Evaluation of the chemical and physical properties of buns fortified with some natural additives for schoolchildren

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ABSTRACT:

Healthy school nutrition buns are formulated to combat nutritional problems such as anemia and osteoporosis. Variations of school buns have been suggested to include lentil flour, chickpea flour and sweet potato flour in proportions of 5%, 10%, and 15% (either individually or in combination) to wheat flour, extracting rate of 72%, with the addition of date syrup in order to raise the levels of proteins, fibers, iron, calcium, and some other minerals in the resulting buns. The produced buns were chemically, physically and Rheological analyzed and sensory evaluations were carried out. The results indicated that buns prepared with lentil model were higher in protein and fiber than buns prepared from chickpea and sweet potato models .Buns prepared with chickpea flour model were higher in fat than buns prepared with lentil and sweet potato flour models. Meanwhile, ash content values ranged from 1% to 1.3% for the three group models, compared to 1 % for control. Regarding flour blended models, it could be noticed that combination between lentil and chickpea flours lead to increasing protein content compared with individual lentil or chickpea flour models. With respect to minerals, there are no noticeable differences in calcium levels between model samples of lentils, chickpeas, and sweet potatoes. But as for iron and zinc, all samples recorded percentages greater than the control sample. The sensory characteristics of the buns samples showed that the best treatments were when sweet potato flour was added, followed by chickpea flour samples, then lentil flour model.

Keywords: Buns; wheat flour; lentil flour; chickpea flour; sweet potato flour.

INTRODUCTION:

In Egypt, malnutrition is a widespread health problem, and the population most vulnerable to this condition are children (Rashed, 2002). School feeding is described here as the providing of meals to schoolchildren. There are as many kinds of programs as there are nations, but they may be divided into two categories depending on their delivery approaches: (1) in-school feeding, in which children are fed at school, and (2) take-home rations, in which families are provided food if their children attend school. There are two types of in-school feeding programs: those that give meals and those that provide high-energy cookies or snacks (Gelli and Daryanani, 2013) and (No, 2015).

Insufficient levels of essential minerals, particularly iron, calcium, and zinc, have detrimental consequences for human well-being and may result in ailments such as iron deficiency anemia, rickets, osteoporosis, and immune system disorders (Al Rifai *et al*., 2016; Goulder *et al*., 2016; Hwalla *et al*., 2017 and Wander *et al*., 2017). Bread made from wheat *(Triticum aestivum L.)* is thought to have low nutritional value, hence adding high-protein flour to wheat flour is an effective way to enhance the nutritional value of baked goods (Sabanis and Tzia, 2009; Shahine- Fatma *et al*., 2013 and Siddiq *et al*., 2013). Protein-enriched foods from plant sources are rich in lysine, a limiting amino acid in wheat flour (Day, 2013; Chardigny and Walrand, 2016). Lentils (Lens culinaris) are classified as leguminous plants due to their significant nutritional value. These compounds are composed of phytochemicals, bioactive molecules, and antioxidants, all of which contribute to their advantageous impacts on human health (Srivastava and Vasishtha, 2012). A growing number of people throughout the globe are beginning to consume this well-known legume because of the growing interest in functional foods that include nutraceutical contents (Jahreis *et al*., 2016). Lentils are a substantial and inexpensive source of protein (Ladjal-Ettoum *et al*., 2016). These food items are often used as a replacement for meat (Jallinoja *et al*., 2016) and may enhance the consumption of cereal proteins by providing various essential amino acids (Migliozzi *et al*., 2015).

