Nutritional Evaluation of Cupcake Fortified with Carrot Powder and Sweet Potato Powder

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Abstract

In the present study, the effect of carrot and sweet potato powder at levels 5,10 and 15 % on chemical composition, minerals content,caloric value, polyphenols, flavonoids, β. carotene, peroxide value during storage period , sensory evaluation and physical properties of cupcake was evaluated.The results indicated that using carrot and sweet potato powders in preparing cupcake led to decreasing moisture content. The highest values of protein were found in cupcake fortified with 10 and 15% sweet potato powder. The highest values of fat were found in cupcake fortified with 5% carrot powder and that with 5% sweet potato powder. Using carrot and sweet potato powders increased ash content, fibers, total calories, minerals , total phenolic content , total flavonoids content and β–carotene content of cupcake .Using carrot and sweet potato powders in preparing cupcake led to delaying rancidity, as it decreased peroxide value in all samples during storage period compared with control. Physical properties improved by using carrot and sweet potato powders.

Key words: Carrot, sweet potato, cupcake, sensory evaluation and physical properties .

التقييم الغذائي للكب كيك المدعم بمسحوق الجزر ومسحوق البطاطا الحلوة

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الملخص العربي :

في الدراسة الحالية تم تقييم تأثير مسحوق الجزر والبطاطا الحلوة بمستويات ٥، ١٠، ١٥% على التركيب الكيميائي ، محتوى المعادن ، القيمة الحرارية ، الفينولات ، الفلافونويدات ، البيتاكاروتين، قيمة البيروكسيد خلال فترة التخزين والتقييم الحسي والخصائص الفيزيائية للكب كيك . أشارت النتائج الى أن استخدام مساحيق الجزر والبطاطا الحلوة في تحضير الكب كيك أدى الى انخفاض محتوى الرطوبة . سجلت أعلى قيمة من البروتين في الكب كيك المدعم ب ١٠،١٥ % من مسحوق البطاطا الحلوة . سجلت اعلى قيم الدهون في الكب كيك المدعم ب ٥% مسحوق الجزر وذلك الذى يحتوى على ٥% من مسحوق البطاطا الحلوة . أدى استخدام مساحيق الجزر

والبطاطا الحلوة الى زيادة محتوى الرماد ومحتوى الألياف في الكب كيك ومجموع السعرات الحرارية والمعادن ومحتوى الفينولات الكلية ومحتوى الفلافونويدات الكلية ومحتوى البيتاكاروتين. أدى استخدام مساحيق الجزر والبطاطا الحلوة في تحضير الكب كيك الى تأخير التزنخ ، حيث انخفضت قيمة البيروكسيد في جميع العينات خلال فترة التخزين مقارنة بالعينة الضابطة . تم تحسين الخواص الفيزيائية للكب كيك باستخدام مساحيق الجزر والبطاطا الحلوة .

الكلمات المفتاحية : الجزر ،البطاطا الحلوة، الكب كيك ،التقييم الحسى ، الخصائص الفيزيائية .

Introduction

Wheat (*Triticum aestivum* L.) is a major staple crop to billions of people around the world and is used in a wide variety of food products such as bread, breakfast cereal, flatbreads, tortillas, cookies, pie crusts, soup thickeners, noodles and gravies **(Lev-Yadun *et al.*, 2000)**. Wheat has been consumed by humans but for at least 40,000 years, with bread making dating back at least 14,000 years. It currently accounts for over a quarter of all cereal production and is produced on a larger area, grown over a wider geographic range, and traded more internationally than any other arable crop. It provides 20% of the calories and protein in the global human diet, a greater contribution than any other crop **(Shiferaw *et al.*, 2013).**

Carrot *(Daucus carota* L.*)* is one of the important nutritious root vegetables grown throughout the world and it is the most important crop of *Apiaceae* family, which is considered as a main source of vitamins (A, B, C) and beta carotene. It is also considered an important source of trace elements, in addition to some phytonutrients and an excellent source of calcium pectate and pectin that has cholesterol lowering properties, and reduces the risk of high blood pressure, stroke, heart disease and some types of cancer (**Bystricka *et al.*, 2015).** Dried pomace has β carotene and ascorbic acid in amount of 9.87 to 11.57 mg and 13.53 to 22.95 mg per 100 g, respectively (**Upadhyay *et al.*, 2008)**. Dried carrot pomace can be used to develop exudates and flavours **(Alam *et al.*, 2013)**.Carrots are known as a multi-nutritional food source and are rich in natural bioactive compounds, such as phenolics, carotenoids, polyacetylenes, and ascorbic acid **(Ahmad *et al.*, 2019)**, fiber, and minerals. Carrots can be used as a functional ingredient in any product to increase the biological and nutritional values **(Ergun, 2018)**. Carrot being perishable and seasonal, it is not possible to readily make it available throughout the year. Dehydration of carrot during the main growing season is one of the important alternatives of preservation to further develop value added products throughout the year **(Krishan *et al.*, 2012)**. Current scientific researches indicate that consumption of foods containing β-carotene helps in prevention of eye disorders, skin diseases and may reduce the risk of developing certain types of cancer and heart disease (**Li *et al.*, 2016**).

Sweet potato (*Ipomoea batatas* L.) is one of locally available food crops used to consume in many parts of the world in East Africa. It is most versatile for snack food, but it is used as staple food or as a substitute in many countries for different types of foods **(Zuraida, 2003)**. It is a low input crop, wide production geography, adaptability to marginal condition, short production cycle, high nutritional value and sensory versatility in terms of flesh colors, taste and texture. It ranks the seventh most important food crop in the world and fourth in tropical countries **(FAO, 2008)**. Sweet potatoes comprise β -carotene, anthocyanins, total phenolics, dietary fiber, ascorbic acid, folic acid and minerals **(Chassy *et al*., 2008).** Orange – fleshed sweet potato cultivars often have high β - carotene content in their composition , which , once ingested is converted into pro- vitamin A by human organism resulting in beneficial health effects (**Tanaka *et al*., 2017)**. Sweet potato flour can easily be promoted as a substitute for wheat flour in sweet baked products and can also be used for its high carotenoid content. However, the price of the sweet potato flour must be competitive with wheat flour and be good quality. Sweet potato can be used in food and feed , as well as in the food industries . In addition to vitamins and minerals depending on the cultivar, sweet potatoes may have high levels of bioactive compounds , such as anthocyanins and carotenoids , which are recognized for their antioxidant activity and anti- mutagenic properties (**Rodrigues *et al* ., 2019 and Vizzotto *et al.*, 2017)**. Blending of sweet potato flour with wheat flour can be used for production of bakery goods with improved functional properties and reduced retro-graduation, staling rate and production time and also helps in making a good baking product with increased economic value **(Adeleke and Odedeji, 2010**).Sweet potato flour can add natural sweetness, color, and flavor to processed food products. It can also serve as a source of energy and nutrients and minerals and contributes to the daily nutrient needs for β-carotene, thiamin, iron, vitamin C and protein. Sweet potato flour provides 14%-28% of the dietary reference intake (DRI) for magnesium and20-39% for potassium (**Van Hal, 2000**).Sweet potato is rich in carbohydrate, dietary fiber, B-carotene, ascorbic acid, folic acid and minerals (**Bovell, 2007 and ILSI, 2008**). Therefore, sweet potato is now widely used as an important human diet around the world.

Cakes are the most commonly consumed bakery product and are increasing globally by almost 1.5% per year **(Jabeen *et al.*, 2022)**. Cakes are popular bakery items that are consumed by nearly all levels of society in Egypt due to their low price, good nutritional quality and easy availability **(Abdallah**

***et al*., 2017)**.Cakes are bakery products high in fat and sugar. Base ingredients include wheat flour, shortening, sugar, leavening agents, liquid (water, milk, or buttermilk), and eggs. Cake making requires the formation of a structure that supports these ingredients, keeping it light and delicate. Cakes can be divided in two main categories: foam and shortened. In foam type cakes (angel food, sponge, chiffon), the structure and volume depend on foaming and aeration properties of eggs. In shortened type cakes (pound cake, chocolate cake, etc.), the structure results from the fat-liquid emulsion created throughout batter processing **(Conforti, 2006)**.Cake main attributes are structure, texture, moistness, color (brown crust), high volume, and sweet flavour **(Martins *et al*., 2017)**.Cakes are largely consumed by children and adults. They are normally made with wheat flour. Cake is prepared with natural sources of beta carotene, and would help to decrease the vitamin A deficiency, which is still common in Egypt. The objective of this study is to evaluate the chemical composition of carrot and sweet potato powders , effect of using carrot and sweet potato powders at levels 5,10 and 15 % on chemical composition , caloric values ,minerals, polyphenols, flavonoids, β - carotene content of cupcake, sensory , physical properties and peroxide value of cupcake during storage at room temperature for 15 days.

