9.15 ±2.81	9.25 ±2.84	8.80 ±2.73	53.55 ±16.26
T8	7.30 ±0.67	6.00±0.71	6.00±0.71	8.30 ±0.54	7.80 ±1.03	7.10 ±0.91	42.50 ±3.87
LSD (at 5%)	0.75	0.58	0.62	0.77	0.79	0.67	3.40

** Means of ten replicates ± SD.
* T0: control cookies with 100% wheat flour, T5: cookies with 10% spinach powder, T6: cookies with 20% spinach powder, T7: cookies with 10% chard powder, T8: cookies with 20% chard powder.

4. Conclusion

Due to high dietary fiber content and low calorie value for each of carrot ,pumpkin ,spinach and chard powder, the powder of the carrot, pumpkin, spinach, and chard tested in this study can be regarded ideal ingredients for cookies. Additionally, adding of carrot, pumpkin, spinach, and chard powder increased the protein, mineral, ash and fiber content, which could alleviate malnutrition since baked goods made from wheat flour are deficient in dietary fiber, minerals and ash.

Reference

Abdo, E.M., Shaltout, O.E.S., El-Sohaimy, S., Abdalla, A.E., and Zeitoun, A.M. (2021). Effect of functional beetroot pomace biscuit on phenylhydrazine induced anemia in albino rats: Hematological and blood biochemical analysis. Journal of Functional Foods, 78, 104385.

Abi Peluola-Adeyemi, O., Abdus-Salaam, R.B., Obi, T. E., and Toyiemedo, N. C. (2021). Quality evaluation of Bread produced from Wheat flour using Avocado (Persea americana) paste as substitute.

Alshehry, G.A. (2020). Preparation and nutritional properties of cookies from the partial replacement of wheat flour using pumpkin seeds powder. World, 9(2), 48-56.

Anitha, S., Ramya, H., and Ashwini, A. (2020). Effect of mixing pumpkin powder with wheat flour on physical, nutritional and sensory characteristics of cookies. Int J Commun Syst, 8(4), 1030-5.

Arfaoui, L. (2021). Dietary plant polyphenols: Effects of food processing on their content and bioavailability. Molecules, 26(10), 2959.

Assenova, B., Okuskhanova, E., Smolnikova, F., Nikolaeva, N., Vlasova, K., Gayvas, A., and Rotanov, E. (2021). Study of the chemical composition of carrot powder and its effect on the nutritional value of sausage products. International Journal of Modern Agriculture, 10(2), 3659-3669.

Astm, S. (1975). Annual book of American society of testing materials standard water.

Ayo-Omogie, H.N. (2023). Unripe banana and defatted sesame seed flours improve nutritional profile, dietary fibre and functional properties of gluten-free sorghum cookies. Food Production, Processing and Nutrition, 5(1), 1-17.

Bourne M. (2002). Food texture and viscosity: Concept and measurement Elsevier.

Castro, M., Tatuszka, P., Cox, D. N., Bowen, J., Sanguansri, L., Augustin, M.A., and Stonehouse, W. (2019). Effects on plasma carotenoids and consumer acceptance of a functional carrot-based product to supplement vegetable intake: A randomized clinical trial. Journal of Functional Foods, 60, 103421.

Chapman, H. D., and Pratt, P. F. (1978). Methods of analysis for soils, plants and waters. 50, California Univ. Div. Agriculture Science Priced Publication, 4034.

Das, A. K., Nanda, P. K., Madane, P., Biswas, S., Das, A., Zhang, W., and Lorenzo, J. M. (2020). A comprehensive review on antioxidant dietary fibre enriched meat-based functional foods. Trends in Food Science & Technology, 99, 323-336.

Elleuch, M., Bedigian, D., Roiseux, O., Besbes, S., Blecker, C., and Attia, H. (2011). Dietary fibre and fibre-rich by-products of food processing: Characterisation, technological functionality and commercial applications: A review. Food chemistry, 124(2), 411-421.

El-Sayed, S. M. (2020). Use of spinach powder as functional ingredient in the manufacture of UF-Soft cheese. Heliyon, 6(1), e03278.

Franco, V. A., GARCIA, L. G. C., & SILVA, F. A. D. (2020). Addition of hydrocolidics in gluten-free bread and replacement of rice flour for sweet potato flour. Food Science and Technology, 40, 88-96.

