A Study on Fortification of Nutritive Value and Improving the Acceptability of Meal Offered at Egyptian Schools

Manal Mohammed El-Sayed Mohammed Shehata

Department of Food Science, Faculty of Agriculture, Zagazig University, Zagazig, Egypt.
shehata_manal@yahoo.com

Abstract: School meals have increase the nutritional status of school-age children by reduction in malnutrition. In this study, a school meal (pie) was prepared. The main objective of this study was to enhance the nutritional value of pies by fortification with different levels of soy protein concentrate SPC and/or casein as a source of good quality proteins. The study was conducted including two parts. At the first part fortification processes were conducted by substituting specified concentrations (5% and 10%) of SPC and/or casein from the total percent of wheat flour (100%) in compare with control. The pie was evaluated for nutritional and sensory quality. Various nutritional parameters, such as protein, fat, carbohydrate and ash were determined in fortified and control pie. The results indicated that fortification of pie with either SPC or casein showed significant (p<0.05) increase in protein content of the pie and this increase was associated with the level of fortification. Pie fortified with 10% casein showed the significant (p <0.05) highest protein content in compare with the control pie. Result of sensory evaluation showed that the pie fortified with 10% of 1:1 mixture of SPC and casein was most acceptable. So, it was used as a control pie in the second part of study. During this part pie was padded with minced date paste and/or processed cheese at different levels. The protein contents of the pies increased significantly (p <0.05) with the increase of processed cheese levels whereas there was reduction in carbohydrate content as compared with control pie. The carbohydrate contents of the pies increased significantly (p <0.05) with the increase in padding level by minced date paste as compared to the control pie. Results of sensory evaluation showed that pie which contains mixture 5% of minced date paste and 5% of processed cheese, gained the most acceptability regarding to the other pies. Fortification of pies with SPC and/or casein increased protein quality by improving essential amino acid profile. Also, addition of SPC and processed cheese increased the calculated energy values of resultant pies. It could be concluded that good quality pie could be obtained by fortification with mixture 5% of SPC and 5% casein padding the pie with mixture 5% of minced date paste and 5% processed cheese.

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1. Introduction

Malnutrition due to protein deficiency is an atrocious dilemma among the masses whose diet is generally based on cereals or other starchy foods (***Barker, 2002 and Reilly, 2002***). Feeding on protein-deficient diets can lead towards many disorders such as breast cancer, colon cancer, heart disease and osteoporosis (***Alam et al., 2003 and Bhan et al., 2003***). Therefore, the utilization of protein-enriched diet is very important to fight against infections and diseases as it facilitates production of antibodies to activate our immune system (***Friedman, 1996 and Alexander et al., 1998***).

Bakery products in the Middle East especially in the Arab countries are considered an important source of nutrients i.e., energy, protein, minerals and vitamins. Most bakery products can easily be enriched and fortified at low cost with proteins, vitamins and minerals to meet specific needs of the target groups of the population (***Indrani et al., 2007***). Soy protein and casein are the best protein sources to improve the quantity and quality of protein found in the cereals.

In many countries, legume seeds are considered as the distinguishing source of protein in the diet (***Marcello and Cristina, 1997***). Moreover, consumption of legumes is also associated with reduction in proinflammatory status and improvement in some metabolic features (***Hermsdorff et al., 2011***). Soybean is one of the oldest and the widely consumed legumes in the world, so it is called meat of the field from ancient time. Soybean is a very rich source of essential nutrients and one of the most versatile foodstuffs. It possesses good quality protein which is comparable to other food proteins and is suitable for all ages, infants to the elderly. Consumption of soy foods is increasing because of reported beneficial effects on nutrition and health, such as lowering of plasma cholesterol, prevention of cancer, diabetes and obesity and protection against bowel and kidney

diseases (***Friedman and Brandon, 2001***). Soy protein is acceptable in almost all diets due to no cholesterol and absence of lactose. The soy protein is highly digestible (92–100%) and contains all the essential amino acids except methionine which is relatively low but good source of lysine. The high lysine content of soy protein makes it a good complement to cereal proteins, which are low in lysine. In bakery products, soy protein ingredients are being used for a variety of functional and nutritional reasons. Soy protein can help to reduce fat, increase protein content and improve overall baking characteristics of baked goods, such as breads, crackers, doughnuts, cakes, pies, muffins and other bakery items (***Hossein, 2011***).

