GLOBAL JOURNAL OF BIO-SCIENCE AND BIOTECHNOLOGY

www.scienceandnature.org

NUTRITIVE VALUE OF BAKERY PRODUCTS FROM WHEAT AND PUMPKIN COMPOSITE FLOUR

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ABSTRACT
Pumpkin (*Curcubita moschata* Duch.) is utilized for its leaves, marrow, fruit pulp and seeds. There is need to add value to the raw pumpkin products to fit into the dietary need of consumers, who are exhibiting a shift in eating habits and preferences. The shift of mineral compositions of composite flours after processing to end products necessitated the present study to be undertaken to determine the effect of preparation of different pumpkin-wheat flour-blended products. Uniform mature pumpkin fruits grown by the researchers in the Chuka University research farm were harvested and processed into flour, using a previously developed protocol. The pumpkin flour was blended with wheat at 0%, 5%, 20%, 50% and 95% w/w and used to bake bread, cakes, cookies, scones and mandazi, analysed for protein, beta-carotene, zinc, iron, calcium and energy, using distillation and spectrophotometric methods. Analysis of variance revealed significant statistical differences among the products and nutrients. In bread, there was significant difference ($P<0.05$) in iron and energy, with 0% flour giving 0.021 mg/g and 95% flour giving 0.149 mg/g. Calcium in 95% bread was 1.011 mg/g and this exceeded the recommended daily intake. In cakes, significant difference ($P<0.05$) was observed for protein, iron and energy, with 95% blending giving a high of 12%, 0.469 mg/g and 2.4 kcal/g, respectively. Cake contents were higher than bread contents. In cookies, a significant difference ($P<0.05$) resulted in protein, beta-carotene, iron and calcium. The 95% blending had high 4.375 mg/g calcium and 0.367 mg/g iron. This amount was above recommended daily intake levels, while protein and beta-carotene were below recommended daily intake requirements. For mandazi, protein, iron and calcium showed significant difference ($P<0.05$) and a high of 11.17%, 0.228 mg/g and 0.942 mg/g, respectively. It is evident that augmenting pumpkin flour increases nutritive value of food products. Augmentation levels recommended for adoption in similar human foods are up to 20% pumpkin flour.

KEYWORDS: Blending, Baking, Human nutrition, Postharvest loss, Preservation, Value Addition.

INTRODUCTION
Pumpkins belonging to the genus Cucurbita are natives of Central and South America and have spread all over the tropics and subtropics. Pumpkin (*Curcubita moschata* Duchesne) is a multipurpose fruit and leaf vegetable (Mnzava and Mbewe, 1997). Pumpkins are extensively grown in tropical and subtropical countries where they are traditionally consumed as freshly boiled and steamed or as processed foods such as soups (Bhaskarachary *et al*., 2008). The cooked mature fruit of pumpkin is popular for making sweets and desserts in South-East Asia where fruit flesh is steamed with grated coconut and sugar, or steamed fruit flesh is dusted with cassava flour and fried into crisps. The fruit is prepared into multiple dishes. In Swaziland, the flesh is cut into cubes, boiled and thickened with mealie meal to make *sidvudvu*; when milk is added it is called *ludvwidvwi*. Commercially in China, India and USA, pumpkin is canned. *Cucurbita moschata* has medicinal applications in Thailand and China (Mnzava and Mbewe, 1997). Pumpkin can be processed into flour which has a longer shelf life. Preservation of vegetables and fruits is an excellent way to curb post-harvest losses which are major challenge in Sub-Saharan Africa countries (Ptichkina *et al*., 1998; Gajigo and Lukoma, 2011). The rich nutrition base of pumpkin can be tapped to improve the nutritional quality of baked products, soups and sauces. Pumpkin powder contains 40% cellulose, 4.3% hemi-cellulose and 4.3% lignin, the main components of insoluble dietary fibre (Ptichkina *et al*., 1998). Consuming this fibre is reportedly protective against degenerative disorders such as diabetes mellitus, cardiovascular diseases, constipation, appendicitis, hemorrhoids and colon cancer. Fruit fibre buffers the stomach pH by binding to the excess acids produced by the digestive system, helps in fecal bulking and intestinal emptying (Vergara-Valencia, 2006).