It is thus possible for the intake of lentils on a regular basis to not only improve the nutritional status of humans but also to prevent and lessen the occurrence of chronic illnesses, such as cardiovascular diseases, malignancies, obesity and overweight, metabolic syndrome, and diabetes (Bouchenak and Lamri-Senhadji, 2013). One of the oldest and most frequently planted grains and crops in the Middle East is chickpea, also known as *Cicer arietinum L*. Chickpea was first cultivated in the Nile Valley of Egypt during the time of the Pharaonic New Kingdom (Grelda *et al.*, 1997) and (Darby *et al.*, 1997). The chickpea is an excellent source of carbs and proteins, which together constitute around 80% of the total weight of the dried seed (Aurella *et al.*, 2009). The chickpea is a very significant legume crop globally, with a total worldwide production of 10.4 million metric tons (FAO/STAT, 2011). Chickpeas are a very nutritious food, rich in calories, protein, minerals, fibers, and other beneficial compounds that may contribute to good health (Vega *et al*., 2010).

Sweet potato (*Ipomea batatas L.*) is a very significant vegetable crop in several nations, including Egypt. The sweet potato is the only economically significant member of the Convolvulaceae family, which comprises more than 400 species of Ipomea found in tropical regions. Sweet potato is one of the two significant crops, along with common beans, that play a crucial role in the traditional cuisines of many nations. Sweet potato, namely the kind rich in beta-carotene and orange flesh, rich sweet potato (alternatively referred to as orange- fleshed sweet potato), is a significant nutritive substance and an excellent source of energy that can help improve the nutrient status of the community (Burri, 2011).

Orange-fleshed sweet potatoes are a very beneficial source of beta carotene and vitamin A. In addition, they possess anti-inflammatory properties and are rich in potassium, vitamin C, vitamin B6, riboflavin, copper, pantothenic acid, and folic acid. Sweet potato flour is a valuable source of energy and nutrients such as carbohydrates, β–carotene, pro vitamin A, minerals including calcium, phosphorus, iron, potassium, and zinc. Additionally, it may enhance the natural sweetness, color, flavor, and dietary fiber content of processed food items (Alloush, 2015). Research conducted in South Africa showed that consuming 125g of OFSP (orange-fleshed sweet potato) enhanced the vitamin A levels in children. This finding suggests that OFSP might be an effective long-term food-based approach to address vitamin A insufficiency in poor nations (Van Jaarsveld, *et al.*, 2005).

Sweet potatoes are vegetables that are very abundant in nutrients; yet, the consumption of sweet potatoes is gradually decreasing, particularly in industrialized countries Grabowsk, *et al.*, (2006). Makhlouf, (1991) supported the idea that sweet potato powder should be included in the food chain as a component that serves an important function.

The objective of this study is to determine whether date syrup could be used in place of sugar to provide children in primary school with calcium and iron, and whether lentil, chickpea, and sweet potato flour could be incorporated into buns to enhance their intake of vitamin C, vitamin E, proteins, fibers, and mineral components.

MATERIALS AND METHODS

Materials:

Wheat flour (72% extraction rate) used in the technological preparation of school feeding bun samples was obtained from *North Cairo Flour Mills Company*, Cairo, Egypt.

Lentil flour, Chickpea flour and Sweet Potato flour were obtained from *Epics Group for Food Industries,* 6th of October, industrial zoon, Giza , Egypt.

Date Syrup, dark chocolate, fresh eggs, butter, active dry yeast and Skimmed milk powder were purchased from local market.

Other raw materials were obtained from local market.

Methods:

Preparation of buns samples:

The recipe used to prepare models of school feeding buns, which is made using a mixture of wheat flour with: either 1- lentil flour, 2 chickpea flour and 3- sweet potato flour at different levels of added individually or together according to **Jan *et al.*, (2008)** with modification, as follows: table (1)

Instructions

Warm the milk to about 40° C and add one tablespoon sugar and active dry yeast stir and let it in a warm place for about 15 minutes.

Add flour, sugar, and salt in the bowl of a mixer.

Pour the yeast mixture and eggs into the flour and knead it slowly for 4 min., Add softened butter and continue to knead the dough at high speed for another 8 minutes, (during this stage add raisins).

On a lightly floured surface, shape the dough into a ball, cover the balls with plastic wrap and keep in a warm place for one hour.

Put each ball on a baking sheet lined with parchment paper and take it to proof for about 30 to 50 minutes.