Material and Methods

Materials

Carrot (*Daucus carota*) and sweet potato (*Ipomoea batatas L. Lam)* roots were obtained from local market at Kafrelsheikh city, Egypt. Commercial ingredients for baking were obtained from the same local market.

Chemicals: Alpha-amylase, protease, amyloglucosidase, sodium metabisulfate, H_2SO_4, NaOH, HNO_3, Na_2SO_4, DPPH, Folin-Ciocalteu reagent, Gallic acid, β-carotene, methanol, ethanol, were purchased from Sigma-Aldrich Co. (St. Louis, MO, USA).

Methods

Preparation of carrot and sweet potato powders

Carrot and sweet potato roots were washed in tap water, hand peeled then cut into thin slices and then blanched in hot water containing 0.1 % sodium meta-bisulphite for 3 minutes. The slices were then dried at 60^{o}C in air oven (Ecocell Drying Oven, MMM Med center, Germany 10 hours for carrot and 16hours for sweet potato). The dried slices were grounded to a fine powder using a high-speed blender mill (25000/min), (WK-1000A; Qing Zhou Machinery Co., Ltd.), then sieved through a 60 mesh. The powder samples were packed in polyethylene bags and stored at ambient temperature prior use according to methods by **(Akubor and Eze, 2012)**.

Preparation of control and fortified cupcake samples

Table (A): Ingredient used in preparing cupcake

Ingredients	Amount (g)
Flour	100
Egg yolk	43.23
Egg white	96.77
Sugar	83.87
Baking powder	5.00
Salt	1.00
Total amount	329.87

According to **Angelov *et al*., (1974)**.

In particular, a double mixing procedure was applied by partitioning the whipping of whites and egg yolk. Carrot powder and sweet potato powder were added into cupcake flour to substitute 5,10 and 15 % of wheat flour. Cake batter was distributed in cupcake molds and baked in an electric oven at 180° C for 30 min.

Proximate chemical composition

Carrot , sweet potato powder, wheat flour and fortified cupcake were analyzed for chemical composition. All analyses were carried out in triplicate. Moisture, crude protein, fat, ash and fiber content were determined according to (**A.O.A.C., 2005)**. Carbohydrate content were calculated by difference **(Menezes *et al*., 2004).**

Caloric values

Caloric values of carrot, sweet potato powders and cupcake were calculated according to (**Lawrence, 1965)**.

Caloric value (K.cal/100 g) = (protein x4)+ (carbohydrate content x4) + (fat content x 9).

Determination of minerals

The contents of minerals such as sodium and potassium were determined by the flame photometry method reported by **(Jahan *et al.*, 2011)**. Calcium, magnesium, iron and zinc were determined by flame atomic absorption spectrometry **(Kirl and Sawyer, 1991)**.

Determination of total phenols content (TPC)

Total phenolic content (TPC) of the extracts were determined calorimetrically using Folin-Ciocalteau reagent according to the method described by (**Mythili *et al.*, 2014**). 3 grams of each sample were dissolved in 25 ml of methanol 98%.The extracted sample (1 ml) was mixed with Folin-Ciocalteu reagent (1 ml with distilled water at a rate of 1:10) for 3 min then; 3 ml of 2% sodium carbonate (1 M) was added. The mixture was left at room temperature for 15 min, the polyphenolswere determined by an automated UV-VIS spectrophotometer at 765 nm and the results were calculated using a gallic acid calibration curve (0–0.6 mg/ml). Gallic acid was used to set up the standard curve (Figure 1). The blank was prepared using the same procedure with 20µl of pure water in place of the extract. The results were expressed as equivalents to gallic acid (mg GAE/g extract).

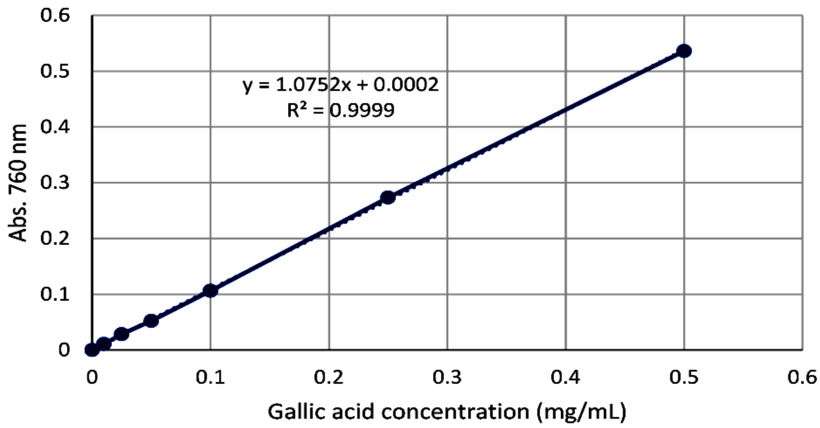

Fig. (1): Standard curve gallic acid

Determination of total flavonoids content (TFC)

The total flavonoid content (TFC) of extracts were determined according to the method described by (**Ebrahimzadeh *et al.*,2010)** and (**Nabavi *et al.*, 2009)**. 3 grams of each sample were dissolved in 25 ml of methanol 98%. 1 ml of extract was mixed separately with 1.5 ml methanol, 0.1ml of 10% aluminium chloride, 0.1ml of 1 M potassium acetate and 2.8ml of distilled water. They then left at room temperature for 10min. The absorbance of the mixture was measured at 415nm on a UV/visible spectrophotometer. The quercetin (µg/ml) was used as a standard for the calibration curve.

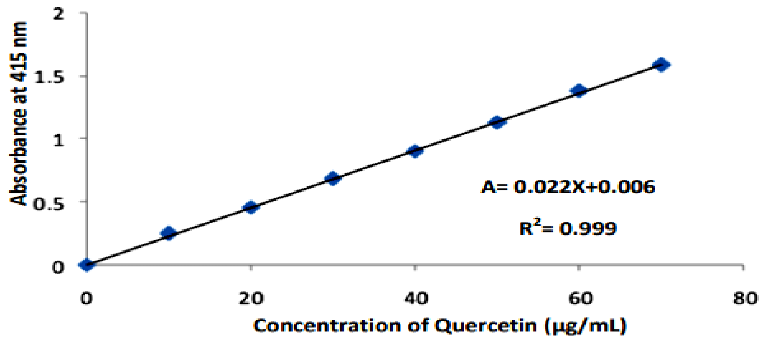

Fig. (2): Standard curve of quercetin

Determination of β - carotene

Standard preparation

The standard stock solution of (1000 ppm) concentration was prepared by dissolved the β – carotene in chloroform. The working standard solutions ranged (10 - 80 ppm) were prepared in the same solvent and kept until analysis.The liner equation is: y = 0.018 x, which is showing good linearity, precision, accuracy and sensitivity, which could be used for determination of β-carotene in cake samples.

Extraction of β-carotene:

10 g of sample were transferred to volumetric flask, 10 ml of ethanol was added and the mixture was heated for 5 minutes. The mixture then filtered and the filtrate was kept in a conical flask, the crude was collected in the bottom of the flask in round-bottom bottle, then 10 ml dichloromethane were added. The solution was condensed for 5 min. Then the supernatant was separate and added to the first filtrate, this step was done three times. The filtrate was collected in a separation funnel, then 10 ml of saturated NaCl solution was added, The contents were shaken gently then the lower layer were collected . Then 1 teaspoon anhydrous Na_2SO_4 was added and allow standing for 5 min. The filtration of contents was carried out and the samples were transferred into a dark bottle **(Pavia *et al.*, 1976)**. The absorbance of the samples was prepared by spectrophotometer for β-carotene absorption at 460 nm according to **(Souri *et al.*, 2005)**.

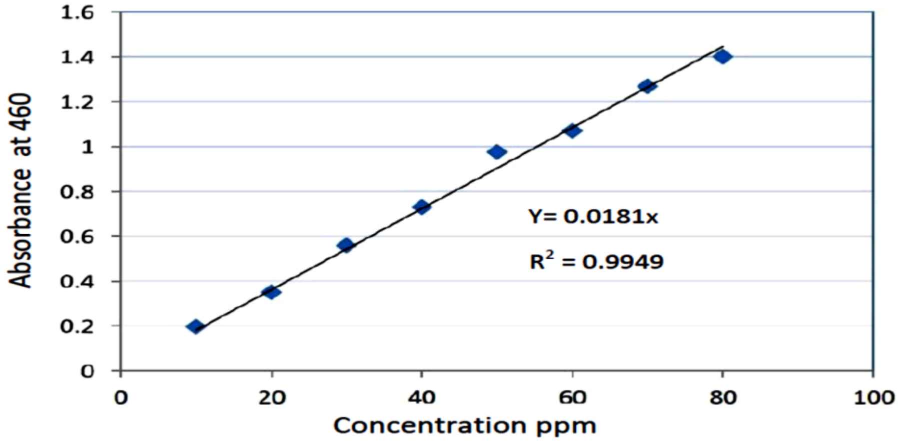

Fig. 3: The standard curve of β-carotene

Peroxide value (PV) of cupcake

Peroxide value of cupcake samples were preceded by extract the oil from samples with ethanol absolute. Filtering and evaporation of the solvent, then PV was performed according to (**A.O.A.C.,2016)**.Two mg of the cake extract were added and mixed in a solution containing chloroform-glacial acetic acid (30 ml, 3:2 v/v) and saturated thiosuphate (1 ml. 0.1M) until the disappearance of yellow color. PV (meq O_2/1000g fat) was calculated by the following equation:

PV (meq O_2/1000g oil) = C × (V-V_0) × 12.69 × 78.8 /m

Where: C: is sodium thiosulphate concentration (mol/l), V and V_O volumes of sodium thiosulphate blank, respectively (ml), and m is the mass of cake sample extracts (mg).