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 (Spinacia oleracea L.). International Journal of Gastronomy and Food Science, 7, 20-26.

Guo, C., Bi, J., Li, X., Lyu, J., Xu, Y., and Hu, J. (2021). Investigation on the phenolic composition, related oxidation and antioxidant activity of thinned peach dried by different methods. *LWT*, *147*, 111573.

Hosseini Ghaboos, S.H., Seyedain Ardabili, S.M., and Kashaninejad, M. (2018). Physico-chemical, textural and sensory evaluation of sponge cake supplemented with pumpkin flour. International Food Research Journal, 25(2).

Hussain, A., Kausar, T., Sehar, S., Sarwar, A., Ashraf, A. H., Jamil, M. A., and Majeed, M. A. (2022). A Comprehensive review of functional ingredients, especially bioactive compounds present in pumpkin peel, flesh and seeds, and their health benefits. Food Chemistry Advances, 100067.

Hussain, A., Kausar, T., Sehar, S., Sarwar, A., Quddoos, M. Y., Aslam, J. and Nisar, R. (2023). A review on biochemical constituents of pumpkin and their role as pharma foods; a key strategy to improve health in post COVID 19 period. Food Production, Processing and Nutrition, 5(1), 1-14.

Hussein, M. A., Yonis, A. A. M., and El-Mageed, A. (2013). Effect of adding carrot powder on the rheological and sensory properties of pan bread. Journal of Food and Dairy Sciences, 4(6), 281-289.

Kamaliya MK and Kamaliya KB. (2001). Baking Science and Industries. 1st Edn., 1.

Kaur, S., Panghal, A., Garg, M. K., Mann, S., Khatkar, S. K., Sharma, P., and Chhikara, N. (2020). Functional and nutraceutical properties of pumpkin–a review. Nutrition & Food Science, 50(2), 384-401.

Khouryieh, H., and Aramouni, F. (2012). Physical and sensory characteristics of cookies with flaxseed flour. Journal of the Science of Food and Agriculture, 92(11), 2366-2372.

Khoza, M., Kayitesi, E., and Dlamini, B. C. (2021). Physicochemical characteristics, microstructure and health promoting properties of green banana flour. *Foods*, *10*(12), 2894.

Kohajdová, Z., Karovičová, J., and Jurasová, M. (2012). Influence of carrot pomace powder on the rheological characteristics of wheat flour dough and on wheat rolls quality. Acta Scientiarum Polonorum Technologia Alimentaria, 11 (4), 381-387.

Kumar, S., and Brooks, M.S. L. (2018). Use of red beet (Beta vulgaris L.) for antimicrobial applications—a critical review. Food and bioprocess technology, 11, 17-42.

Li, S. F., Guo, Y. J., Li, J. R., Zhang, D. X., Wang, B. X., Li, N., Deng, C. L., and Gao, Y. (2019). The landscape of transposable elements and satellite DNAs in the genome of a dioecious plant spinach (Spinacia oleracea L.). Mobile DNA, 10 (1), 3.

Li, Y., Jiang, S., Zhu, Y., Shi, W., Zhang, Y., & Liu, Y. (2023). Effect of different drying methods on the taste and volatile compounds, sensory characteristics of Takifugu obscurus. Food Science and Human Wellness, 12(1), 223-232.

Libutti, A., Russo, D., Lela, L., Ponticelli, M., Milella, L., and Rivelli, A. R. (2023). Enhancement of Yield, Phytochemical Content and Biological Activity of a Leafy Vegetable (Beta vulgaris L. var. cycla) by Using Organic Amendments as an Alternative to Chemical Fertilizer. Plants, 12(3), 569.

Lokuge, G. M., Vidanarachchi, J. K., Thavarajah, P., Siva, N., Thavarajah, D., Liyanage, R., ... and Alwis, J. (2018). Prebiotic carbohydrate profile and in vivo prebiotic effect of pumpkin (Cucurbita maxima) grown in Sri Lanka. Journal of the National Science Foundation of Sri Lanka, 46(4).

Mala, S. K., Aathira, P., Anjali, E. K., Srinivasulu, K., and Sulochanamma, G. (2018). Effect of pumpkin powder incorporation on the physico-chemical, sensory and nutritional characteristics of wheat flour muffins. International Food Research Journal, 25(3), 1081-1087.