Brush each bun with egg wash and sprinkle with sesame seeds.

In preheated electric oven to 180° C, bake at for 25-30 minutes or until they are golden brown.

Chemical analysis:

Determination of chemical composition:

Moisture, crude protein, crude fat, crude fiber and total ash were carried out according to methods of A.O.A.C. (2000).

Carbohydrates were calculated by difference as mentioned as follows:

Carbohydrates = 100 – (% protein + % fat + % ash + % crud fiber).

Determination of mineral contents:

Minerals content, i.e., Fe, Zn, Ca, K and P were determined by Atomic Absorption Spectrophotometer (3300 Perkin-Elmer) as described in (A.O.A.C, 2012).

Determination of rheological properties:

The brabender farinograph test was performed to study the water absorption (%), mixing time (min), dough development time (min), stability (min) and dough weakness (B.U.) characteristic of the flour under investigation. These readings were described in (A.A.C.C., 2000).

Determination of Specific volume:

Specific volume was calculated according to Bennion and Bamford (1997).

With using the following equation:

$$\text{Specific volume} = \frac{\text{Volume of rolls in (cm}^3\text{)}}{\text{Weight of rolls in (gm)}}$$

Determination of sensory evaluation of school feeding buns:

The prepared experimental school feeding buns models were sensory evaluated according to the method reported the Mohamed (1992) by panelists from the staff of the Food Technology Research Institute, Agriculture Research Center. The scoring scheme was as follows:

	Properties	Score
External Properties	Crust quality	10
	Softness	15
	Crust color	10
Internal Properties	Crumb color	10
	Texture	15
	Taste	20
	Odor	20
Overall acceptability		100

RESULTS AND DISCUSSION

Chemical Composition of raw materials and additives:

The Table (2) displays the proximate chemical composition of the raw materials used in the production of buns. Lentil flour has the greatest protein level, with a percentage of 24.4%. Chickpea flour follows with a protein content of 21.3%, while wheat flour has a protein value of 10.8%. Sweet potato flour and date syrup have protein contents of 2.8% and 2.3% respectively. Observations indicate that date syrup has the greatest percentage of carbohydrates (94.7%), followed by sweet potato flour (93.5%). The carbohydrate content in lentil flour was 56.6%. In contrast, lentil flour had the highest fiber content, followed by chickpea flour, sweet potato flour, date syrup, and wheat flour, with percentages of 14.5%, 9.9%, 1%, 1%, and 0.48% respectively. The findings also indicated that lentil flour and chickpea flour had the greatest levels of ash, followed by date syrup, sweet potato flour, and wheat flour (2.7%, 2.7%, 1.8%, 1.6%, and 0.5% respectively). These results were nearly in accordance with (Ladjal-Ettoum *et al*., 2016; Allam, 2001; Heinonen *et al.*, 1989 and Grabowsk *et al*., 2008).

Minerals contents of raw materials and additives:

The mineral content of raw materials is a highly significant component of food mixes. Calcium, iron, magnesium, and zinc are the minerals that are most essential for meeting the physiological needs of children. Magnesium is essential for all living cells, it is a catalyst in numerous metabolic reactions, and zinc is an integral part of at least 20 enzymes that belong to a large group known as metalloenzymes. For instance, calcium is combined as the salts give hardness to bones and teeth, iron is required for an expanding blood volume and increasing amounts of hemoglobin in grown children, magnesium is essential for all living cells, and it increases the amount of hemoglobin in grown children (Beard, 2001; Hotez and Brown, 2004 and Soetan *et al*., 2010).