Sensory evaluation

Cupcakes were cooled for 1-2 h at room temperature (25±3 º C) in a sealed plastic bag. Sensory evaluation of prepared cupcake was carried out by 20 trained panelists for shape, taste, flavor, crust color ,crust characters, crumb, lightness, mouth feeling, texture, softness and acceptance .Samples were evaluated using a 7- point hedonic scale (1= dislike very much to 7= like very much) **(Eneche, 1999)**.

Physical properties

Physical properties of fortified cupcake were evaluated for weight, width, thickness and spread ratio. Weight (g) were measured by using sensitive balance (WJ, china),the width and thickness of the products were measured to the nearest (cm) according to (**A.A.C.C.,1983)**,The spread ratio was calculated according to **(A.A.C.C., 1983)**,as follows :Spread ratio (cm) = width (cm)/ thickness (cm).All objective measurements were done on triplicates and the main value was calculated.

Statistical analysis:

The data were statistically analyzed using SPSS 16.0 software. Means and standard deviations were determined using descriptive statistics. Comparisons between samples were determined using analysis of one-way variance (ANOVA) and multiple range tests. Statistical significance was defined at $P \leq 0.05$.

Results and Discussion

Chemical composition of carrot , sweet potato powder and wheat flour

Chemical compositions of carrot and sweet potato powders were showed in Table (1). The results indicated that moisture content are significantly higher for wheat flour and sweet potato powder (13.02±0.01 and 12.88±0.01 g/100 g), respectively. Protein was recorded the highest value for wheat flour and carrot powder **(**11.55±0.01 and 9.00±0.00 g/100 g), respectively. Fat was recorded the highest value for carrot powder (3.00±0.11 g/100 g) compared with (0.90±0.02 and 0.30±0.10 g/100 g), respectively for wheat flour and sweet potato powder . Carrot powder was recorded the highest value of ash (6.80±0.10 g/100 g) compared with (0.90±0.02 and 0.53±0.01 g/100 g), respectively for sweet potato powder and wheat flour, respectively. Carrot powder was rich in crude fiber (7.15±0.01 g/100 g), followed by sweet potato powder (2.30±0.10 g/100 g).Carbohydrates was recorded the highest value for wheat flour and sweet potato powder (73.24. ±0.02 and 75.32±0.10 g/100 g), respectively. Energy was recorded the highest value for sweet potato powder and wheat flour (337.18±0.11 and 347.26±0.01 k.cal/100 g.).Significant differences at $P<0.05$ were found between cupcake samples for nutrients.

Hussein *et al*.,(2013) studied the chemical composition of carrot powder and found that carrot powder analysis showed 9.2, 65.26, 2.9, 6.83 and 7.16%, respectively for crude protein, total carbohydrates, fat, ash and crude fiber .Sweet potato is low in fat (1-3% dry weight) and protein content (3-5% dry weight) **(Dansby and Bovell, 2003)**.The moisture, protein, fat, ash, and fiber concentrations of wheat flour were determined to be 11.66, 12.54, 1.44, 0.58 and 0.92 g/100g, respectively, in (**Fatema *et al*., 2021)** study.

Table (1): Chemical composition of carrot and sweet potato powder as (g/100 g)

Chemical composition	Carrot powder	Sweet potato powder	Wheat flour
Moisture	8.65±0.01 c	12.88±0.01 b	13.02±0.01 a
Crude protein	9.00±0.00 b	8.30±0.02 c	11.55±0.01 a
Crude fat	3.00±0.11 a	0.30±0.10 c	0.90±0.02 b
Ash	6.80±0.10 a	0.90±0.02 b	0.53±0.01 c
Crude fiber	7.15±0.01 a	2.30±0.10 b	0.76±0.01 c
Carbohydrates	65.40±0.10 c	75.32±0.10 a	73.24. ±0.02 b
Energy (k.cal/100 g.)	324.60±0.01 c	337.18±0.11 b	347.26±0.01 a

Mean values in the same row which are not followed by the same letter indicate significant difference at P<0.05.

Chemical composition of cupcake

The main ingredients in baked goods are refined wheat flour (*Triticum* spp.), oil, sugar, and flavorings of choice. This results in the promotion of high energy density foods that are lacking in nutrients necessary for health, such as protein, dietary fiber, and bioactive substances (**Pessanha *et al*., 2021**). Cakes are the best target snacks as food product development has progressed from routine manufacture to the combination of components for nutritional benefit (**Akoja and Coker, 2018**).

Table (2) cleared the chemical composition of cupcake .The results cleared that control sample was the highest value in moisture content as it recorded 15.76±0.15 g/100 g, it was observed that using carrot and sweet potato powders in preparing cupcake led to decreased moisture content , it may be due to that moisture content in carrot and sweet potato powders was significantly lower than that of wheat flour . The highest value of protein were found in cupcake fortified with 10 and 15% sweet potato powders (13.49±0.03 and 13.84±0.04 g/100 g), respectively, protein value decreased in carrot cupcake compared with control, these results were in agreement with **(Nahed *et al*., 2018)**. Significant differences at P<0.05

were found between all samples for protein . The fat content of cupcake cleared significant differences at P<0.05 between all samples. The highest values of fat were found in cupcake fortified with 5% carrot powder and that with 5% sweet potato powder (5.27±0.01 and 5.35±0.02 g/100 g), respectively. Ash content cleared significant differences at P<0.05 between cupcake fortified with 5,10 and 15 % carrot powder, 5,10and 15% sweet potato powder compared with control. Using carrot and sweet potato powders increased ash content, it may be due to that ash content in carrot and sweet potato powder was significantly higher than that of wheat flour .The high ash contents of fortified cupcake are clear indications of their high mineral contents. These results were in agreement with **(Nahed *et al*., 2018)**. Fiber plays a significant role in digestion and absorption of food in the human body. It also has a protective function against some diseases such as diabetes, high blood pressure and arteriosclerosis **(Betancur *et al*., 2004)**. Fibers content cleared significant differences at P<0.05 between cupcake fortified with 10, 15% carrot powder compared with control. Using carrot and sweet potato powders increased fibers content of cupcake. Results in the same line with (**Hussein *et al*., 2013)** who noticed that crude protein was slightly decreased in the produced pan bread, while ash and crude fiber contents were increased with increasing the levels of carrot powder. Carbohydrates increased by using carrot and sweet potato powders. Significant differences at P<0.05 were found among cupcake fortified with 5,10 and 15% carrot powder, Non significant differences at P<0.05 were found between cupcake fortified with 10and 15% sweet potato powder.

Carrot powder contained appreciable amount of ash and dietary fiber, it improved the mineral and fiber content of both types of biscuits **(Kumari and Grewal, 2007).**

Omran and Hussien, (2015) reported a similar trend of rising carbohydrate content regarding the addition of malted sweet potato flour during biscuit manufacture. Sweet potatoes are low in protein but rich in dietary fiber and carbohydrate content, so a successful combination of sweet potato variety with high nutritive value with wheat flour for bread production would be nutritionally advantageous. Fiber is an important nutritional contributor of sweet potatoes in human diet, so integration of wheat flour and sweet potato flour enhance the fiber content of bread and may have a significant effect on human health **(Anton, 2008).**

Table (2): Chemical composition of cupcake as (g/100 g)

Chemical composition / Samples	Moisture	Crude protein	Crude fat	Ash	Crude fibers	Carbohydrates
Control	15.76±0.15 a	13.06±0.05 c	5.17±0.01 c	0.39±0.01 f	0.80±0.01 c	64.82±0.20 e
Cupcake fortified with 5% carrot powder	14.06±0.11 ab	12.58±0.03 e	5.27±0.01 b	0.41±0.01 e	0.82±0.00 bc	66.86±0.05 c
Cupcake fortified with 10% carrot powder	12.80±0.10 ab	12.26±0.01 f	4.74±0.04 e	0.43±0.01 d	0.83±0.01 b	68.94±0.50 b
Cup cake fortified with 15% carrot powder	10.23±0.05 b	11.58±0.00 g	3.88±0.01 g	0.45±0.01 c	0.85±0.01 a	73.01±0.07 a
Cupcake fortified with 5% sweet potato powder	13.00±0.00 ab	12.72±0.02 d	5.35±0.02 a	0.45±0.01 c	0.81±0.01 c	67.67±0.05 c
Cupcake fortified with 10% sweet potato powder	13.46±0.05 ab	13.49±0.03 b	5.03±0.01 d	0.51±0.01 b	0.82±0.01 bc	66.69±0.08 d
Cupcake fortified with 15% sweet potato powder	14.10±0.10 ab	13.84±0.04 a	4.23±0.02 f	0.57±0.01 a	0.83±0.01 bc	66.43±0.14 d

Mean values in the same column which are not followed by the same letter indicate significant difference at P<0.05.