Casein is the principal protein found in milk, it comprises 80% of the protein content of bovine milk (***Miller et al., 1990***). Casein is considered as a 'slow' protein because it coagulates in the stomach and delays gastric emptying (***Boirie et al., 1997***). The slower digestion rate of casein results in smaller but prolonged increased postprandial plasma amino acid levels (***Boirie et al., 1997 andDangin et al., 2001***). Casein is consequently known as a phospho-protein. All the amino acids that are essential to human are present in casein at high proportions, with the possible exception of cysteine. Thus, casein may be considered as a highly nutritious protein. Casein contains an adequate supply of all the essential amino acids with the possible exception of the sulphur-containing amino acids methionine and cysteine. Casein are mainly used in bakery products to enhance flavor and other sensory properties and also for nutritional fortification of the wheat flour. The limiting amino acid (lysine) in most cereal proteins can be very well be complemented with dairy proteins. Casein can be added to breakfast cereals, milk biscuit and protein enriched bread.

School feeding programs can make important contributions to improve children meal and nutrient intake. School-aged children spend at least 6 h at school every school day and obtained up to 47% of their calories from meals and snakes consumed at school (***Condon et al., 2009***). Good nutrition is an essential part of healthy children.

Therefore, the objective of this study was to prepare protein-enriched pies by using soy protein concentrate SPC and casein to enhance nutritional and sensory properties of those protein-enriched pies. Improving the quality of the pies by padding with both minced date paste and processed cheese was also a goal of the study.

2. Material and Methods

Material

Soy protein concentrate and casein preparation were purchased from Sigma Chemical Co. (USA) while, wheat flour, sugar, salt, margarine, eggs, sesame, bakery yeast, improver, vanillin, oil, dried milk, date paste and processed cheese were purchased from local markets in Egypt. All other reagents used were analytical grade.

Methods

Preparation of pies formula

The study was conducted including two parts as follows:

First part

Seven pies were prepared from seven formulas (F_0, F_1, F_2, F_3, F_4, F_5 and F_6) using the recipes summarized in Table 1. The pies were fortified by soy protein concentrate SPC, casein and a mixture of both of them at a 1:1 ratio at levels 5 and 10% from the amount of wheat flour. All the other ingredients were added at the same ratio percentages as in the control. Pie-producing components of the school feeding project (S.F.P) Ministry of Agriculture and land reclamation were used as a sample basis for manufacturing (control pie).

Second part

Best formula F_6 (Pie fortified by SPC and casein (1:1) at the level of 10%) was used as a control pie. Then six treatments padding with minced date paste (ajwa), processed cheese (Cheddar cheese blocks) and a mixture of both of them at a 1:1 ratio at levels 5 and 10% per 100 g of the resulting dough when shaping pies. Padding pies were prepared using the recipe summarized in Table 2. All the other ingredients were added at the same ratio percentages.

Pies making

Pies were prepared according to the method described in school feeding project. The procedure was applied as following: Sugar and salt were dissolved in part of the water in making-dough pot. Then, flour, yeast, dried milk, SPC, casein, sesame and improver were added and mixed. The fat, eggs and vanillin were then added, and mixed. After that, remaining water was added and mixed until the development of the dough. Then the oil was added to the dough for polishing. The dough was transferred to the shaping, also the minced date paste, proceed cheese and a mixture of both of them were added. After the shaping of the pies, transferred to the fermentation room for 1 h until the pies were fermented. The pies were transferred to oven at 210 °C for 11–13 min., then ventilated and packaged.

Nutritional evaluation of pies

Pies were analyzed for protein, fat, and ash contents according to their respective methods as described in ***AACC (2000)***. Carbohydrate was calculated by difference, and Formulas energy was calculated as Kcal/100g using the following equation: Energy value of food = Fat energy + protein energy +carbohydrate energy.