Pumpkins are very rich in macro- and micro-nutrients, including calcium, iron, vitamin A, specifically unsaturated oleic and linoleic acid oil, protein, with high amounts of arginine, aspartate and glutamic acid (Usha *et al*., 2010). Due to high omega-3 (6 and 9) fatty acids, seeds and oil have been claimed to promote HIV/AIDS wellness. The lignins and phytosterols, such as delta 7-sterols and delta 5-sterols, are of special interests. Anti-oxidative compounds, such as vitamin E, especially gamma-tocopherol are also high. In fresh dried seeds, content of alpha-tocopherol is 37.5 µg/g and gamma tocopherol is 383 µg/g. However, the potential of pumpkins in food and nutrition security is yet to be fully exploited (David *et al*., 2007).

Experimental studies suggest that a higher dietary intake of carotenoids offers protection against lung, skin, uterine, cervical, gastrointestinal tract cancers, muscular degeneration, cataracts, and other health conditions linked to oxidative or free radical damage (Mavek *et al*., 2007). Special physiological activity of these compounds as vitamin A precursors and antioxidants provokes increasing interest among researchers in determining their content in different products (Mavek *et al*., 2007). Pumpkin is high in beta-carotene, a major source of vitamin A, which gives it yellow or orange colour and plays a crucial role in prevention of chronic diseases during adult life due to their antioxidant abilities (Blumberg, 1995; Jones and Engleson, 2010). Today rapid changes are taking place in every human activity domain, prompting deepening of consumer choice issues. Consumers are becoming more conscious of healthy eating and prefer locally grown foods that support a healthy lifestyle more than imported foods. To find success in today's market, food products must be conveniently prepared, while cutting back on saturated fat, cholesterol, sodium and calories (Barkema, 1993). But with changing lifestyles, there has been a fundamental shift in people's eating habits in favour of convenience, speed and nutritional benefits. Consequently regardless of culture and region, urban households are changing food consumption patterns by moving from home cooked meals to processed ones (Goyal and Singh, 2007). Thus, modern consumers are counting on the food industry to play a major role in meal preparation (Barkema, 1993; Ene, 2008). Consumer preferences have taken over and are geared towards taste, price, nutrition, health, technological innovation and convenience (Ene, 2008). The increasing demand for convenience is due to time constraints. Presently, there are more convenience products and snacks consumed at the workplace than before (Ene, 2008).

The downturn of this shift is that traditional food crops are facing poor consumption, especially in urban and cosmopolitan centers where dwellers are purchasing more processed and packaged food (Onyango *et al.*, 2008). Traditional cuisines have been replaced with away-from-home consumption meals, comprising mainly fast foods. Furthermore, pleasure in eating fast foods is a major characteristic of today's demanding or "spoilt" consumer, who is looking for reward and comfort in food (Ene, 2008). The consumption of baked products such as bread, cakes, biscuits and doughnuts made from wheat flour is very popular (Young, 2001) and such are the third most important components of staple diets (Cichon and Misniakiewicz, 2001). Their nutritional value depends on the recipes used in production. The low protein content of wheat flour, due to deficiency in one or two essential amino acids, and yet it is the most vital ingredient in these baked products, is the major concern in its utilization (Gopalan *et al*., 1991; Young, 2001; Cichon and Misniakiewicz, 2001). The use of white flour from processed whole wheat grain leads to drastic reduction in nutritional density and fibre content (Maneju *et al*., 2011). These days, awareness by consumers on the need to eat high quality and healthy foods, known as functional foods that contain ingredients providing additional health benefits beyond the basic nutritional requirements, is increasing (Ndife and Abbo, 2009). Therefore, the trend is to produce specialty breads made from whole grain flour augmented with other functional ingredients. Use of functional ingredients is increasingly becoming important in bakery industries and emerging markets (Dewettinck *et al*., 2008). Bakery and confectionary products are fortified with nutrients for enrichment (Tee and Lim, 1991).