Caloric values of cupcake

The cake is one of the most common bakery products consumed all over the world. Cupcake is produced from different ingredients such as wheat flour, eggs, butter, sugar, milk and baking powder **(Fatma *et al*.,2017)**. A common ingredient is wheat flour. Replacement of the type of flour can change the cake's properties and improve the nutritive value **(Zhang *et al*., 2012)**.Table (3) showed caloric value of cupcake. Cupcake fortified with 10, 15 % sweet potato powder and control had the highest values of protein calories (53.96±0.10,55.36±0.15 and 52.24±0.01 k.cal./100g), respectively. Significant differences at P<0.05 were found among cupcake fortified with 5,10 and 15% carrot powder. Significant differences at P<0.05 were found among cupcake fortified with 5,10 and 15% sweet potato powder compared with control. Cupcake fortified with 5% carrot powder and cupcake fortified with 5% sweet potato powder recorded the highest value of fat calories (47.43±0.10 and 48.15±0.10 k.cal./100g), respectively, it may be due to protein and fat content in carrot and sweet potato powders (Table.1). Significant differences at P<0.05 were found among cupcake fortified with 5,10 and 15% carrot powder. Significant differences at P<0.05 were found among cupcake fortified with 5,10 and 15% sweet potato powder compared with control. Cupcake fortified with 10 and 15 % carrot powder recorded the highest value of carbohydrates calories (275.76±0.10 and 292.04±0.00k.cal./100g), respectively. Significant differences at P<0.05 were found among cupcake fortified with 5,10 and 15% carrot powder. Cupcake fortified with 15% carrot powder and cupcake fortified with 5% sweet potato powder recorded the highest value total calories (373.28±0.02 and 369.71±0.10k.cal./100g), respectively. Significant differences at P<0.05 were found among cupcake fortified with 5,10 and 15% carrot powder. Significant differences at P<0.05 were found among cupcake fortified with 5,10 and 15% sweet potato powder .Fat is important in the diets because it supplies essential fatty acids and facilitates the absorption of fat soluble vitamins in humans. It is also important in human diets because it is a high energy yielding nutrient **(Michaelsen *et al.*, 2000)**.

Omran and Hussien, (2015) noted a similar pattern of rising energy content by using sweet potato flour in biscuit. With substitution by sweet potato powder, the cake's energy content likewise increased significantly (P ≤ 0:05), ranging from 363.33 kcal/100 g for cake T0 (the control) to 370.82 kcal/100 g for cake T3 (30% sweet potato powder**) (Enas *et al.*,2023)**.

Table (3): Caloric values of cupcake (k.cal./100g)

Samples	Sources of calories			Total caloric values
	Protein	Fat	Carbohydrates	
Caloric values				
Control	52.24±0.01 bc	46.53±0.02 c	259.28±0.15 e	358.05±0.00 e
Cupcake fortified with 5% carrot powder	50.32±0.15 c	47.43±0.10 b	267.44±0.02 cd	365.19±0.10 d
Cupcake fortified with 10% carrot powder	49.04±0.00 d	42.66±0.15 d	275.76±0.10 b	367.46±0.15 c
Cupcake fortified with 15% carrot powder	46.32±0.02 e	34.92±0.10 e	292.04±0.00 a	373.28±0.02 a
Cupcake fortified with 5% sweet potato powder	50.88±0.15 d	48.15±0.10 a	270.68±0.00 c	369.71±0.10 b
Cupcake fortified with 10% sweet potato powder	53.96±0.10 b	45.27±0.15 c	266.76±0.15 d	365.99±0.00 d
Cupcake fortified with 15% sweet potato powder	55.36±0.15 a	38.07±0.10 e	265.72±0.10 d	359.15±0.02 e

Mean values in the same column which are not followed by the same letter indicate significant difference at P<0.05.

Minerals content of cupcake

Minerals content of cupcake included Na, Ca, Mg, K, Zn and Fe showed in Table (4). It was observed that using carrot and sweet potato increased cupcake minerals content compared with control. Cupcake fortified with

15% sweet potato powder was found to contain (6.4871, 34.2564, 29.3284, 144.3812, 1.0277 and 14.6658 mg/100g), respectively for Na, Ca, Mg, K, Zn and Fe, respectively followed by cupcake fortified with 10% sweet potato powder (5.6822, 29.1054, 26.1802, 137.1557, 0.8681 and 12.2407)), respectively. Control recorded the lowest value (2.1852, 14.1248, 15.9254, 104.2286, 0.6386 and 7.2843 mg/100g), respectively. The results of this study are comparable to those found by **(Ariyo *et al.*, 2022) and (Roger *et al.*, 2022)** who found that substitution of wheat flour with sweet potato flour increased all minerals content of cake.

Table (4): Minerals content of cupcake (per 100 g)

Minerals / Samples	Minerals (mg/100g)					
	Macro-elements				Micro-elements	
	Sodium (Na)	Calcium (Ca)	Magnesium (Mg)	Potassium (K)	Zinc (Zn)	Iron (Fe)
Control	2.1852	14.1248	15.9254	104.2286	0.6386	7.2843
Cupcake fortified with 5% carrot powder	2.6891	16.5841	16.8610	116.8942	0.6772	7.8310
Cupcake fortified with 10% carrot powder	3.4289	19.2541	17.2281	121.0736	0.70125	8.2377
Cupcake fortified with 15% carrot powder	3.9218	23.3233	19.3444	128.1054	0.7358	9.1163
Cupcake fortified with 5% sweet potato powder	4.8321	26.1069	23.5419	132.3608	0.8014	10.8119
Cupcake fortified with 10% sweet potato powder	5.6822	29.1054	26.1802	137.1557	0.8681	12.2407
Cupcake fortified with 15% sweet potato powder	6.4871	34.2564	29.3284	144.3812	1.0277	14.6658

Total phenolic content of cupcake

Phenolics or polyphenols have received considerable attention because of their physiological functions, including antioxidant, antimutagenic and antitumor activities. They have been reported to be a potential contender to combat free radicals, which are harmful to our body and foods systems **(Nagai *et al.*, 2003)**. Phenolic content of cupcake was showed in Table (5).Using carrot and sweet potato powders increased total phenolic content of cupcake (141.592±3.09, 143.043±3.11, 144.856±3.14, 147.786±3.00, 155.691±3.29 and 173.688±3.34 mg GAE/g), respectively compared with control 140.922±3.15 mg GAE/g). Non - Significant differences were found among cupcake fortified with 5,10 and 15% carrot powder. Non - Significant differences were found among cupcake fortified with 5,10 and

15% sweet potato powder. Non- significant differences at P<0.05 were found between cupcake fortified with carrot powder compared with control . Phenolic content increased significantly in cupcake fortified with sweet potato powder compared with control. These results were in agreement with **(Nahed *et al*., 2018)** who found that total phenolic compounds ranging between 19.10 and 20.21 mg/100gm for cakes with 10 and 15% carrot powder. **Dalia *et al*.,(2022)** found that carrot powder is a good source of nutrients, such as minerals,β-carotene, lycopene, phenolic compounds, and flavonoids. Phenolic contents of sweet potato range from 10.13 – 80.78 mg GAE per 100 g dry matter **(Huang *et al*., 2005)**. Phenolic contents of sweet potato recorded (42.24±2.19) mg GAE per 100 g dry matter **(Shaari *et al*., 2020)**.

Table (5): Total phenolic content of cupcake

Samples	Total phenolic content (TPC) mg GAE/g sample
Control	140.922±3.15 [c]
Cupcake fortified with 5% carrot powder	141.592±3.09 [bc]
Cupcake fortified with 10% carrot powder	143.043±3.11 [b]
Cupcake fortified with 15% carrot powder	144.856±3.14 [ab]
Cupcake fortified with 5% sweet potato powder	147.786±3.00 [a]
Cupcake fortified with 10% sweet potato powder	155.691±3.29 [a]
Cupcake fortified with 15% sweet potato powder	173.688±3.34 [a]

Mean values in the same column which are not followed by the same letter indicate significant difference at P<0.05.

