PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

Pakistan Journal of Nutrition 14 (12): 841-848, 2015
ISSN 1680-5194

Nutritional and Sensory Evaluation of Wheat Flour Biscuits Supplemented with Lentil Flour

Amir Mahgoub AwadElkareem and Eyad AL-Shammari
Department of Clinical Nutrition, Faculty of Medical Sciences, University of Hail, Hail, Saudi Arabia

Abstract: Protein-enriched biscuits were prepared by supplementing lentil seeds flour into wheat flour at levels of 0, 5, 10 and 15% and analyzed for chemical composition, mineral profile and amino acid contents. The supplementation resulted in a significant ($p \leq 0.05$) increase in protein, fat, crude fibre and ash contents of the biscuit samples. The results regarding the mineral content of wheat and lentil flour indicated that significantly ($p \leq 0.05$) the lowest values of calcium, magnesium, iron, phosphorus, sodium and potassium contents were found in biscuit wheat flour (WF) compared to lentil flour (LF). The results of mineral profile of lentil seed flour revealed that legumes may provide sufficient amounts of minerals to meet the human mineral requirement recommended dietary allowance (RDA). The supplementation resulted in a significant ($p \leq 0.05$) increase in macro minerals contents of the biscuit samples. Supplementation of biscuit wheat flour with lentil seeds flour showed a significant ($p \leq 0.05$) increase in lysine and threonine contents (Most limiting amino acids in wheat flour) of biscuits samples. Data obtained from the sensory evaluation indicated that the mean score for taste, color, flavor, texture and overall acceptability were generally high for biscuit containing 5% lentil flour.

Key words: Lentil, wheat, supplementation, mineral, amino acid, sensory evaluation

INTRODUCTION

Micronutrient malnutrition affects more than two billion people worldwide. Particularly vulnerable are women and preschool children in south Asia, Africa and Latin America. Solutions to micronutrient malnutrition have included food fortification, dietary supplementation and agronomic-fortification of staple crops, but such programs have had limited success to date. Sustainable solutions to micronutrient malnutrition call for approaches linking food systems with the dietary needs of people. Legume flours, due to their amino acid composition and fibre content, are ideal ingredients for improving the nutritional value of bread and bakery products, (Hefnawy *et al*., 2012). There are numerous protein-calorie malnutrition problems over the world. Legumes may be helpful in solving this problem. It has been demonstrated that legume protein is the natural protein suitable to complement the protein content present in cereals grains and on the other hand, legume grains are an important part of human diet (Riberio and Melo, 1990). That legumes are helpful in enhancing the protein content. Legumes have been considered a rich source of protein throughout the world and contain approximately three times more proteins than cereals (Karadavut and Asir, 2010; Amjad *et al*., 2006). Legumes represent, together with cereals, the main plant source of proteins in human diet. They are also generally rich in dietary fibre and carbohydrates (Rochfort and Panozzo, 2007). Legume proteins can be successfully used in baked products to obtain a protein-enriched product with improved amino acid balance (Bojnanska *et al*., 2012; Mohammed *et al*., 2012). One of the most important properties of legume proteins is their high content of lysine, an essential amino acid and their deficiency in sulphur-containing amino acids, which makes them a great complement to other well-known cereal proteins (e.g., wheat) which are deficient in lysine, but have good sulphur amino acid content (Eggum and Beame, 1983). Minor compounds of legumes are lipids, polyphenols and bioactive peptides (Pastor-Cavada *et al*., 2009). Legumes including lentil, beans and chickpea are important crops because of their nutritional quality. They are rich sources of complex carbohydrates, vitamins and minerals (Wang *et al*., 2010) Micronutrient rich pulse crops, such as lentil, field pea and chickpea, may provide an answer to global micronutrient malnutrition Lentil is a traditional pulse crop mostly grown in low rainfall, dry land cropping systems in rotation with wheat and rice. Lentil (Lens culinaris Medik) was first identified in the Near East countries of western Asia between the Mediterranean and Iran and has been part of the human diet since 8500BC. Currently, annual world lentil production is approximately 4 million tones (MT),more than 85% of which occurs in fives specific regions: India, Nepal and Bangladesh (32%); western Canada (29%); Turkey and northern Syria (18%); Australia (4%) and, as an emerging crop, in the upper Midwest to f USA, including North Dakota, South Dakota and eastern

Corresponding Author: Amir Mahgoub AwadElkareem, Department of Clinical Nutrition, Faculty of Medical Sciences, University of Hail, Hail, Kingdom of Saudi Arabia

Montana (3%), Thavarajah *et al.* (2011). North American lentils, encompassing several diverse market classes, are exported to more than 100 countries in Europe, the Middle East, Africa and Asia, Thavarajah *et al.* (2008). Lentil is one of the most important crops with 4.4% protein, 1.8 oil, 41-50.8% carbohydrates, 21.4 % fibers, high percentage of other mineral nutrients and unsaturated linoleic and oleic acid for human consumption (Ozdemir, 2002). The present investigation was undertaken to study the chemical composition, mineral profile, amino acid as well as sensory assessment of biscuit made from wheat and lentil seeds flour.