Amino acids

Amino acids profile were analyzed using LC3000 amino acid analyzer, Eppendrof-Germany, according to the method of the ***AOAC (2006)*** at National Research Center.

Sensory evaluation of the pies

Sensory evaluation was carried out by 20 students and staff of the department of the Food Science, faculty of Agricultures, Zagazig University, Egypt. Pies produced were evaluated for their appearance, colour, pulp, texture, flavor, taste and overall acceptability according to the method described by ***Hassan et al., 2012***.

Statistical analysis

All experiments were run in triplicate and mean values were calculated. The data was statistically analyzed using the Statistical Package for Social Sciences (SPSS, version17.0). One-way analysis of variance (ANOVA) test was performed to test differences between treatments followed by mean separation using Duncan's Analysis with significance level at $p<0.05$ (***Ihekoronye and Ngoddy, 1985***).

3. Results and Discussion

First part: Effect of fortification by soy protein concentrate and casein on nutritive value and quality of pies.

The effect of fortification by different percentage of soy protein concentrate SPC and/or casein on the nutritional value of pies prepared as school meal are given in Table 3. Fortification increased significantly ($P<0.05$) protein contents and decreased significantly ($P<0.05$) carbohydrate contents of the pies in compare with the control pie (F_0). The protein contents of the pies increased significantly ($P<0.05$) with the increase in fortification level. Formula 2 (10% casein) showed the highest protein content and had significant difference ($P<0.05$) with the control pie. Fortification of pies with 5 and 10% casein increased protein contents by 22.8 and 46.3%, respectively, than control pie. The increase was probably due to the high protein content of casein. There was also an increase in the protein contents of pies by 21.1 and 43.1% in compare with control with SPC at levels of 5 and 10%, respectively. These results probably due to the higher protein content of soy protein concentrate. Results were in agreement with ***Awadelkareem et al., 2008*** who reported that sorghum-soy composite meals had increased protein contents of 18 to 26% after adding soy protein concentrate between 4 to 12% levels. ***Mashayekh et al., 2008*** also reported similar increase in protein content of the bread as a result of the addition of soy flour. In addition, these results were in accordance with findings of ***Oluwamukomi et al., 2011*** who reported that addition of 10% soybean flour to the cassava flour CF biscuit resulted in an increase the protein content of the biscuit from 8.41 to 11.39% in biscuits with 50% CF. Furthermore, the present findings are in accordance with data reported by ***Mohsen et al., 2009***, who achieved a 12 to 20% increase in protein content by substituting wheat with 5 to 20% soy protein isolate. Addition of 5 and 10% mixture of casein and SPC to the pies resulted in an increase the protein content of the pies by 22 and 44.7%, respectively. The increase was due to the high protein content of SPC and casein. This high protein contents of fortified pies would be of nutritional importance in most developing countries, where many people can hardly afford high protein foods because of their expensive costs. However, the carbohydrate contents of the pies decreased significantly ($P<0.05$) with the increase in fortification level .This decrease can be explained by the low carbohydrate content of SPC and casein and the increase in protein content. The carbohydrate contents decreased with increase proportion of the soy protein concentrate. This result is in agreement with that of ***Olaoye et al., 2006*** who reported that the carbohydrate contents decreased with increase proportion of the soy flour. The carbohydrate content was highest in control pie F_0 (68.59 %) and lowest in 10% soy protein concentrated F_4 (61.5 %). There were no significant differences in fat contents in all formulas. This results probably due to the standardization of fat content of different formulas. Fortification with soy protein concentrated (5 and 10%) and 10% mixture of SPC and casein had increased significantly ($P<0.05$) in ash content as compared to the control pie. This is probably due to addition of soy protein concentrate to pies formulation. Consequently, there were no significant differences in ash contents in other formulas. These results were in accordance with findings of ***Awadelkareem et al., 2008*** who reported that sorghum-soy composite meals had increased ash contents after adding soy protein concentrate. It could be also noticed that fortification of pies with SPC and mixture of SPC and casein significantly ($P<0.05$) increase the energy values of treatment pies. This could be explained on the basis that SPC may content some fats.