Total flavonoids content of cupcake

Flavonoids content of cupcake was showed in Table (6) . Using carrot and sweet potato powders increased total flavonoids content of cupcake (57.959±1.82, 58.500±1.56 , 61.695±1.87 , 63.218±1.95 , 65.768±1.68 and 72.236±2.68 mg QE/g sample, compared with control (56.913±1.75 mg QE/g) , it may be due to flavonoids content in carrot and sweet potato powders . Non -significant differences at P<0.05 were found among cupcake fortified with carrot powder. Non-significant differences at P<0.05 were found among cupcake fortified with cupcake fortified with 5, 10% sweet potato powder compared with control. Flavonoids content increased significantly in cupcake fortified with sweet potato powder compared with control. Total flavonoids of sweet potato range from 22.02 – 35.47 mg quercetin per 100 g, dry matter **(Huang *et al*., 2005)**. Total flavonoids of sweet potato recorded 9.55± 0.82 g quercetin per 100 g dry matter (**Shaari *et al.*, 2020**).

Table (6): Total flavonoids content of cupcake

Samples	Total flavonoids content (TFC) mg QE/g sample
Control	56.913±1.75 [b]
Cupcake fortified with 5% carrot powder	57.959±1.82 [ab]
Cupcake fortified with 10% carrot powder	58.500±1.56 [ab]
Cupcake fortified with 15% carrot powder	61.695±1.87 [ab]
Cupcake fortified with 5% sweet potato powder	63.218±1.95 [a]
Cupcake fortified with 10% sweet potato powder	65.768±1.68 [a]
Cupcake fortified with 15% sweet potato powder	72.236±2.68 [a]

Mean values in the same column which are not followed by the same letter indicate significant difference at P<0.05.

β – carotene content of cupcake

Carotenoids are broadly known as provitamin A, while there is an expanding enthusiasm for their job as an antioxidant **(Bohm *et al.*, 2002).**β – carotene content of cupcake was showed in Table (7) . Using carrot and sweet potato powders increased β – carotene content of cupcake (1.247±0.10, 1.530±0.20, 1.725±0.20, 1.917±0.30, 2.055±0.40 and 2.158±0.30 mg QE/g sample), respectively compared with control (0.963±0.10 mg QE/g sample). Non-significant differences at P<0.05 were found between cupcake fortified with 5, 10 % carrot powder compared with control. Significant differences at P<0.05 were found between cupcake fortified with15% carrot powder,5,10,15% sweet potato powder compared with control. β-carotene is found in carrot powder at a rate of 1,154.20 μg/g or 115.42 mg/100g **(Pitchiah, 2004),** whereas another reported higher β-carotene (254.0 mg/100 g) on a dry basis **(Bettega *et al.*, 2014)**.The dried carrot pomace has carotene in the range of 9.87 to 11.57 mg per 100 g **(Upadhyay *et al.*, 2008)**. Carrots can give a lot of vitamin A; food matrices incredibly influence the bioavailability of the plant carotenoids or their productivity of change to vitamin A, or both **(Tang *et al.* 2005)**. Nutritional quality of food supplements based on carrot powder and grits have been reported to be good source of β-carotene, fiber and many essential micronutrients and functional ingredients **(Singh and Kulshrestha, 2008)**. Carrot is rich in β-carotene, ascorbic acid and tocopherol and is classified as vitaminized food **(Hashimoto and Nagayama, 2004)**.

Salehi *et al.*, (2016) reported that increasing the level of substitution from 0 to 30%, carrot powder, increased the β-carotene content of cakes from 4.98 to 19.94.Sweet potatoes comprise β-carotene, anthocyanins, total phenolics, dietary fiber, ascorbic acid, folic acid and minerals **(Chassy *et al.*, 2008)**.Sweet potato is rich in carbohydrate, dietary fiber, β -carotene, ascorbic acid, folic acid and minerals **(Bovell, 2007; ILSI, 2008)**. Therefore, sweet potato is now widely used as an important human diet around the world. Beta carotene-rich sweet potato (also known as orange - fleshed sweet potato) is one of a few new crops, which is both an excellent source of energy and important nutritive substances that can contribute to improve the nutrient status of the community **(Burri, 2011)**.

Table (7): β – carotene content of cupcake

Samples	β – carotene (mg/100g sample)
Control	0.963±0.10 [c]
Cupcake fortified with 5% carrot powder	1.247±0.10 [c]
Cupcake fortified with 10% carrot powder	1.530±0.20 [bc]
Cupcake fortified with 15% carrot powder	1.725±0.20 [b]
Cupcake fortified with 5% sweet potato powder	1.917±0.30 [ab]
Cupcake fortified with 10% sweet potato powder	2.055±0.40 [ab]
Cupcake fortified with 15% sweet potato powder	2.158±0.30 [a]

Mean values in the same column which are not followed by the same letter indicate significant difference at $P<0.05$.

Peroxide values (PV) of cupcake

During processing and storage numerous changes take place due to the food exposure to wide range of processing conditions. One of the most important changes that occur to bakery products is lipid rancidity on which, lower its quality and nutritional values **(Suje *et al.*, 2004)**. The measurement of rancidity in oils and fats can be carried out by different methods according to the type of rancidity. It is generally accepted that the first product formed by oxidation of oil is a peroxide or hydroperoxide. The most common method of measurement is therefore the peroxide value **(Hamilton and Kristein, 2003)**. The onset rancidity in bakery products causes a great influence on organoleptic parameters and losses the nutritional value **(Sabouri *et al.*, 2012)**. These problems may be prevented by the use of antioxidants and preservatives **(Khaki *et al.*, 2012)**. The use of synthetic antioxidants has to be limited due to their toxicity, liver damage and carcinogenicity. Therefore, the development and use of safer antioxidants from natural sources are of interest because of the possible negative effects of synthetic food additives on human health **(Nanditha *et al.*, 2009)**.Table (8) showed the peroxide value of cupcake at zero time and during storage period for 15 days. Results indicated that peroxide value increased with increasing of storage periods for 15 days . From zero time till after 15 days , fat extracted from control had the highest peroxide values, as it recorded (0.8721±0.03 at zero time to 1.6704±0.03 meq.O2/kg after 15 days). At zero time, non-significant differences at $P<0.05$ were found between cupcake fortified with 5,10,15% carrot powder compared with control. Non-significant differences at $P<0.05$ were found between cupcake fortified with 5,10,15% sweet potato powder. Utilization of carrot and sweet potato powders in preparing cupcake led to delaying rancidity, as peroxide values were less significantly in samples fortified with 10,15 % carrot powder and samples fortified with sweet potato powder after storage period compared with control. After 15 days peroxide value increased in all prepared cupcake, as it ranged between (0.7272±0.02in cupcake fortified with 15% sweet potato powder to 1.6704±0.03 meq.O2/kg in control). It could be concluded that using carrot and sweet potato powders in fortification of cupcake led to delaying rancidity ,it may be due to the content of natural phytochemical in carrot and sweet potato powders (Tables 5,6,7). These results were in agreement with (**Kordsardouei *et al.*, 2013)** and (**Eman *et al*., 2021)**.

Table (8): Peroxide values (PV) of cupcake samples during incubation period (days) at room temperature

Storage period / Samples	Peroxide Values (meq. O_2/1000 g oil) of samples		Increase T_0-T_{15}
	Zero time (T_0)	15 days (T_{15})	
Control	0.8721±0.03 [a]	1.6704±0.03 ab	0.7983
Cupcake fortified with 5% carrot powder	0.8133±0.02 a	1.1560±0.03 ab	0.3427
Cupcake fortified with 10% carrot powder	0.7835±0.03 a	0.9217±0.02 b	0.1382
Cupcake fortified with 15% carrot powder	0.7381±0.02 ab	0.8662±0.02 b	0.1281
Cupcake fortified with 5% sweet potato powder	0.7152±0.02 ab	0.8341±0.02 b	0.1189
Cupcake fortified with 10% sweet potato powder	0.7005±0.01 b	0.7846±0.01 bc	0.0841
Cupcake fortified with 15% sweet potato powder	0.6514±0.01 b	0.7272±0.02 c	0.0758

Mean values in the same column which are not followed by the same letter indicate significant difference at $P<0.05$.