Functional snacks that combine the nutritional benefits of wheat flour with the rich pumpkin four has been proposed for the market to cater for different clientele looking for increased intake of essential nutrients and fiber. The objective of the present study was to formulate and develop functional baked and deep-fried snacks using wheat flour composited with pumpkin flour.

MATERIALS & METHODS

Preparation of Pumpkin Flour

Pumpkin flour was prepared from mature pumpkin fruits of one landrace grown in the Chuka University farm. Fruits were peeled, enhanced-solar-dried and ground to powder using previously developed protocol and procedures (Kiharason *et al*., 2016).

Formulations of Pumpkin-Blended Products

Five types of bakery products namely: cake, cookies, scones, bread and *mandazi* were prepared using five levels of pumpkin flour to substitute wheat flour in the formula of each product at 0%, 5%, 20%, 50% and 95% rate. The ratio of pumpkin and wheat flours was varied in each recipe, while holding all other ingredients constant. All products were arranged and tested in a Completely Randomized Design (CRD). Recipes used in preparing the products are as described below:

Wheat and pumpkin flour blended cake

The ingredients were 200 g (50%) all-purpose wheat flour, 200 g (50%) pumpkin flour, 200 g margarine, 200 g sugar, 10 g baking powder and 3 eggs. The flours and baking powder were sifted, margarine rubbed in followed by sugar addition and mixing. Eggs were then beaten, added to the mixture and mixed thoroughly. The mixture was poured into tins and baked at 135^{o}C for 35 minutes until the cake developed a distinct scent and golden brown crust.

Wheat and pumpkin flour blended cookies

The ingredients were 200 g (50%) all-purpose flour, 200 g (50%) pumpkin flour, 160 g butter at room temperature, 40 g shortening, 2 eggs at room temperature, 200 g sugar and ½ teaspoon salt. The butter and shortening were mixed together using a wooden spoon until uniform. Sugar was added and mixed until ingredients were light and fluffy. Eggs were added and the mixture stirred until ingredients were well combined. The flour, baking powder and salt were whisked together in a separate bowl and ⅓ of the dry ingredients added to the bowl of wet ingredients and stirred until they were just combined. Dry ingredients were gradually added continuously while stirring. The oven was pre-heated to 205°C and a baking sheet lined with parchment paper. The dough was scooped out using a tablespoon and shaped into balls using clean hands. Each ball of dough was placed onto the baking sheet, leaving about 5cm of space all around for spreading as it cooked. The cookies were baked for up to 10 minutes, removed from the oven, cooled for 2 minutes, loosened using a spatula and placed on wire racks to cool down more.

Wheat and pumpkin flour blended scones

The ingredients were 200 g (50%) all-purpose flour, 200 g (50%) pumpkin flour, 30g fat, 125 ml milk, 12.5 g baking powder, and 2.5 g salt. The flour was sifted with other dry ingredients into a large mixing bowl and rubbed in fat while aerating at the same time. A deep well was made in the flour where almost all liquid ingredients were poured and mixed to soft dough with a palette knife. The remaining liquid ingredients were added. On a floured surface, dough was kneaded very lightly until it was just smooth and divided into two pieces that were each lightly shaped into a ball. Each piece was then flattened to 2 cm thickness and cut into 6 triangles. The oven was pre-heated and scones brushed with beaten eggs for a glossy crust. Scones were left to rest for 10 to 15 minutes before baking at 245^{o}C at the top oven, until well risen and brown.

Wheat and pumpkin flour blended mandazi

The ingredients were 200 g (50%) wheat flour, 200 g (50%) pumpkin flour, 100 g margarine, 100 g sugar, 500 ml cooking oil, 3 eggs, 2 teaspoons baking powder and 125 ml milk. All ingredients were mixed by combining dry ingredients well, then adding the beaten eggs and milk. The dough was left to stand for about 15 minutes to rise. Meanwhile, oil was heated in a deep frying pan. Dough was rolled over a lightly floured surface into 0.625 cm thickness, cut into desired size and shape, deep-fried until golden brown and then drained on paper towels.