Results of sensory evaluation in terms of appearance, colour, pulp, texture, flavor, taste and overall acceptability of pies from different formulas fortified with different percentage of soy protein concentrate and/or casein are presented in Table 4. It was observed that significant differences($P<0.05$) were found between pies formulas fortified with soy protein concentrate SPC, casein and their mixture at a 1:1 ratio at levels 5 and 10% from the amount of wheat flour in comparison with the control pie for appearance, colour, pulp, texture, flavor, taste and overall acceptability. The results showed that appearance, colour, taste and overall acceptability

scores increased significantly (P <0.05) with fortification by casein at level 5% in comparison with the control pie. Fortification of pies with 5% of soy protein concentrate had acceptable sensory attributes than control pie. The scores for texture (softness and chewiness) of the pies formulas, increased with increase in soy protein concentrate substitution, when compared to control pie. Similar trend was reported by ***Joel et al., 2011*** when incorporation of soybean flour into whole-wheat bread. Fortification of pies with mixture of soy protein concentrate SPC and casein (5 and10%) significantly improved sensory quality attributes than control pie. Pie containing 10% of 1:1 mixture of soy protein concentrate and casein showed mean maximum overall acceptability of 96.0 compared to 82.0 for the control pie. From obtained results pie formula fortified by1:1 mixture of both SPC and casein at level 10% have been taken as the basis to the second part for improving acceptability of pies with different padding.

Table 1: Formulations of the seven experimental pies (g kg-1) contained different percentage of soy protein concentrate SPC and/or casein.

Ingredients	Formulas						
	F_0	F_1	F_2	F_3	F_4	F_5	F_6
Wheat flour	1000	950	900	950	900	950	900
Sugar	100	100	100	100	100	100	100
Margarine	160	160	160	160	160	160	160
Sesame	30	30	30	30	30	30	30
Yeast	18	18	18	18	18	18	18
Salt	6	6	6	6	6	6	6
Improver	10	10	10	10	10	10	10
Dried milk	40	40	40	40	40	40	40
Eggs	100	100	100	100	100	100	100
Vanillin	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Oil	30	30	30	30	30	30	30
casein	-	50	100	-	-	25	50
Soy protein	-	-	-	50	100	25	50

F_0: contained 1000g wheat flour
F_1: contained 950g wheat flour+50g casein (5% casein)
F_2: contained 900g wheat flour+100g casein (10% casein)
F_3: contained 950g wheat flour+50g soy protein (5% SPC)
F_4: contained 900g wheat flour+100g soy protein (10% SPC)
F_5: contained 950g wheat flour+25g casein+25g soy protein (mixture of 2.5% casein and 2.5% SPC)
F_6: contained 900g wheat flour+50g casein+50g soy protein (mixture of 5% casein and 5% SPC)

Table 2: Formulations of the six experimental pies (g kg-1) contained different percentage of minced date paste (ajwa) and/or processed cheese.

Ingredients	Formulas						
	F_6	F_7	F_8	F_9	F_{10}	F_{11}	F_{12}
Wheat flour	900	900	900	900	900	900	900
Sugar	100	100	100	100	100	100	100
Margarine	160	160	160	160	160	160	160
Sesame	30	30	30	30	30	30	30
Yeast	18	18	18	18	18	18	18
Salt	6	6	6	6	6	6	6
Improver	10	10	10	10	10	10	10
Dried milk	40	40	40	40	40	40	40
Eggs	100	100	100	100	100	100	100
Vanillin	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Oil	30	30	30	30	30	30	30
casein	50	50	50	50	50	50	50
Soy protein	50	50	50	50	50	50	50
Minced date paste (ajwa)	-	5g/100g dough	10g/100g dough	-	-	2.5g/100g dough	5g/100g dough
proceed cheese (Cheddar cheese blocks)	-	-	-	5g/100g dough	10g/100g dough	2.5g/100g dough	5g/100g dough