The data in Table (3) shows that date syrup and chickpea flour had the greatest calcium content, with values of 330 and 45 mg/100g, respectively. The Fe content of date syrup, sweet potato flour, and lentil flour was found to be the highest, with values of 7.5, 7, and 6.6 mg/100g, respectively. Among the flours tested, wheat flour with 72% extraction and chickpea flour had the greatest levels of K, measuring 1200 and 840 mg/100g, respectively. The Zn content in date syrup was the highest, at 104 mg/100g. The P value of chickpea flour was the highest at 322 mg/100g. Although wheat flour with a 72% extraction had the lowest iron content of 4.6 mg/100g, this finding is consistent with the previously reported results by Abde el mageed (1995) and Ramadan *et al* (2010). Furthermore, based on the current findings, it is evident that the combination of wheat flour (72% extraction) with the investigated raw materials as flour supplements resulted in an enhancement of mineral content in the mixed flour.

Chemical composition of school feeding of flour blends:

Table (4) represents the chemical composition of school feeding of flour blend processed by using lentil flour, chickpea flour and sweet potato flour with different levels. Regarding the protein and fiber content, there is a steady rise in the protein and fiber content when compared with unfortified formula. This may be attributable to the high level of protein and fiber that was present prior to their being added to the flour. More reinforced materials were added to the formula, which resulted in an increase in the amount of fat and ash that was present in the formula. The amount of sweet potato flour that was added to wheat flour showed a tendency to enhance the amount of carbohydrates that were included in the supplemented formula. Those results that were published by are consistent with these findings (Ramadan *et al* 2010).

Minerals content of school feeding of flour blends:

The results in Table (5) shows that the sample containing 85% wheat flour and 15% chickpea flour had the greatest levels of calcium (39.9 mg/100g) and phosphorus (301.6 mg/100g). The sample consisting of 70% wheat flour, 10% lentil flour, 10% chickpea flour, and 10% sweet potato flour had the greatest Fe content, which was measured at 5.1 mg/100g. The sample consisting of 58% wheat flour and 15% sweet potato flour had the greatest concentration of Zn, measuring 6.6 mg per 100g. The control sample had the greatest concentration of K, measuring 1200 mg/100gm. In contrast, the control sample had the lowest levels of Ca and Fe, measuring 39.0 and 4.5 mg/100g, respectively. The findings are consistent with those previously reported by Abde el mageed (1995) and Shahine-Fatma *et al*. (2013).

Farinograph parameters of school feeding buns flour blends:

The findings illustrated in Table 6 demonstrate that the increase in the ratio of lentil flour, chickpea flour, and sweet potato flour in the dough led to an increase in the amount of time required for mixing as well as the amount of water that was absorbed by the dough. The ratio of lentil flour, chickpea flour, and sweet potato flour increased, which resulted in a reduction in dough development, stability, and weakening. It is in line with the findings that have been reported by (Hefnawy *et al* 2012).

Chemical composition of school feeding buns models:

The table (7) displays the chemical composition of several buns formulas made using lentil flour, chickpea flour, and sweet potato flour at varying concentrations. The protein, fiber, and ash content of the bun's recipe showed a tendency to rise as the degree of additional fortified components increased. Regarding fat, there is a progressive rise in the fat level when compared to unfortified formula. This might be due to the high fat content present before it is added to the flour. The carbohydrate content of the enhanced buns varied between 54% and 60%. By incorporating lentil flour, chickpea flour, and sweet potato flour into wheat flour, a transformation occurs. These findings are consistent with those reported by (Ramadan *et al* 2010).

Minerals composition of school feeding bun models:

The mineral composition of bun samples containing varying percentages of lentil flour, chickpea flour, and sweet potato flour was analyzed, and the results are shown in Table (8). The inclusion of lentil flour, chickpea flour, and sweet potato flour as supplements in the bun recipe resulted in a significant increase in calcium and iron content, from 90 to 122.8

mg/100 gm and from 5 to 6.4 mg/100 gm, respectively, for these minerals. A similar pattern was seen for phosphorous, as it steadily rose with higher proportions of chickpea flours in the buns mix. The zinc content in the control samples was 12 mg/10gm, whereas in the bun's samples with sweet potato flour at a 15% percentage, it climbed to 12.7 mg/100 gm. Similarly, the potassium level rose to 1275.0 mg/10 gm. The chickpea flour content in the buns samples is controlled at a level of 1333.0 mg/100 gm, when the buns contain 5% chickpea flour. Chickpeas are regarded as a beneficial source of calcium, potassium, and phosphorus. Increasing the proportion of chickpea flour in wheat flour results in a steady increase in calcium, potassium, and phosphorus levels. Similar patterns were seen in the iron content of bun samples that included varying amounts of lentil flour and sweet potato flour. This data is consistent with what has been reported El-Nagar (1997) and El-Shimy (2013).