Sensory evaluation of cupcake

The evaluation of a product's sensory attributes is a significant criterion that enables the assessment of its acceptability by consumers. Table (9) showed the sensory evaluation of cupcake. It is evident from the results that control , cupcake fortified with 10% carrot powder and cupcake fortified with 10% sweet potato powder recorded the highest value of shape (6.66±0.48, 6.60±0.50 and 6.40±0.50), respectively. Control and cupcake fortified with 10% sweet potato powder recorded the highest value of taste (6.13±0.74 and 6.00±0.75), respectively. Flavor value increased by using 10% carrot powder, 5% and 10% sweet potato powder(6.13±0.83, 6.20±0.77 and 6.46±0.74)), respectively. Cupcake fortified with 10% carrot powder and cupcake fortified with 10% sweet potato powder recorded the highest value of crust color (6.33±0.61 and 6.13±0.83), respectively. Control and cupcake fortified with 10% sweet potato powder recorded the highest value of crust characters(6.13±0.83 and 6.13±0.74),), respectively. Cupcake fortified with 10% carrot powder and cupcake fortified with 10% sweet potato powder recorded the highest value of crumb (6.26±0.79 and 6.46±0.63), respectively. Lightness , mouth feeling and texture increased in control and cupcake fortified with 10% sweet potato powder (6.33±0.72, 6.26±0.59),(6.60±0.91 , 6.20±0.86) and (6.80±0.56, 6.53±0.63), respectively. Softness increased in cupcake fortified with 10% carrot powder and cupcake fortified with 10% sweet potato powder (6.26±0.70 and 6.46±0.63), respectively. All cupcakes were accepted, cupcake fortified with 5,10% carrot powder, cupcake fortified with 5,10% sweet potato powder and control had the highest acceptance values (6.26±0.59, 6.46±0.74, 6.06±0.59 , 6.13±0.63 and 6.13±0.51), respectively. For shape, there were non-significant differences between cupcake fortified with 15 carrot powder and 15% sweet potato powder, while there was a significant differences any of them and control. For the other organoleptic properties there were non-significant differences at $P<0.05$ between fortified cupcake compared with control.

Oluwalana *et al.* (2012) reported that a 10% sweet potato flour substitution was preferred based on the textural properties of the bread. The results are in the same line with those of (**Singh *et al*., 2008) and (Srivastava *et al*., 2012)**, who used sweet potatoes to make cake. Additionally, the substitution of more sweet potato flour resulted in substantial changes in color, texture, flavor and overall acceptance. In sweet potato cakes, the flavor (taste and odor) score greatly improved. This might be due to common flavorings and the caramelization of free sugar during baking in sweet potato flour **(Enas *et al*.,2023)**.According to prior research on bread (**Ijah *et al*., 2014 and Zheng *et al*., 2016**), the taste panel's preference for potato cake appears to be mostly due to the bibulous rate of the potato flour being higher than that of wheat flour.

Table (9): Sensory evaluation of cupcake

Sample / Organoleptic properties	control	Cupcake fortified with 5% carrot powder	Cupcake fortified with 10% carrot powder	Cupcake fortified with 15% carrot powder	Cupcake fortified with 5% sweet potato powder	Cupcake fortified with 10% sweet potato powder	Cupcake fortified with 15% sweet potato powder
Shape	6.66±0.48 a	6.13±0.63 ab	6.60±0.50 a	5.73±0.79 b	6.26±0.70 ab	6.40±0.50 ab	5.86±0.83 b
Taste	6.13±0.74 a	5.86±0.63 a	5.93±0.88 a	5.66±0.72 a	5.93±0.79 a	6.00±0.75 a	5.80±0.67 a
Flavor	6.06±0.79 ab	5.93±0.70 ab	6.13±0.83 ab	5.86±0.83 ab	6.20±0.77 ab	6.46±0.74 a	5.46±0.51 b
Crust color	5.80±0.77 a	5.86±0.83 a	6.33±0.61 a	5.66±0.61 a	6.00±0.75 a	6.13±0.83 a	5.80±0.77 a
Crust characters	6.13±0.83 a	5.86±0.63 a	6.06±0.79 a	5.73±0.79 a	5.80±0.67 a	6.13±0.74 a	5.66±0.72 a
Crumb	6.13±0.99 a	5.93±0.88 a	6.26±0.79 a	5.86±0.83 a	6.13±0.74 a	6.46±0.63 a	5.93±0.70 a
Lightness	6.33±0.72 a	6.06±0.70 a	6.20±0.56 a	5.66±0.72 a	6.13±0.83 a	6.26±0.59 a	5.73±0.59 a
Mouth feeling	6.60±0.91 a	6.00±0.65 a	6.06±0.79 a	5.86±0.83 a	6.15±0.83 a	6.20±0.86 a	6.13±0.91 a
Texture	6.80±0.56 a	6.13±0.83 a	6.20±0.86 a	6.00±0.84 a	6.33±0.72 a	6.53±0.63 a	6.26±0.59 a
Softness	5.86±0.51 ab	6.06±0.88 ab	6.26±0.70 ab	5.86±0.63 ab	6.00±0.75 ab	6.46±0.63 a	5.60±0.63 b
Acceptance	6.13±0.51 a	6.26±0.59 a	6.46±0.74 a	5.86±0.74 a	6.06±0.59 a	6.13±0.63 a	6.00±0.65 a

Mean values in the same row which are not followed by the same letter indicate significant difference at $P<0.05$.

Physical properties of cup cake

Table (10) showing the physical properties of cupcake fortified with carrot and sweet potato powders revealed that weight increased in fortified cupcakes compared with control, while the lowest value were found in control (29.67±0.57g.). Results were in the same line of **(Khalifa *et al.*, 2016)** . These results may be related to higher water holding capacity of such additives compared to wheat flour. Results disclosed that width was in the highest value in cupcake fortified with carrot powder 15 % and sweet potato 15 % (19.30±0.10 and 19.33±0.11 cm), thickness of cupcake fortified with 15% carrot powder was the highest value (4.00±0.10 cm), while the lowest value found in cupcake fortified with 5% carrot powder (3.50±0.10 cm) .Results disclosed that the spread ratio of control was the lowest value (4.80±0.05 cm), while the highest value was found in cupcake fortified with 5% carrot powder (5.45±0.10 cm). For weight, there were significant differences at P<0.05 among cupcake fortified with 10 and 15% carrot powder, cupcake fortified with 5,10,15 compared with control. Non-significant differences at P<0.05 were found between cupcake fortified with 5% carrot powder and cupcake fortified with 5% sweet potato powder. For width, there were no significant differences at P<0.05 between cupcake fortified with 5% carrot powder and cupcake fortified with 5% sweet potato powder and between cupcake fortified with 10% carrot powder and cupcake fortified with 10% sweet potato powder too. For thickness, non-significant differences at P<0.05 were found among cupcake fortified with 10,15% carrot powder , cupcake fortified with 10,15% sweet potato powder and control. Non-significant differences were found between cupcake fortified with 5% carrot powder and cupcake fortified with 5% sweet potato powder. For spread ratio, non-significant differences at P<0.05 were found between cupcake fortified with 5,10 % carrot powder, cupcake fortified with 5,10,15% sweet potato powder. Non-significant differences at P<0.05 were found between cupcake fortified with 10,15% carrot powder compared with control. Increase in level of sweet potato in linear decrease of thickness of biscuit (**Srivastava *et al*.,(2012)**.

Table (10):Physical properties of cupcake

Physical properties / Samples	Weight g	Width cm	Thickness cm	Spread ratio cm
Control	29.67±0.57 [f]	18.40±0.10 [d]	3.83±0.06 [ab]	4.80±0.05 [b]
Cupcake fortified with 5% carrot powder	30.67±0.57 [e]	19.10±0.10 [cd]	3.50±0.10 [d]	5.45±0.10 [a]
Cupcake fortified with 10% carrot powder	31.00±1.00 [d]	19.20±0.10 [b]	3.90±0.10 [ab]	4.92±0.11 [ab]
Cupcake fortified with 15% carrot powder	31.67±0.57 [b]	19.30±0.10 [a]	4.00±0.10 [a]	4.82±0.13 [b]
Cupcake fortified with 5% sweet potato powder	30.88±0.57 [e]	19.15±0.06 [cd]	3.63±0.05 [cd]	5.27±0.08 [a]
Cupcake fortified with 10% sweet potato powder	31.22±0.57 [c]	19.23±0.05 [b]	3.76±0.05 [bc]	5.11±0.06 [a]
Cupcake fortified with 15% sweet potato powder	31.80±0.58 [a]	19.33±0.11 [a]	3.80±0.10 [ab]	5.08±0.07 [a]

Mean values in the same column which are not followed by the same letter indicate significant difference at P<0.05.

Conclusion

Carrot and sweet potato powders can be used as alternatives to wheat flour for the preparation of a number of food products. It is generally used in foods to improve sensory and physical properties and enhance the nutritional values. Carrot and sweet potato powders enhance the quality of food products from the aspects of color, flavor, acceptance and supplemented nutrients. Therefore, powders are suggested to produce better quality products which are more appealing to product developers and consumers. It has been observed that substitution of 5%, 10% and 15% wheat flour by either carrot and sweet potato powders has a positive effect on nutritional value and shelf life of cupcake.

References

A.A.C.C.(1983). American Association of Cereal Chemists. Cereal laboratory method. American Association of Cereal Chemists, INC . St .Paul. Minnesota, M.C**.**

Abdallah, M.M.F.; Ghanem, Kh.M.; Abo El-Naga, M.M.; El-Sheshtawy, A.A. and Abd El-Ghany, T.S.A.(2017). Effect of wheat flour supplemented with some seed sprouts powders on cake qualities Journal of biological chemistry and environmental sciences, 12(3): 113-130.