F_6: 10% casein with SPC (control pie)
F_7: 5g ajwa/100g dough (5% ajwa)
F_8: 10g ajwa/100g dough (10% ajwa)
F_9: 5g proceed cheese /100g dough (5% proceed cheese)
F_{10}:10g proceed cheese /100g dough (10% proceed cheese)
F_{11}: 2.5 ajwa+2.5 proceed cheese/100g dough (mixture of 2.5% ajwa and 2.5% proceed cheese)
F_{12}: 5 ajwa + 5 proceed cheese/100g dough (mixture of 5% ajwaand 5% proceed cheese)

Table 3: The effect of fortification by different percentage of soy protein concentrate and/or casein on the nutritional value of pies prepared as school meal ((Dry weight basis %) (Mean±SD).

Formulas	Nutritional value*				Energy values (Kcal/100g)
	Carbohydrate	Protein	Fat	Ash	
F_0	68.59±1.21 ^{a}	12.3±1.65^{c}	18.2±2.21^{ns}	0.91±1.84^{c}	369.2±2.38^{h}
F_1	65.79±1.11 ^{b}	15.1±1.32^{b}	18.2±2.11 ^{ns}	0.91±1.21^{c}	369.2±1.42^{h}
F_2	62.89±1.67 ^{c}	18.0±1.81^{a}	18.2±1.21 ^{ns}	0.91±2.41^{c}	369.2±2.28^{h}
F_3	65.00±2.12 ^{b}	14.9±2.11^{b}	19.0±1.41 ^{ns}	1.10±1.11^{b}	372.4±1.78^{f}
F_4	61.50±1.27 ^{d}	17.6±2.13^{a}	19.7 ±1.91^{ns}	1.20±1.52^{a}	375.5±1.98^{d}
F_5	65.42±2.18 ^{b}	15.0±1.16^{b}	18.6±2.12 ^{ns}	0.98±1.18^{c}	370.9±1.33^{g}
F_6	62.10±1.84 ^{cd}	17.8±1.41^{a}	19.0±1.21 ^{ns}	1.10±2.41 ^{b}	372.6±1.84^{f}

ns Means Non Significant *Means having different letters in the same column are significantly differed.

Table 4: The effect of fortification by different percentage of soy protein concentrate and/or casein on sensory properties of pies prepared as school meal (Mean ±SD).

Formulas	Appearance (10)	Colour (10)	Pulp (10)	Texture (20)	Flavor (20)	Taste (30)	Overall (100)
F_0	8 ±1.31 ^{c}	8±1.78^{c}	8±1.31^{c}	18±0.25^{bc}	15±1.20^{bc}	25±1.12^{e}	82±1.31^{c}
F_1	9±1.52^{b}	9±2.01^{b}	8±1.64^{c}	19±0.34^{ab}	16±1.57^{b}	29±2.12^{ab}	90±1.83^{b}
F_2	8±1.23 ^{c}	8±1.52^{c}	7±1.82 ^{d}	17±0.25^{c}	14±1.13^{c}	28±1.61^{bc}	82±1.32^{c}
F_3	9±2.10^{b}	9±2.45^{b}	10±1.20^{a}	19±0.21^{ab}	19±2.11^{a}	27±1.41^{cd}	93±1.71^{ab}
F_4	9±2.22^{b}	8±1.62^{c}	9±2.11 ^{b}	20±0.22^{a}	18±1.42 ^{a}	26±1.15^{de}	90±1.52^{b}
F_5	9±1.32^{b}	10±1.43^{a}	10±1.46^{a}	19±0.22^{ab}	18±2.34 ^{a}	29±1.11^{ab}	95±2.02^{a}
F_6	10±1.21^{a}	10±2.32^{a}	9±1.13 ^{b}	20±0.55 ^{a}	18±1.10^{a}	29±1.98^{ab}	96±1.81^{a}

Second part: Effect of padding the pies with minced date paste and/or processed cheese of nutritive value and acceptability of prepared pies.