Physical characteristics of buns mixed with lentil flour, chickpea flour, and sweet potato flour:

The Table (9) provides information on the volume, weight, and specific volume of the buns. It shows that as the ratio of lentil flour, chickpea flour, and sweet potato flour in the buns formula grew, the volume (Cm^3) rapidly decreased. There was a contrasting trend in weight (gm), with the control weighing 100 gm and the buns with 5% sweet potato flour being 103 gm. The specific volume (cm3/gm) of the manufactured varieties of buns varied from 3.20 cm3/gm to 3.83 cm3/gm, compared to 4.02 cm3/gm for the control. Similar findings were reported by Malak (2003) and El-Shimy (2013).

Sensory Evaluation of the buns supplemented with lentil flour, chickpea flour and sweet potato flour.

The taste panel testing findings for buns supplemented with lentil flour, chickpea flour, and sweet potato flour are shown in Table (10). Slightly elevating the ratio of lentil flour, chickpea flour, and sweet potato flour in the buns recipe resulted in a little decrease in the quality of the crust, softness, crust colour, texture, odour, and taste rating. The acceptability ratings for the control and samples with 5%, 10%, and 15% sweet potato flour were 97.5%, 96.5%, 95%, and 91%, respectively. The findings demonstrate that samples with greater proportions of sweet potato flour exhibited superior overall acceptance. These were in line with (Hussien 2001). The variations in baking qualities may be ascribed to the changes in the quality and amount of protein that occur because of the addition of ingredients. Additionally, the changes could be attributed to the gas retention of dough that occurs throughout the baking process (Sai *et al.,* 1997).

CONCLUSION:

Bottom of Form Based on the results of this research, it can be concluded that buns resulting from mixing wheat flour (72% extraction) with lentil flour, chickpea flour, and sweet potato flour led to an increase in the nutritional value and mineral content of the buns. Unleavened buns made with the above ingredients are recommended as an important lunch option in institutional nutrition programs for primary Schoolchildren.

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Table 1: School feeding buns formula.

Models	Blends	WF	LF	CKF	SF	Yeast	Sugar	Salt	Milk Powder	Butter	Egg	Date syrup	Vitamin Mix
Control	(W)	100				2	12	1	3	20	50	5	0.7
Lentil Model	W + L	95	5			2	12	1	3	20	50	5	0.7
		90	10			2	12	1	3	20	50	5	0.7
		85	15			2	12	1	3	20	50	5	0.7
Chickpea Model	W + C	95		5		2	12	1	3	20	50	5	0.7
		90		10		2	12	1	3	20	50	5	0.7
		85		15		2	12	1	3	20	50	5	0.7
Sweet Potato Model	W + S	95			5	2	12	1	3	20	50	5	0.7
		90			10	2	12	1	3	20	50	5	0.7
		85			15	2	12	1	3	20	50	5	0.7
Blend Models	W + L + C	80	10	10		2	12	1	3	20	50	5	0.7
	W + L + S	80	10		10	2	12	1	3	20	50	5	0.7
	W + C + S	80		10	10	2	12	1	3	20	50	5	0.7
	W + L + C + S	70	10	10	10	2	12	1	3	20	50	5	0.7

WF = Wheat flour
LF = Lentil flour
CF = Chickpea flour
SF = Sweet potato flour

Table 2: Chemical Composition of raw materials and additives.