Adeleke, R. O. and Odedeji, J. O. (2010). Functional properties of wheat and sweet potato flour blends. Pakistan Journal of Nutrition, 9 (6): 535-538.

Ahmad ,T.; Cawood , M.; Iqbal, Q.; Ariño , A.; Batool, Rana, M. S. T. and Muhammad, A. S.A.(2019). Phytochemicals in Daucus carota and Their Health Benefits-Review Article, Food, 8(9):424.

Akoja, S.S. and Coker, O.J. (2018). Physicochemical, functional, pasting and sensory properties of Wheat flour biscuit incorporated with okra powder. International Journal of Food Science and Nutrition, 3 (5): 64-70.

Akubor, P.I. and Eze, J.I. (2012). Quality evaluation and cake making potential of sun and oven dried carrot fruit. International Journal of Biosciences, 2(10):19-27.

Alam, M.S.; Gupta, K.; Khaira, H. and Javed, M.(2013). Quality of dried carrot pomace powder as affected by pretreatments and methods of drying. Agriculture Engineering International: CIGR Journal, 15(4): 236－243.

Angelov, L.; Bekirov, B.; Genadieva, M. and Atanasov, S.(1974). Collection-branch norms,expense norms and technologicalinst-ructions in confectionaryture. Central Cooperative Union - Sofia,1:176-183.

Anton, M. (2008). Utilization of sweet potato starch, flour and fiber in bread and biscuits: physico chemical and nutritional characteristics. A thesis submitted in partial fulfillment of the requirements for the degree Master of Technology in Food Technology. Massey University.

A.O.A.C.(2005). Official Methods of Analysis of the Association of Official Analytical Chemist. 18th Ed. Washington D.C.

A.O.A.C.International, Latimer, G.W. (Eds.), (2016). Official methods of analysis. 20th edition. AOAC International, Rockville, Maryland 20850-3250, USA.

Ariyo,O.; Dudulewa, B.I. and Atojoko, M.A. (2022). Nutritional and sensory properties of biscuits based on wheat (Triticum aestivum), beniseed seed (Sesamum indicum) and sweet potato (Ipomoea batatas) composite flour. Agro-Science, 21 (2): 66-73.

Betancur, A.D.;Peraza, M. G.; Moguel, O. Y. and Yuertes, B.S.(2004). Physicochemical characterization of lima bean (*Phaseolus lunatus*) and jack bean (*Canavalia ensiformis*) fibrous residues. Food Chemistry, 84(2):287-295.

Bettega, R.; Rosa, J. G.; Correa, R. G. and Freire, J. T.(2014). Comparison of carrot (*Daucus carota*) drying in microwave and in vacuum microwave. Brazilian Journal Chemical Engineering, 31(2):403–412.

Bohm, V.; Putpitasari-Nienaber, N.L.; Ferruzzi, M.G. and Schwartz, S.J. (2002). Trolox equivalent antioxidant capacity of different geometrical isomers of alfa-carotene, beta-carotene, lycopene and zeaxanthin. Journal of Agricultural and Food Chemistry, 50 (1): 221–226.

Bovell, B. A.C.(2007). Sweet potato: A review of its past, present, and future role in human nutrition. Advances in Food and Nutrition Research, 52:1- 48.

Burri, B.J. (2011). Evaluating sweet potato as an intervention food to prevent vitamin A deficiency. Compr. Review Food Science, Food Safety. 10(2): 118-130.

Bystricka, J.P.; Kavalcova, J.; Musilova, A.; Vollmannova, T. Ó.; Tomas, T.H. and Lenkova, M. (2015). Carrot (*Daucus carota L. ssp. Sativus* (Hoffm.) Arcang.) as sources of antioxidants. Acta agriculturae Slovenica, 105(2): 303-311.

Chassy, B. M.; Egnin, Y.; Gao, K.; Glenn, G.A.; Kleter, P.;Nestel, M.; Newell-McLoughlin, Phipp, R. H. and Shillito, R. (2008). Nutritionally improved sweet potato, in Nutritional and safety assessments of foods and feeds nutritionally improved through biotechnology: Case studies (prepared by a task force of the ILSI International food biotechnology committee). Comprehensive Reviews in Food Science and Food Safety,7(1): 81-97.

Conforti, F.D. (2006). Cake manufacture. In: Y. H. Hui (Ed.), Bakery products: Science and technology (pp. 393-410). Oxford, UK: Blackwell Publishing.

Dalia, G. K.; Ahmed, R. A. H.; Mohamed, A. H.; Nagm El-diin, Nancy, A. and Asmaa, M.A.(2022). Nutritional, antioxidant, and antimicrobial assessment of carrot powder and its application as a functional ingredient in probiotic soft cheese. Journal of Dairy Science, 106(3):1672-1686.

Dansby, M.A. and Bovell, B. A.C.(2003). Sensory characterization of a ready-to-eat sweet potato breakfast cereal by descriptive analyses. Journal of Food Science, 68(2): 706-709.

Ebrahimzadeh, M. A.; Nabavi, S. M.; Nabavi, S. F.; Bahramian, F. and Bekhradnia, A. R. (2010). Antioxidant and free radical scavenging activity of H. officinalis L. Var. angustifolius,V. odorata, B. hyrcana and C. speciosum. Pakistan Journal of Pharmaceutical Sciences, 23(1): 29- 34.

Eman, A.; Wahba, El-Adawy, T. A.; Amal A. A.and El-Beltagy, A. E. (2021). Utilization of some plant material extracts to extent the shelf life of cupcakes during storage. Menoufia Journal of Food and Dairy Science,6 (10):21-31.

Enas M.E. A.; Al-Nashwy, A.A.; Abu Al-Maati ,S.M. and Eman T. A.(2023). Physico Chemical Nutritional and Sensory Properties of Cake Based on Broken Rice and Sweet Potato Composite Flour.
Food, Dairy and Home Economic Research, Zagazig Journal Agriculture Research, 50 (6) : 893-912.

Eneche, E.H.(1999).Biscuit –Making Potential of Miller /Pigeon Pea Flour Blends. Plants Foods Human Nutrition, 54(1):21-27.

Ergun, M. (2018). Evaluating carrot as a functional food. Middle East Journal Science, 4(2):113-119.

FAO (Food and Agriculture Organization). (2008). Production and area harvested statistics for sweet potato for 2007.

Fatema, H.A.; Ahdab, A. E.; Soliman, Z. and Atwaa, E.H.(2021). Physicochemical and Sensory Properties of Snacks Supplemented with Pomegranate Pomace and Mushroom Stalk Powders. Water Energy Food and Environment Journal, 2 (1):23- 30.

Fatma, I. Ş. ; Urganci, Ü. and Turan, F. (2017). Yaban mersini ilaveli muffin keklerin bazı kimyasal, fiziksel ve duyusal özellikleri. Akademik Gıda, 15(2), 130-138 .

Hamilton,C. and Kristein, D. (2003). Does rancidity as measured by peroxide value effect animal performance?.MPOB Test Method. MPOB.,Bangi:395-405.

Hashimoto, T. and Nagayama, T.(2004). Chemical composition of ready-to-eat fresh carrot. Journal Food Hygiene Society of Japan,39:324–328.

Huang, Y.C.; Chang, Y.H. and Shao, Y.Y. (2005). Effects of genotype and treatment on the antioxidant activity of sweet potato in Taiwan. Food Chemistry, 98(3), 529–538.

Hussein, M. A. ; Yonis, A. A. M. and Abd El – Mageed, H. A.(2013). Effect of Adding Carrot Powder on rheological and Sensory Properties of Pan Bread. Journal of Food and Dairy Science, Mansoura University, 4 (6): 281 – 289.

Ijah, U.J.; Auta, H.S.; Aduloju, M.O. and Aransiola, S.A. (2014). Microbiological, nutritional and sensory quality of bread produced from wheat and potato flour blends. International Journal of Food Science,(1) 2014: 1–6.

ILSI (International. Life Sciences Institute) (2008). Nutritionally improved sweet potato. Washington, D.C. Life Sciences, 7(1):81-91.

Jabeen, S.; Khan, A.U.; Ahmad, W.; Ahmed, M.U.; Ali, M.A; Rashid, S.; Rashid, A. and Rad, J.S. (2022). Development of gluten-free cupcakes enriched with almond, flaxseed and chickpea powders. Journal of Food Quality,2022(1):1-11 .

Jahan, S.; Gosh, T.; Begum, M. and Saha, B. K. (2011). Nutritional profile of some tropical fruits in Bangladesh: specially anti-oxidant vitamins and minerals. Bangladesh Journal of Medical Science, 10 (2), 95-103.