Table 5 presented, the effect of padding by different percentage of minced date paste and/or processed cheese on the nutritional value of pies prepared as school meal. The protein contents of the pies increased significantly (P <0.05) with the increase in padding level by processed cheese in compare with the control pie. The increase was probably due to higher protein content of processed cheese. Results were in agreement with ***Eküçüköner and Zuhaque, 2006 and Main et al., 2008*** who showed that the Cheddar cheese containing higher protein content being 26.37%. Furthermore, these results are agreement with ***Malomo et al., 2012*** who reported that the protein of wheat bread significantly increased as enrichment with West African cottage cheese (Warankashi) was increased. Formula 10 (10% processed cheese) showed the significant (P <0.05) highest protein content in comparison with the control pie. Padding of pies with 5 and 10% processed cheese increased protein content by 10.4 and 16%, respectively, in compare with control. There was also an increase in the protein content by 5.2 and 9.7% of the pies padded with mixture of minced date paste and processed cheese at levels of 5 and 10%, respectively. However, the protein contents of the pies decreased significantly (P <0.05) with the increase in padding level by minced date paste alone as compared to the control pie. The present findings are in accordance with data reported by ***Ibrahim et al., 1999*** who demonstrated that the protein contents decreased as the level of dates increased in both dates: bran and dates: maize mixture. The carbohydrate contents of the pies increased significantly (P <0.05) with the increase in padding level by minced date paste as compared to the control pie. This results probably due to the high carbohydrate content of minced date paste. Results were in agreement with ***El-Sohaimy and Hafez, 2010*** who reported that the date palm extract contains a high level of carbohydrate content (73%). While, the carbohydrate contents of the pies decreased significantly (P <0.05) with the increase in padding level by processed cheese and mixture of minced date paste and processed cheese as compared to the control pie. The decrease probably due to low carbohydrate content of processed cheese. The fat contents of the pies increased with the increase in padding level by processed cheese as compared to the control pie. The increase probably due to high fat content of processed cheese. The results are agree with ***Eküçüköner and Zuhaque, 2006 and Main et al., 2008*** who stated that the Cheddar cheese containing high level of fat content (32.33%). Furthermore, these results are agreement with ***Malomo et al., 2012*** who reported that the fat content of wheat bread significantly increased but carbohydrate levels decreased significantly as enrichment with West African cottage cheese (Warankashi) increased. While, fat content of the pies

decreased with the increase in padding level by minced date paste in comparison with the control pie. The present findings are in accordance with data reported by ***Ganbi, 2012*** who showed that the date palm containing low level of lipids content (0.92%). Additionally, these results are accordance with data reported by ***Ibrahim et al., 1999*** who demonstrated that the fat contents decreased as the level of dates increased in both dates : bran and dates : maize mixture. The ash contents of the pies increased significantly (P <0.05) with the increase in padding level by processed cheese as compared to the control pie. This is probably due to addition of processed cheese in its formulation. Data also indicated that pies padded with processed cheese alone or in combination with minced date paste at different levels showed significantly (p<0.05) increase in energy values than control or pies padded with minced date paste alone. This could be due to the higher fat content of processed cheese. Also, the resulted showed that the energy values decreased significantly (P <0.05) with increase proportion of the minced date paste. This results probably due to low fat and protein contents of minced date paste. These results were in accordance with findings of ***Tehseen et al., 2013*** who demonstrated that calorific value decreased by increasing the amount of date syrup in date muffins. Furthermore, the results indicated that formula 10 showed the highest energy value compared to other formulas.

Data presented in Table 6 showed the effect of padding by different percentage of minced date paste and/or processed cheese on sensory properties of pies prepared as school meal. There were significant differences (P <0.05) in the sensory attributes of appearance, colour, pulp, texture, flavor, taste and overall acceptability between the pies padded by different percentage of minced date paste and/or processed cheese at all levels as compared to the control pie. The results showed that as the level of minced date paste increased, texture scores increased in comparison with the control pie. Results were in agreement with ***Tehseen et al., 2013*** who demonstrated that increasing concentrations of date syrup in date muffins caused an increasing level of softness in texture. The results showed that as minced date paste and/or processed cheese level increased, all of sensory attributes scores increased significantly (p<0.05) in comparison with the control pie. Pie padded with 10% of 1:1 mixture minced date paste and processed cheese showed the maximum overall acceptability of 98.0 compared to 74.0 for the control pie.