Raw materials Chemical Composition	Wheat flour 72	Lentil flour	Chickpea flour	Sweet Potato flour	Date Syrup	Sk. Milk	Yeast	Butter	Eggs
Moisture	13.7	10.7	12.8	6	22	3.6	2	15	88
Protein	10.8	24.4	21.3	2.8	2.3	33.5	40	0.4	12.6
Fat	1.1	1.8	5.9	1.1	0.2	0.7	7.5	70	9
Fiber	0.48	14.5	9.9	1	1	1.4	27	0	0
Ash	0.5	2.7	2.7	1.6	1.8	7.7	6	0.1	0.8
Carbohydrate	87.1	56.6	60.2	93.5	94.7	56.7	19.5	29.5	77.6

Table 3: Minerals contents of raw materials and additives.

Raw materials Minerals	Wheat flour72%	Lentil flour	Chickpea flour	Sweet Potato flour	Date Syrup	Sk. Milk	Yeast	Butter	Eggs
Ca (mg/100g)	39	40	45	35	330	1100	30	24	56
Fe (mg/100g)	3.6	6.6	4.7	7	7.5	0	2	0.1	1.75
K (mg/100g)	1200	300	840	250	200	1600	955	24	138
Zn (mg/100g)	5.6	1.3	2.6	6.4	104	0	8	0.1	1.29
P (mg/100g)	298	210	322	16	10	900	630	22	198

Table 4: Chemical composition of school feeding of flour blends.

Models	Blends	Ratios %	Protein	Fat	Fiber	Ash	Carbohydrate
Control	(W)	100	10.8	1.1	0.48	0.5	87.12
Lentil Model	W + L	95/5	11.5	1.1	1.2	0.6	85.6
		90/10	12.2	1.2	1.9	0.7	84
		85/15	12.8	1.2	2.6	0.8	82.6
Chickpea Model	W + C	95/5	11.3	1.3	1	0.6	85.8
		90/10	11.9	1.6	1.4	0.7	84.4
		85/15	12.4	1.8	1.9	0.8	83.1
Sweet Potato Model	W + S	95/5	10.4	1.1	0.5	0.6	87.4
		90/10	10	1.1	0.5	0.6	87.8
		85/15	9.6	1.1	0.6	0.7	88
Blend Models	W + L + C	80/10/10	13.2	1.7	2.8	0.9	81.4
	W + L + S	80/10/10	11.4	1.2	1.9	0.8	84.7
	W + C + S	80/10/10	11.1	1.6	1.5	0.8	85
	W + L + C + S	70/10/10/10	12.4	1.7	2.9	1.1	81.9

Table 5: Minerals contents of school feeding of flour blends.

Models	Blends	Ratios %	Ca (mg/100g)	Fe (mg/100g)	K (mg/100g)	Zn (mg/100g)	P (mg/100g)
Control	(W)	100	39.0	3.5	1200	5.6	298.0
Lentil Model	W + L	95/5	39.1	4.7	1155	6.2	293.0
		90/10	39.1	4.8	1110	6.0	289.0
		85/15	39.2	4.9	1065	5.7	285.0
Chickpea Model	W + C	95/5	39.3	4.6	1182	6.3	299.2
		90/10	39.6	4.6	1164	6.1	300.4
		85/15	39.9	4.6	1146	5.9	301.6
Sweet Potato Model	W + S	95/5	38.8	4.7	1153	6.5	283.9
		90/10	38.6	4.8	1105	6.5	269.8
		85/15	38.4	5.0	1058	6.6	255.7
Blend Models	W + L + C	80/10/10	39.7	4.8	1074	5.6	291.6
	W + L + S	80/10/10	39.7	5.0	1015	6.0	261.0
	W + C + S	80/10/10	39.2	4.9	1069	6.1	272.2
	W + L + C + S	70/10/10/10	39.3	5.1	979	5.6	263.4

Table 6: Farinograph parameters of school feeding buns flour blends.