Manzoor, M. F., Ahmed, Z., Ahmad, N., Aadil, R. M., Rahaman, A., Roobab, U., Rehman, A., Siddique, R., Zeng, X.-A., and Siddeeg, A. (2020). Novel processing techniques and spinach juice: Quality and safety improvements. Journal of Food Science, 85(4), 1018–1026. https://doi.org/10.1111/1750-3841.15107.

Mzoughi, Z., Chahdoura, H., Chakroun, Y., Cámara, M., Fernández-Ruiz, V., Morales, P., and Majdoub, H. (2019). Wild edible Swiss chard leaves (Beta vulgaris L. var. cicla): Nutritional, phytochemical composition and biological activities. Food Research International, 119, 612-621.

Nur Huda, F.; Arifin, N. and Izyan, S. (2019). Physical properties and consumer acceptability of basic muffin made from pumpkin puree as butter replacer. Journal of Food Research, 3 (6): 840 - 845.

Pérez-Corría, K., Botello-León, A., Mauro-Félix, A. K., Rivera-Pineda, F., Viana, M. T., Cuello-Pérez, M., and Martínez-Aguilar, Y. (2019). Chemical composition of earthworm (Eisenia foetida) co-dried with vegetable meals as an animal feed. Ciencia y Agricultura, 16(2), 79-92.

Prosky, L., Asp, N. G., Schweizer, T. F., Devries, J. W., and Furda, I. (1988). Determination of insoluble, soluble, and total dietary fiber in foods and food products: interlaboratory study. Journal of the Association of Official Analytical Chemists, 71(5), 1017-1023.

Robinson, J. W., Frame, E. S., and Frame II, G. M. (2014). Undergraduate instrumental analysis. CRC press.

Sagar, N.A., Pareek, S., Sharma, S., Yahia, E.M., and Lobo, M. G. (2018). Fruit and vegetable waste: Bioactive compounds, their extraction, and possible utilization. Comprehensive reviews in food science and food safety, 17(3), 512-531.

Sakr, A.M., Hussien, H.A., and Salem, E.M. (2012). Physicochemical and sensory properties of instant noodles fortified with pomegranate peel. Journal of Food and Dairy Sciences, 3(11), 587-597.

Salehi, B., Tumer, T.B., Ozleyen, A., Peron, G., Dall'Acqua, S., Rajkovic, J., Labanca, F., and Milella, L. (2019). Plants of the genus Spinacia: From bioactive molecules to food and phytopharmacological applications. Trends in Food Science and Technology, 88, 260–273.

Salehi, F., and Aghajanzadeh, S. (2020). Effect of dried fruits and vegetables powder on cakes quality: A review. Trends in Food Science & Technology, 95, 162-172.

Salehi, F., Kashaninejad, M., Akbari, E., Sobhani, S.M., and Asadi, F. (2016). Potential of sponge cake making using infrared–hot air dried carrot. Journal of texture studies, 47(1), 34-39.

SAS (2010). Statistical Analysis System. User's Guide: Statistics, SAS Institute Inc, Gary, Nc., USA.

Snedecor, G.W., and Cochran, W.G. (1980). Statistical methods. 7th. Iowa State University USA, 80-86.

Soetan, K.O.; Olaiya, C.O. and Oyewole, O.E. (2010). The importance of mineral elements for humans, domestic animals and plants: A review. African journal of food science, 4(5): 200 -222.

Stone, H., Bleibaum, R., and Thomas, H.A. (2020). Sensory evaluation practices. Academic press.

Wani, S.H., Gull, A., Allaie, F., and Safapuri, T.A. (2015). Effects of incorporation of whey protein concentrate on physicochemical, texture, and microbial evaluation of developed cookies. Cogent Food & Agriculture, 1(1), 1092406.

Waseem, M., Akhtar, S., Manzoor, M.F., Mirani, A.A., Ali, Z., Ismail, T., and Karrar, E. (2021). Nutritional characterization and food value addition properties of dehydrated spinach powder. Food Science and Nutrition, 9(2), 1213-1221.

Yegin, S., Kopec, A., Kitts, D.D., and Zawistowski, J. (2020). Dietary fiber: A functional food ingredient with physiological benefits. In Dietary sugar, salt and fat in human health (pp. 531-555). Academic Press.