According to the ***WHO 2007*** expert consultation, the protein requirements of children aged 3-10 and 10-18 years are 0.73 and 0.7 g/kg/day, respectively. Based ***FAO 2004*** weight for age values, the daily protein requirements for these children to 11-22 and 24-40 g/day for 3-10 and 10-18 year olds, respectively. According to the ***FAO/WHO/UNU 2001*** the energy requirements of children aged 7-8, 8-9, 9-10, 10-11 and 11-12 years are 1623, 1764, 1916, 2078 and 2245 Kcal/day in the mean, respectively. The pie fortified with mixture of 5% SPC, 5% casein and padded with mixture of 5% processed cheese and 5% minced date paste met the target of providing 19.52g protein and 377.2 Kcal energy in 100g pie weight. So, consumptions of 50 and 100g of pies would provide half the protein intake for children aged 3-10 and 10-18 years, respectively, and provide 23.2, 21.4, 19.7, 18.2 and 16.8%, respectively, from the daily energy requirements for children aged 7-8, 8-9, 9-10, 10-11 and 11-12 years, respectively.

The amino acids profile of pies are presented in Table 7. Fortification of pies with SPC and/or casein elevated protein content as well as protein quality (essential amino acid profile). The obtained results are in agreement with ***Awadelkareem et al., 2008*** who reported that supplementation of sorghum by SPC increased protein content and quality. Also, the present findings are in accordance with data reported by ***Stark et al., 1975*** who demonstrated that fortification of wheat flour with soy protein increased protein quality by improving essential amino acid profile. In SPC-fortified pies, at level 10%, the total lysine content increased from1.97 to 3.03 g/100 g protein. The increase was found to be 53.8%. This might be due to the high content of total lysine in soy protein concentrate. These results are accordance with data reported by ***Awadelkareem et al., 2008*** who indicated that supplementation of sorghum flour with SPC increased the lysine content when compared to sorghum flour. Furthermore, the present findings are in accordance with data reported by ***Shfali and Sudesh, 2001*** who observed an increase in lysine content of breads substituted with soy flour (full fat and defatted) at 10% substitution, the increase was found to be 28 and 29%, respectively. Fortification of pies with casein and mixture of casein and SPC increased essential amino acid profile. Also, padding of pies with processed cheese and mixture of minced date paste and processed cheese increased essential amino acid profile as compared with control pie. This finding was backed by the fact that the milk proteins, casein and cheddar cheese had an adequate supply of the essential amino acids with the possible inclusion of sulphur-containing amino acids such as methionine. Therefore, the increase in lysine, improved its limiting attributes in wheat flour. It also improved the sulphur containing amino acids methionine present in pies as well as improving the level of Aspartic acid. A similar finding was recorded by ***Malomo et al., 2012*** who

illustrated that supplementation of wheat bread with West African cottage cheese (warankashi) increased the essential amino acid profile contents.

Table 5: The effect of padding by different percentage of minced date paste (ajwa) and/or processed cheese on the nutritional value of pies prepared as school meal (Dry weight basis %) (Mean ±SD).

Formulas	Nutritional value*				Energy values (Kcal/100g)
	Carbohydrate	Protein	Fat	Ash	
F_6	62.10±1.84^{c}	17.80±1.41^{d}	19.00±1.21^{bc}	1.10±2.41^{c}	372.6±1.84^{f}
F_7	62.97±2.12^{b}	17.80±1.45^{d}	18.08 ±2.21^{cd}	1.14±1.31^{bc}	367.2±1.78^{i}
F_8	64.50±1.20^{a}	17.04±2.12^{e}	17.27±1.43^{d}	1.19±2.42^{bc}	363.2±1.22^{j}
F_9	58.64±2.72^{e}	19.66±1.22^{b}	20.43±2.21^{ab}	1.27±1.43^{b}	378.9±1.54^{b}
F_{10}	56.35±1.78^{f}	20.64±2.61^{a}	21.58±1.22^{a}	1.43±1.26^{a}	384.0±2.41^{a}
F_{11}	60.81±2.22^{d}	18.73±1.62^{c}	19.26±2.16^{bc}	1.21±2.52^{bc}	373.1±2.35^{e}
F_{12}	60.64±1.11^{d}	19.52±1.22^{b}	19.43±1.84^{bc}	1.22±2.31^{bc}	377.2±1.61^{c}