Blends	Ratios %	Water absorption%	Mixing time min.	Develop. Time min.	Stability min	Dough Weakening B .U.
(W)	100	63	1.5	2	7	100
W + L	95/5	64	2	2	6	90
	90/10	65.5	3	3.5	4.5	80
	85/15	67	4.5	5	2.5	60
W + C	95/5	63.5	2	2.5	6	90
	90/10	65	2.5	3	5	80
	85/15	66	3	4	4	70
W + S	95/5	63	1.5	2	6.5	90
	90/10	63.5	2	2.5	6	90
	85/15	64	2.5	3	5	80
W + L + C	80/10/10	63.5	2.0	2.5	6.5	90
W + L + S	80/10/10	63.5	2.0	2.0	6.5	90
W + C + S	80/10/10	63.5	2.0	2.0	6.5	90
W + L + C + S	70/10/10/10	63.5	2.0	2.5	6.5	90

Table 7: Chemical composition of school feeding buns models.

Models	Blends	Ratios %	Protein	Fat	Fiber	Ash	Carbohydrate
Control	(W)	100	19.1	19.6	1.1	1	59.2
Lentil Model	W + L	95/5	19.8	19.8	1.8	1.1	57.5
		90/10	20.5	19.9	2.5	1.2	55.9
		85/15	21.1	20.0	3.2	1.3	54.4
Chickpea Model	W + C	95/5	19.6	20	1.6	1.1	57.7
		90/10	20.2	20.3	2.1	1.2	56.2
		85/15	20.7	20.5	2.5	1.3	55
Sweet Potato Model	W + S	95/5	18.7	19.8	1.1	1	59.4
		90/10	18.3	19.8	1.2	1.1	59.6
		85/15	17.9	19.8	1.2	1.1	60
Blend Models	W + L + C	80/10/10	21.5	20.3	3.5	1.4	53.6
	W + L + S	80/10/10	19.7	19.9	2.6	1.3	56.5
	W + C + S	80/10/10	19.4	20.3	2.1	1.3	56.9
	W + L + C + S	70/10/10/10	20.7	20.3	3.5	1.5	54

Table 8: Minerals contents of school feeding buns models.

Models	Blends	Ratios %	Ca (mg/100g)	Fe (mg/100g)	K (mg/100g)	Zn (mg/100g)	P (mg/100g)
Control	(W)	100	90	4.8	1275	10.2	440.0
Lentil Model	W + L	95/5	122.0	6.0	1305.0	12.3	437.0
		90/10	122.0	6.2	1260.0	12.0	432.0
		85/15	122.0	6.3	1216.0	11.7	428.0
Chickpea Model	W + C	95/5	122.2	5.9	1333.0	12.3	443.0
		90/10	122.5	5.9	1315.0	12.1	444.0
		85/15	122.8	5.9	1297.0	11.9	445.0
Sweet Potato Model	W + S	95/5	121.7	6.0	1303.0	12.5	427.0
		90/10	121.5	6.2	1256.0	12.6	413.0
		85/15	121.3	6.3	1208.0	12.7	399.0
Blend Models	W + L + C	80/10/10	122.6	6.1	1225.0	11.6	435.0
	W + L + S	80/10/10	121.6	6.4	1166.0	12.0	404.5
	W + C + S	80/10/10	122.1	6.2	1220.0	12.1	416.0
	W + L + C + S	70/10/10/10	122.2	6.4	1130.0	11.6	407.0

Table 9: Specific volume (Cm³/gm) of school feeding buns models.

Models	Blends	Ratios %	Volume Cm^3	Weight gm	Sp. V. Cm^3/gm
Control	(W)	100	402	100	4.02
Lentil Model	W + L	95/5	350	101	3.47
		90/10	348	102	3.41
		85/15	325	101	3.22
Chickpea Model	W + C	95/5	359	102	3.52
		90/10	355	102	3.48
		85/15	345	100	3.45
Sweet Potato Model	W + S	95/5	395	103	3.83
		90/10	384	102	3.76
		85/15	366	102	3.59
Blend Models	W + L + C	80/10/10	326	102	3.20
	W + L + S	80/10/10	341	102	3.34
	W + C + S	80/10/10	340	101	3.37
	W + L + C + S	70/10/10/10	333	102	3.26

Table 10: Sensory evaluation of school feeding buns models.