Wheat and pumpkin flour blended bread

The ingredients were 200 g (50%) strong flour, 200 g (50%) pumpkin flour, 12 g vegetable fat, 240 ml water, 16 g fresh yeast, 16 g sugar and 8 g salt. Baking tins were lightly greased. Flour and salt were shifted into a large bowl. Fat was added and rubbed into flour using finger tips. One-third of water was boiled and added to the remaining cold water to make it warm. Fresh yeast and sugar were put into a basin and mixed with the liquid. A deep hole was made in the flour and the liquid mixture added and mixed thoroughly using hands with a clawing movement for 3 minutes until the dough freely peeled off fingers. Dough was turned onto lightly floured surface and kneaded for 10 minutes until smooth and elastic. Dough was shaped, covered with greased heat-proof polythene and left to rise for 45 minutes. Dough surface was then dusted with flour and baked in a hot oven at 245^{o}C until golden brown.

Determination of products' nutritive value

In determination of nutrient contents, four replicates of each blending level and product were analysed for β-carotene, protein, zinc, iron, calcium and calories. Beta-carotene was determined by extracting 2 g of each sample using acetone. The sample was crushed using a mortar and pestle until the residue turned colourless. The extract was passed through a funnel stuffed with glass wool, and then 25 ml of this extract was put in a round-bottomed flask and evaporated to dryness at about 60°C. A 1ml of petroleum ether was added into the evaporated sample to dissolve the β-carotene. The solution was then eluted using a column chromatography. For preparation of the column, slurry made from silica gel with 60-120 mesh and petroleum ether was laid in a glass column of 15cm in length fitted with glass wool at the elution point. After the slurry had settled, the column top was packed with anhydrous Na_2SO_4, and 1 ml absolute ethanol was added to activate both anhydrous Na_2SO_4 and silica gel. The mixture was then eluted using petroleum ether until a volume of 25 ml had been collected. The elute absorbance was read in UV-VIS spectrophotometer (Shimadzu Pharmaspec Model 1700) at 450 nm. Five standard solutions of β-carotene with concentrations between 0.4 μg/g and 2.4 μg/g were prepared and their absorbance read at the same wavelength and plotted against their corresponding concentrations to give a standard curve (Okalebo *et al*., 2002). Beta-carotene was determined using the formula: Beta-carotene = (0.4/0.12)*(Absorbance*FV/sample weight)*DF, where FV = final volume, DF = dilution factor.

Protein analysis was done by weighing 0.3 g sample, putting in a test tube, adding 4ml of digestion mixture with H_2SO_4, H_2O_2 and selenium catalyst, and reagent blanks for each sample batch. These were digested for 1 hour at 110°C and 330°C to complete digestion in a digester. Mixture turning colourless indicated complete digestion then 25 ml of distilled water was added and mixed well until no more sediment dissolved. The mixture was allowed to cool and made up to 50 ml using distilled water, allowed to settle and then a clear solution was taken from top to determine total nitrogen by Kjeldal method, where 25 ml NaOH were dispensed in the digested sample in a conical flask, then 25 ml of boric acid added plus 3 drops of mixed indicator with 0.99 g bromocressol green, 0.066 g methyl red and 0.011g thymol blue in 1ml ethanol. Distillation was done to 150 ml in a conical flask. The pale pink colour of the distillate turned to green. The distillate was back-titrated with 0.1 M HCl until the colour changed from green to pale pink (Okalebo *et al*., 2002). The amount of HCl used was recorded and the percentage protein determined using a conversion factor 6.25 (AOAC, 1990). Protein % = (T5-TB)× 0.1× N14.007× 100/ [0.3×6.25 (F)], Where: T5 = titration volume for sample (ml); TB = Titration volume for blank (ml); N = normality of acid; F = conversion factor for N_2 to protein.