Khaki, M.; Sahari, M.A. and Barzegar, M (2012). Evaluation of antioxidant and antimicrobial effects of chamomile (Matricaria chamomilla L.) essential oil on cake shelf life. Journal of Medicinal Plants, 11(43):9-18.

Khalifa, I.; Barakat, H.; **El-Mansy, H.A. and Soliman, S.A.(2016).** Influencing of guava processing residues incorporation on cupcake characterization.Journal of Nutrition and Food Sciences, 6 (4):513-521.

Kirk, R. S. and Sawyer, R. (1991). Pearson's Composition and Analysis of Foods, 9th ed. (student edition), England: Addision Wesley Longman Ltd. 33-36.

Kordsardouei, H.; Barzegar, M. and Sahari, M. A. (2013). Application of *Zataria multiflora* Boiss and *Cinnamon zeylanicum* essential oils as two natural preservatives in cake. Avicenna Journal of Phytomedicine, 3 (3): 238-247.

Krishan, D. S.; Swati, K.; Narayan, S.T. and Surekha, A., (2012). Chemical composition, functional properties and processing of carrot Journal Food Science Technology,49(1):22–32.

Kumari, S. and Grewal, R.B.(2007). Nutritional evaluation and utilization of carrot pomace for preparation of high fiber biscuits. Journal Food Science and Technology, 44(1):56-58.

Lawrence, R.D.(1965). The diabetic life Journal and A . churchill , LTD . London. 17th edn, p. 155.

Lev-Yadun, S.; Gopher, A. and Abbo, S. (2000). The cradle of agriculture science, 288 (5471): 1602–1603.

Li, W.; Li, X. ; Wu, Z. ; Li, X. ; Yang, A. ; Tong, P. and Chen, H. (2016). Quantitative Determination of β-carotene Aided by Hexane/Ethanol Extraction. Journal of the Chemical Society of Pakistan, 38(6): 1263-1266.

Martins, Z.E.; Pinho, O. and Ferreira, I.M. (2017). Food industry by-products used as functional ingredients of bakery products. Trends Food Science and Technology, 67(7): 106-128.

Mazzonetto, A.C. and Fiates, G.M.R.(2014). Perceptions and choices of Brazilian children as consumers of food products. Appetite, 78 (7): 179-184.

Menezes,E.W.;De-Melo,A.T.;Lima,G.H.andLajolo,F.M.(2004). Measurement carbohydrate component and their impact on energy value of foods. Journal of Food Composition and Analysis, 17:331-338.

Michaelson, K.; Weaver, L.; Branca, F. and Robertson, A.(2000). Feeding and nutrition of infants and young children. Journal of Science and Immunology, 52(5):483-490.

Mythili, K.; Reddy, C.U.; Chamundeeswari, D. and Manna, P.K. (2014). Determination of total phenol, alkaloid, flavonoid and tannin in different extracts of Calanthe triplicate. Journal of Pharmacognosy and Phytochemistry, 2(2): 40-44.

Nabavi, S.M.; Ebrahimzadeh, M.A.; Nabavi, S.F.; Fazelian, M. and Eslami, B. (2009). In vitro Antioxidant and Free Radical Scavenging Activity of Diospyros lotus and Pyrus boissieriana growing in Iran. Phrmacologonsy Magazine, 5(18):122–126**.**

Nagai, T.; Reiji, I.; Hachiro, I. and Nobutaka, S.(2003). Preparation and antioxidant properties of water extract of propolis. Food Chemistry , 80 (1):29–33.

Nahed, L. Z.; Marwa, A. S.; Amany, M. S.(2018). The efficiency of some natural beta-carotene sources in improving the quality of the cake. Middle East Journal of Applied Sciences, 89(4): 1437-1450.

Nanditha, B. R.; Jena, B. S. and Prabhasankar, P. (2009). Influence of natural antioxidants and their carry- through property in biscuit processing. Journal of Agriculture and Food Science, 89: 288-98.

Oluwalana, I.B.; Malomo, S.A. and Ogbodogbo, E.O.(2012). Quality assessment of flour and bread from sweet potato wheat composite flour blends. International Journal of Biological and Chemical Sciences, 6 (1): 65-76.

Omran,A.A. and Hussien,H.A. (2015). Production and evaluation of gluten-free cookies from broken rice flour and sweet potato. Advances in Food Science, 37 (4): 184-192.

Pavia, D. L.;Lampman G. M . and Kriz, G.S. (1976).Introduction to organic laboratory Technique , Saunders Co.,Philadelphia, 50-54.

Pessanha, K.L.F.; De Menezes, J.P. ; Silva, A.D.A. ; Ferreira, M.V.S. ; Takeiti, C.Y. and Carvalho, W.P. (2021). Impact of whole millet extruded flour on the physicochemical properties and antihyperglycemic activity of gluten free bread. LWT - Food Science and Technology, 147(1): 111495.

Pitchiah, S. (2004). Development and Evaluation of Carrot Powder as A Food Ingredient. Texas Tech University Partial FulfiUment of the Requirements for the Degree of master of science, 1-72.

Rodrigues, T.M.; Sampaio, K.B. and Leite, E. (2019). Sweet potato roots: unrevealing an old food as a source of health promoting bioactive compounds: A review. Trends Food Science Technology,85: 277-286.

Roger, P.; Bertrand, B.M.M.; Gaston, Z.; Nouhman, B. and Elie, F. (2022). Nutritional Composition of Biscuits from Wheat-Sweet Potato-Soybean Composite Flour. International Journal of Food Science, (5):1-8.

Sabouri, Z.; Barzegar, M.; Sahari, M. A. and Badi, H. (2012). Antioxidant and antimicrobial potential of *Echinacea purpurea* extract and its effect on extension of cake shelf life. Journal of Medicinal Plants, 11(43): 28-40.

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: 34–39.

Shaari, N.; Shamsudin, R.; Mohd Nor, M.Z. and Hashim, N.(2020). Phenolic, flavonoid and anthocyanin contents of local sweet potato (*Ipomoea batatas*) . Journal Food Research 4 (1):74 – 77.

Shiferaw , B.; Smale, M . and Braun, H.J. (2013). Crops that feed the world 10. Past successes and future challenges to the role played by wheat in global food security. Food Security, 5(3):291-317.

Singh, P and Kulshrestha, K.(2008). Nutritonal quality of food supplements based on carrot powder and grits. Journal of Food Science and Technology,45(1):99-101.

Souri, E.; Jalalizadeh,H.; Farsam, H. and Rezwani, A. M. (2005). Simultaneous determination of anthocyanoside and beta-carotene by third derivative ultraviolet spectrophotometry , DARU ,13(1) : 6- 11.

Srivastava, S. ; Genitha , T.R and Yada, Vrijesh (2012). Preparation and Quality Evaluation of Flour and Biscuit from Sweet Potato. Journal of food processing and technology, 3(12):1-5.

Suje,K.; Abraham, J.; NThamaizah, S. and Arumughan, C.(2004). Antioxidant efficacy of sesame cake extract in vegetable oil production .Food Chemistry,84 (3):393-400.

Tanaka, M.; Ishiguro, K.; Oki, T.and Okuno, S. (2017). Functional components in sweet potato and their genetic improvement. Breed Science, 67 (1): 52-61.

Tang, G.W.; Qin, J.; Dolnikowski, G.G.; Russell, R.M. and Grusak, M.A. (2005). Spinach or carrots can supply significant amounts of vitamin A as assesssed by feeding with intrinsically deuterated vegetables. American Journal of Clinical Nutrition, 82: 821–828.

Upadhyay, A.; Sharma, H.K. and Sarkar, B.C. (2008). Characterization of dehydration kinetics of carrot pomace. Agriculture Engineering International. The CIGR E journal, 10: 1-9.

Van Hal, M.V.(2000). Quality of sweet potato flour during processing and storage. Food Reviews International, 16 (1):1-37.

Vizzotto, M.; Pereira, E.S.; Vinholes, J.R.; Munhoz, P.C.; Ferri, N.M.L. and Castro, L.A.S.(2017). Physico chemical and antioxidant capacity analysis of colored sweet potato genotypes: In natura and thermally processed.Food technology, Cienc Rural, 47: 1-8.

Zhang, Y. Y.; Song, Y.; Hu, X. S.; Liao, X. J.; Ni, Y. Y. and Li, Q. H.(2012). Effects of sugars in batter formula and baking conditions on 5-hydroxymethylfurfural and furfural formation in sponge cake models. Food research international, 49(1): 439-445 .

Zheng, Y.; Wang, Q.; Li, B. ; Lin, L. ; Tundis, R.; Loizzo, M.R. ; Zheng.; B. and Xiao, J. (2016). Characterization and prebiotic effect of the resistant starch from purple sweet potato. Molecules, 21(7): 932.

Zuraida, N. (2003). Sweet potato as an alternative food supplement during rice storage. Journal of Lubang Pertanian, 22(4): 150-155.