Models	Blends	Ratios %	External Properties			Internal Properties				Total acceptability
			Crust quality	Softness	Crust color	Crumb color	texture	Odor	Taste	
	Score		10	15	10	10	15	20	20	100
Control	(W)	100	9.5	14.5	9.5	9.5	14.5	20	20	97.5
Lentil Model	W + L	95/5	8.5	13	8	8	12.5	17	18	85
		90/10	8	13	8	7.5	12	16	15.5	80
		85/15	8	12	8	7	12	15	13	75
Chickpea Model	W + C	95/5	9	14	9	9	13	18	18	90
		90/10	9	14	9	8	13	17	16	86
		85/15	8.5	13	8.5	8	13	17	16	84
Sweet Potato Model	W + S	95/5	9.5	14	9.5	9.5	14	20	20	96.5
		90/10	9	14.5	9.5	9.5	14.5	19	19	95
		85/15	8.5	13.5	8	9	14	19	19	91
Blend Models	W + L + C	80/10/10	7	11	7	7	11	15	16.5	74.5
	W + L + S	80/10/10	7	11.5	7.5	7	12	16.5	16.5	78
	W + C + S	80/10/10	7.5	12	7	8	12	16	16.5	79
	W + L + C + S	70/10/10/10	8	12	7	7	11	15	16	76

تقييم الخصائص الكيميائية والطبيعية للفطير المدعم ببعض الإضافات الطبيعية لأطفال المدارس

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الملخص العربي:

تم إعداد فطير صحي للتغذية المدرسية للحد من أمراض سوء التغذية مثل فقر الدم وهشاشة العظام. وتم إقتراح عدة نماذج لفطير مدرسي بإضافة دقيق العدس ودقيق الحمص ودقيق البطاطا الحلوة بنسب 5% و 10% و 15% (في صورة منفرة أو مختلطة) إلي دقيق القمح استخلاص 72% مع إضافة دبس التمر وذلك لرفع مستوى البروتينات والألياف والحديد والكالسيوم وبعض المعادن للفطير الناتج. أجريت التحاليل الكيميائية والفيزيائية والريولوجية وكذلك التقييم الحسي للفطير الناتج. أوضحت النتائج أن نموذج الفطير المحضر من دقيق العدس يحتوي علي نسبة عالية من البروتين والألياف عن نماذج الفطير المحضر من دقيق الحمص ودقيق البطاطا الحلوة. بينما كان نموذج الفطير المحضر من دقيق الحمص عالي في محتواه من الدهون عن نماذج الفطير المحضر من دقيق العدس ودقيق البطاطا الحلوة . في حين تراوحت قيم الرماد من (1 – 1.3 %) لنماذج المجموعات الثلاثة مقارنة بالكنترول (1%). بالنسبة لنماذج الدقيق المخلوط يمكن ملاحظة أن الخلط بين دقيق العدس ودقيق الحمص أدي إلي زيادة محتوي البروتين مقارنة بنماذج دقيق العدس أو دقيق الحمص كلا علي حدة. بالنسبة للمعادن لا توجد فروق ملحوظة في قيم الكالسيوم بين عينات نماذج دقيق العدس و دقيق الحمص و دقيق البطاطا الحلوة. ولكن بالنسبة للحديد والزنك فقد سجلت جميع العينات نسب أكبر عن عينة الكنترول . أظهرت الصفات الحسية لعينات الفطير أن أفضل المعاملات كانت عند إضافة دقيق البطاطا الحلوة يليها نماذج عينات دقيق الحمص ثم نماذج عينات دقيق العدس.

الكلمات الاسترشادية : فطير مدرسي، دقيق القمح، دقيق العدس، دقيق الحمص، دقيق البطاطا الحلوة.