Mineral analysis was done by weighing 10 g of samples from four replicates of each of the blending levels. For analysis of Ca, Fe and Zn contents in the sample, 0.3 g of the sample was weighed and placed in a dry clean glass digestion tube, 4 ml of the digestion mixture with selenium-sulphuric acid mixture added and heated to 300^{o}C in a block digester, until the digest turned colourless or pale yellow. The tubes were then removed from the block digester and cooled to room temperature. The digest was then transferred into a 100 ml volumetric flask and filled to the mark with de-ionized water. After cooling, the digests were analyzed for trace metals of calcium, iron and zinc by measuring their absorbance at 422.7 nm, 248.33 nm and 213.86 nm, respectively, using an Atomic Absorption Spectrophotometer (Shimadzu Model AA-6300, Tokyo-Japan). Standards of 2.5, 5.0, 7.5 and 10ppm were prepared from 1000ppm standard stock solution and absorbance determined. The stock solutions were prepared from salts of calcium, iron and zinc nitrates for calcium, iron and zinc standards, respectively. The results were used to construct calibration curves with absorbance against corresponding concentration.

Determination of calorific value of the products was done using oxygen combustion bomb calorimeter using benzoic acid as standard (AOAC, 1990) whereby 1 g of sample was weighed in a crucible and placed inside a stainless steel container filled with 30 bar of oxygen. The sample was ignited using a cotton thread connected to an ignition wire inside the bomb calorimeter and burned. Temperature change was monitored and recorded at 3 minutes intervals. The heat created during the burning process was determined by comparing with the heat obtained from 1 g of standard benzoic acid. The calorific value of the food sample was calculated by multiplying its temperature rise in the calorimeter by the previously determined energy equivalent from the standard and divided by the weight of the sample.

Data Analysis

Data were subjected to ANOVA using SAS version 9.3. Significant means were separated using the Least Significance Difference test at $P = 0.05$.

RESULTS

Content of various nutrients in cake was determined and results are shown in Table 1. ANOVA analysis showed significant difference ($P<0.05$) in protein, iron and energy at different pumpkin flour (PF) blending levels. The 95% blending had the highest 12.3% protein, while 0% blending had a low of 2.9% protein. Iron content increased with increasing PF, and 95% blending yielded the highest 0.4690 mg/g, while 0% blending yielded the least 0.3789 mg/g. Calorific value was lowest at 2.49 kcal/g for 95% blending and highest 3.49 kcal/g for 0% blending. All the nutrients increased with increasing PF, but energy content had a slight decrease with increasing PF. Analysis of cookies indicated a significant difference in protein, beta-carotene, calcium and iron. Beta-carotene was highest at 5.8µg/g for 95% blending and lowest for 5% blending (Table 2). Calcium and iron also showed an increasing trend with increasing PF, where calcium reached a maximum of 4.3759 mg/g.

Results for mandazi generally revealed higher amounts of protein, calcium and zinc with increasing pumpkin flour. Table 3 shows higher levels of protein (11.1%), beta-carotene (13.8 µg/g), 0.9422 mg/g of calcium and zinc (0.1922 mg/g) for 95% blending, compared to less amounts of the same nutrients at less PF levels. Calories were 3.0 kcal/g for 95% blending, compared to 3.2 kcal/g for 0% level. Significant differences ($P<0.05$) occurred in protein and iron contents across the various blending levels.

TABLE 1: Means of nutrient content of pumpkin cake at five blending levels

Level (% PF)	Protein (g/100g)	β-carotene (µg/g)	Calcium (mg/g)	Iron (mg/g)	Zinc (mg/g)	Energy (kcal/g)
1 (0%)	0.0291c *	0.500b	3.401b	0.3789c	0.1206a	3.4958a
2 (5%)	0.0328c	1.2025ab	3.627ab	0.4095bc	0.1448a	3.4712a
3 (20%)	0.0897b	1.655ab	3.797ab	0.4419ab	0.1442a	3.0785b
4 (50%)	0.0992b	2.1275ab	3.877a	0.4643a	0.1426a	2.7990bc
5 (95%)	0.12.3275a	3.040a	3.922a	0.4690a	0.1416a	2.4942c
F-value	76.51	2.46	2.31	4.91	0.91	17.28
P-value	<.0001	0.1015	0.1178	0.014	0.4914	<.0001
LSD	1.4749	1.8798	432.47	53.098	33.151	0.3204
RDI (adult)	34-71 g/d	*600-1300 µg/d	1000-1300 mg/d	8-18 mg/d	8-13 mg/d	2403-3067 kcal/d
RDI (child)	13-19 g/d	*300-400 µg/d	500-800 mg/d	7-10 mg/d	3-5 mg/d	1046-1742 kcal/d

*Means followed by the same letter within a column are not significantly different at $P = 0.05$. PF = pumpkin flour. g/d = grams per day. mg/d = milligrams per day. kcal/d = kilocalories per day. *applies to retinol: 1 µg retinol=12 µg β-carotene, hence RDI values should be multiplied by 12 to relate to table values (Wardlaw *et al*., 2004).