*Means having different letters in the same column are significantly differed.

Table 6: The effect of padding by different percentage of minced date paste (ajwa) and/or processed cheese on sensory properties of pies prepared as school meal (Mean ±SD).

Formulas	Appearance (10)	Colour (10)	Pulp (10)	Texture (20)	Flavor (20)	Taste (30)	Overall (100)
F_6	8±1.33^{c}	8±2.33^{c}	8±1.21^{c}	15±2.10^{de}	15±1.31^{d}	20±2.16^{e}	74±1.55^{f}
F_7	9±1.19^{b}	8±2.16^{c}	9±1.54^{b}	16±1.22^{cd}	18±1.14^{c}	24±1.45^{d}	84±1.22^{e}
F_8	10±1.41^{a}	9±3.15^{b}	9±1.36^{b}	18±1.27^{cb}	19±1.72^{b}	28±2.34^{b}	93±1.23^{cd}
F_9	10±2.22^{a}	10±1.43^{a}	10±1.23^{a}	19±2.41^{b}	20±1.31^{a}	25±1.40^{cd}	94±2.10^{bc}
F_{10}	10±1.32^{a}	9±1.22^{b}	10±2.41^{a}	19±1.14^{b}	18±2.16^{c}	29±1.23^{ab}	95±1.44^{b}
F_{11}	10±1.54^{a}	10±2.19^{a}	9±1.42^{b}	19±2.31^{b}	18±1.21^{c}	26±2.21^{c}	92±1.64^{d}
F_{12}	10±1.72^{a}	10±1.43^{a}	9±2.20^{b}	20±2.34^{a}	19±1.32^{b}	30±1.63^{a}	98±1.22^{a}

Table 7: Amino acids profile of pies formulas (g/100g protein).

Amino acids	Formulas					
	F_0	F_2	F_4	F_6	F_{10}	F_{12}
Threonine	3.56	3.82	3.73	3.78	3.86	3.80
Valine	6.57	6.82	6.43	6.74	6.73	6.71
Isoleucine	4.13	5.09	4.71	4.90	4.99	4.95
Leucine	7.54	7.59	7.99	7.74	7.82	7.81
Lysine	1.97	4.03	3.03	3.54	4.08	3.76
Methionine	1.99	2.37	1.94	2.16	2.23	2.17
Phenylalanine	5.47	5.17	5.39	5.28	5.24	5.26
Tyrosine	3.54	3.99	3.56	3.78	4.01	3.89
Histidine	2.52	2.47	2.36	2.42	2.14	2.10
Aspartic acid	5.48	6.23	7.22	6.72	6.83	6.74
Serine	5.93	5.29	6.06	5.67	6.65	6.80
Glutamic acid	26.68	23.76	22.88	23.35	22.95	22.35
Proline	7.91	7.93	6.66	7.30	7.76	7.60
Glycine	3.76	2.87	4.49	3.67	3.68	3.50
Alanine	4.42	3.97	4.41	4.19	4.00	4.06
Arginine	5.42	4.78	6.85	5.81	5.24	5.44

Conclusion

From the obtained results it could be concluded that protein contents, energy values and amino acids of fortified pies with soy protein concentrate and/or casein and padded with processed cheese and mixture of processed cheese and minced date paste were higher than those of control pies. Pie prepared from formula fortified with 1:1 mixture of SPC and casein and padded with 1:1 mixture of

processed cheese and minced date paste, at 10% level, was considered as most acceptable pie.

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