TABLE 2: Means of nutrient content of pumpkin cookies at five blending levels

Level (% PF)	Protein (g/100g)	β-carotene (µg/g)	Calcium (mg/g)	Iron (mg/g)	Zinc (mg/g)	Energy (kcal/g)
1 (0%)	0.0321b	1.455b	0.3416c	0.2393c	0.1355b	4.3563a
2 (5%)	0.0415b	1.708b	0.6476c	0.2781bc	0.1522ab	4.1563ab
3 (20%)	0.0474ab	1.763b	3.8999b	0.2970b	0.1548ab	4.1515ab
4 (50%)	0.0532ab	4.293a	4.1606ab	0.3076b	0.1648ab	4.1118ab
5 (95%)	0.0656a	5.835a	4.3759a	0.3675a	0.1729a	3.9921b
F-value	3.28	5.99	181.2	6.9	1.85	2.37
P-value	0.0492	0.0069	<.0001	0.004	0.1838	0.1108
LSD	2.1392	2.4611	460.03	54.905	31.982	460.03
RDI (adult)	34-71 g/d	*600-1300 µg/d	1000-1300 mg/d	8-18 mg/d	8-13 mg/d	2403-3067 kcal/d
RDI (child)	13-19 g/d	*300-400 µg/d	500-800 mg/d	7-10 mg/d	3-5 mg/d	1046-1742 kcal/d

Means followed by the same letter within a column are not significantly different at $P = 0.05$. PF = pumpkin flour. g/d = grams per day. mg/d = milligrams per day. kcal/d = kilocalories per day. *applies to retinol: 1 µg retinol=12 µg β-carotene, hence RDI values should be multiplied by 12 to relate to table values (Wardlaw *et al*., 2004).

TABLE 3: Means of nutrient content of pumpkin Mandazi at five blending levels

Level (% PF)	Protein (g/100g)	β-carotene (μg/g)	Calcium (mg/g)	Iron (mg/g)	Zinc (mg/g)	Energy (kcal/g)
1 (0%)	0.0262c *	6.278b	0.5900a	0.1467c	0.1418a	3.2573a
2 (5%)	0.0306c	6.563b	0.6136a	0.1584c	0.1696a	3.2445a
3 (20%)	0.0350c	10.250ab	0.6581a	0.1777bc	0.1845a	3.2416a
4 (50%)	0.0649b	10.858ab	0.8856a	0.2094ab	0.1867a	3.1658a
5 (95%)	0.1117a	13.830a	0.9422a	0.2289a	0.1922a	3.0952a
F-value	16.76	2.18	0.65	5.36	0.99	0.39
P-value	<.0001	0.1327	0.6373	0.0103	0.4495	0.809
LSD	2.6946	6.6078	624.66	45.856	62.916	0.3394
RDI (adult)	34-71 g/d	*600-1300 μg/d	1000-1300 mg/d	8-18 mg/d	8-13 mg/d	2403-3067 kcal/d
RDI (child)	13-19 g/d	*300-400 μg/d	500-800 mg/d	7-10 mg/d	3-5 mg/d	1046-1742 kcal/d

*Means followed by the same letter within a column are not significantly different at $P = 0.05$. PF = pumpkin flour. g/d = grams per day. mg/d = milligrams per day. kcal/d = kilocalories per day. *applies to retinol: 1 μg retinol=12 μg β-carotene, hence RDI values should be multiplied by 12 to relate to table values (Wardlaw *et al*., 2004).

In scones, a significant difference ($P<0.05$) was noted in all nutrients except zinc. Specifically, zinc was lowest (0.1143 mg/g) in level 1 and highest (0.1202 mg/g) in level 5, although there were no significant differences in zinc content across the five levels (Table 4). Both beta-carotene and calcium showed an increasing trend with increasing pumpkin flour levels, with a high of 5.2 μg/g and 4.0246 mg/g respectively in level 5. Energy levels were noted to reduce with increasing pumpkin flour, whereby level 5 recorded the lowest (2.2 cal/g).

TABLE 4: Means of nutrient content of pumpkin scones at five blending levels

Level (% PF)	Protein (g/100g)	β-carotene (μg/g)	Calcium (mg/g)	Iron (mg/g)	Zinc (mg/g)	Energy (kcal/g)
1 (0%)	0.0372c *	0.6375b	3.1747c	0.0563b	0.1143a	2.8401a
2 (5%)	0.0517bc	0.290b	3.2200bc	0.5712ab	0.1143a	2.6789a
3 (20%)	0.1014ab	1.300b	3.5940abc	0.6068ab	0.1172a	2.6438a
4 (50%)	0.1116a	3.920a	3.6619ab	0.6567a	0.1190a	2.6687a
5 (95%)	0.1269a	5.250a	4.0246a	0.6595a	0.1202a	2.2189b
F-value	5.33	23.78	5.02	3.65	0.1	5.36
P-value	0.0106	<.0001	0.013	0.0362	0.9795	0.0103
LSD	5.2225	1.3818	480.51	91.861	25.898	480.51
RDI (adult)	34-71 g/d	*600-1300 μg/d	1000-1300 mg/d	8-18 mg/d	8-13 mg/d	2403-3067 kcal/d
RDI (child)	13-19 g/d	*300-400 μg/d	500-800 mg/d	7-10 mg/d	3-5 mg/d	1046-1742 kcal/d

*Means followed by the same letter within a column are not significantly different at $P = 0.05$. PF = pumpkin flour. g/d = grams per day. mg/d = milligrams per day. kcal/d = kilocalories per day. *applies to retinol: 1 μg retinol=12 μg β-carotene, hence RDI values should be multiplied by 12 to relate to table values (Wardlaw *et al*., 2004).

When bread was analysed for various nutrients, higher contents were found in 95% for calcium, iron and beta-carotene that were 1.011 mg/g, 0.149 mg/g and 5.1μg/g, respectively. Protein content was high (more than 12%) in 5% to 95% blending, as compared to 0% blending that had a low of 11%. Significant differences ($P<0.05$) resulted in iron content and calories (table 5).

TABLE 5: Means of nutrient content of pumpkin bread at five blending levels

Level (% PF)	Protein (g/100g)	β-carotene (μg/g)	Calcium (mg/g)	Iron (mg/g)	Zinc (mg/g)	Energy (kcal/g)
1 (0%)	0.1108b *	1.433b	0.2736b	0.0216a	0.0344b	2.6792a
2 (5%)	0.1284ab	3.583ab	0.2850b	0.0739c	0.0407ab	2.4494b
3 (20%)	0.1298ab	3.768ab	0.4549ab	0.1064bc	0.0512ab	2.3141bc
4 (50%)	0.1350a	5.125a	0.8063ab	0.1175ab	0.0551ab	2.2147bc
5 (95%)	0.1378a	5.128a	1.0113a	0.1495a	0.0631a	2.1104c
F-value	1.91	1.8	2.84	13.45	1.99	4.67
P-value	0.1743	0.1931	0.0717	0.0002	0.1605	0.0167
LSD	2.3481	3.4745	601	40.801	24.95	0.3151
RDI (adult)	34-71 g/d	*600-1300 μg/d	1000-1300 mg/d	8-18 mg/d	8-13 mg/d	2403-3067 kcal/d
RDI (child)	13-19 g/d	*300-400 μg/d	500-800 mg/d	7-10 mg/d	3-5 mg/d	1046-1742 kcal/d

*Means followed by the same letter within a column are not significantly different at $P = 0.05$. PF = pumpkin flour. g/d = grams per day. mg/d = milligrams per day. kcal/d = kilocalories per day. *applies to retinol: 1 μg retinol=12 μg β-carotene, hence RDI values should be multiplied by 12 to relate to table values (Wardlaw *et al*., 2004).

DISCUSSION

Changes occurred in contents of various nutrients in products prepared from various wheat-pumpkin flour composites as compared to the control products. Most of the micronutrients as well as protein increased with addition of PF into the recipe. In cookies, scones and bread the trend was similar, with up to 50% more protein realized in pumpkin blended products, while mandazi recorded as high as 450% more protein with increasing PF level in the recipe. There was more iron content in the products with increasing PF in all the products, some of which showed drastic improvement. Scones had more than 1000% more iron in 95% blending level compared to 0% level. The other products had between 14% and 64% more iron in blended products compared to the control. Calcium also showed a similar trend where products had between 11% and 24% more calcium from level 3 through level 5.

The nutrient increases were attributed to the addition of PF which is very rich in both macro- and micro-nutrients. Usha et al. (2010) observed calcium, iron and vitamin A to be among the most abundant micronutrients in pumpkin, as well as proteins especially as amino acids arginine, aspartate and glutamic acid. Increasing PF levels in the recipes was the reason for increase in the nutrients.

The results are comparable with previous studies which reported increased beta-carotene content from trace amounts in a standard weaning mix compared to 110.8 µg/g in weaning mix fortified with 20% PF (Usha *et al*., 2010). Das and Banerjee (2015) in their study similarly reported significant enhancement in the protein, beta carotene and fibre contents of bakery products supplemented with PF. Previous studies have shown increased protein levels with increased PF (Pratyush et al., 2015). Usha *et al.* (2010) reported an increase of protein from 4.61g in a standard weaning mix to 5.8g in the same product enriched with 20% PF. A study on pumpkin blended biscuits recorded more calcium, iron and phosphorus compared to the control biscuit, as reported by Kulkarni and Joshi (2012).

Energy content, on the other hand, showed a uniform trend of slight reductions with increasing PF across all products. At highest PF levels, cake had up to 11% reduction in energy content, while cookies showed a 5% reduction, mandazi up to 7% and scones up to 21% less energy. The reduction of calories with increasing PF can be associated with more fibre content, and PF has been found to contain high amounts of fibre which includes cellulose at 40.4g/100g, hemicelluloses (4.3g/100g) and lignin at 4.3g/100g (Pratyush *et al*., 2015 and Ptitchkina *et al*., 1998). See et al. (2007) reported that substitution of PF to wheat flour led to a reduction in total carbohydrate content of breads. Similarly, Ndife and colleagues (2011) reported lower carbohydrate content in wheat and soy flour composite breads, which had higher fibre content. High fibre was the reason for reduced calories under increased PF levels in the recipes used in this study. Snacks with more fibre, which translate to reduced calories, are considered healthier as they are associated with reduced risk to lifestyle diseases (Vergara-Valencia, 2006).

CONCLUSIONS & RECOMMENDATIONS

The present study revealed the positive effect of replacing wheat flour with PF on the nutritional qualities of the snacks. Therefore, augmentation of PF in baked products increases the content of essential nutrients present. Increasing levels of PF in the recipes significantly enhanced iron, calcium, beta-carotene and protein contents of the products. Consumption of such pumpkin blended wheat products will lead to higher intake of these essential nutrients, coupled with reduced calorie intake. Nutrient dense snacks with fewer calories and more of the essential nutrients as well as fibre would be a healthier option due to their important role in health promotion. There is need to determine consumer acceptability levels of such wheat and pumpkin flour composite products to determine the most appropriate percentage of PF for adoption into commercial products. Formulating snacks with up to 20% PF is recommended to boost human nutrient intake. Much higher PF levels results in poor quality products due to dilution of wheat flour which contains good baking properties and hence is not recommended.

ACKNOWLEDGEMENTS

This research was made possible by funds provided by the Kenya Agricultural Productivity and Agribusiness Project (KAPAP) and the Kenya National Commission for Science, Technology and Innovation (NaCoSTI) and which we greatly appreciated.

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