MATERIALS AND METHODS

Materials: Commercial wheat flour and lentil were purchased from the local market. Lentil was reduced into fine flour, both flours were well kept in polyethylene bags and kept at 4°C for processing and further investigations.

Three sets of biscuits (A, B and C) were produced each containing different proportions of lentil flours (5%, 10% and 15%) incorporated in wheat flour. After weighing all the necessary ingredients. All the ingredients except flours were mixed thoroughly. The flours and sodium bicarbonate were added with continuous mixing until smooth dough was obtained. A piece of this dough was cut, placed on a clean plat form of board with a rolling pin to roll out the dough until the required uniform texture and thickness were obtained. A sharp edge was used to cut the sheet of the dough into required shapes and sizes. These were transferred on to a greased (with oil) baking tray. The baking tray was then put inside an oven set at 200°C and baked for 15-20 min. After baking, the hot biscuits were removed from the pan and placed on a clean surface to cool down. The biscuits were then packed immediately in plate.

Methods

Proximate analysis: Flours and biscuit samples were analyzed on dry weight basis in triplicate for crude protein, carbohydrate, crude fat, moisture, ash and crude fiber were carried out according to AOAC (1984).

Determination of total minerals: Minerals were extracted from the samples by dry ashing method that was described by Chapman and Pratt (1982) the amount of Fe, Ca and Mg were determined using atomic absorption spectroscopy (Perkin-Elmer 2380). Ammonium vanadate was used to determine phosphorous along with ammonium molybdate method of Chapmann and Pratt (1982). Sodium and potassium contents were determined by flame photometer (CORNIGEEL) according to AOAC (1984).

Measurement of acid-stable amino acids: The amino acid content was determined according to the official methods of analysis (AACC, 2000) using LKB Biochrom 4150 (Alpha) Automatic Amino acid Analyzer based on ion-exchange Chromatography.

Sensory evaluation: The sensory quality characteristics of biscuit were investigated utilizing a numerical scoring test. Each test of the 15 untrained panelists was asked to evaluate every quality aspect, i.e. Test Color, taste, Flavor, Texture, Overall acceptability. The data obtained was statistically analyzed for significant differences among the various treatments (Ihekoronye and Ngoody, 1985).

Statistical analysis: Each determination was carried out on three separate samples and analyzed in triplicate and figures were then averaged. Data was assessed by the Analysis of Variance (ANOVA) (Snedecor and Cochran, 1987). Duncan Multiple Range Test (Duncan, 1995) was used to separate means. Significance was accepted at $p \leq 0.05$.

RESULTS AND DISCUSSION

Analysis of raw material: The results regarding chemical analyses of lentil and wheat flours are presented in Table 1. Wide variation existed in the chemical compositions between lentil and wheat flours. Lentil flour yielded higher contents of protein, fat, ash and crude fiber as compared to wheat flour sample. It is evident from the results given in Table 1 that wheat flour can be supplemented with lentil seeds flour for improving the nutritional status of wheat flour based bakery product. The chemical composition of the biscuit wheat flour for moisture, ash, crude protein, crude fat, crude fibre and carbohydrate was 8.80, 0.35, 10.16, 0.98, 0.08 and 54.30%, respectively. The results of chemical composition of wheat flour are comparable with the results reported by Shelton and Martin (2007) and Feillet (2000). While the chemical composition of lentil flour was 7.35, 3.20, 30.40, 3.35, 2.40 and 54.30% for moisture, ash, crude protein, crude fat, crude fiber and carbohydrate, respectively. The results of chemical composition of lentil seed flour are comparable with the results found by Iqbal *et al.* (2006) who reported 3.35% fat, 26.20% protein, 2.4% total dietary fiber, 7.35% moisture and 3.20% ash content. The minerals contents are often more influenced by ecological condition in the area where the crop is grown than by genetic factors as reported by Buerkert *et al.* (2001). The distributions of mineral elements vary greatly in different part of the grain, with most of them located in the germ and aleurone layer (Anjumi *et al.*, 2008). The results regarding the mineral content of wheat and lentil flour given in Table 2 indicated that significantly the lowest values of calcium, magnesium, iron, phosphorus, sodium and potassium contents were found in wheat flour (WF) compared to lentil flour (LF). The minerals content of biscuit wheat flour were 16.21, 19.13, 173.02,

Table 1: Proximate composition of wheat and lentil flours

	Parameter					
Cultivars	Moisture	Ash	Protein	Fat	Fibre	Carbohydrates
Wheat flour	8.80±0.01[a]	0.35±0.02[b]	10.16±0.12[b]	0.98±0.01[b]	0.08±0.05[b]	79.63±0.04[a]
Lentil flour	7.35±0.05[b]	3.20±0.01[a]	26.20±0.09[a]	3.35±0.07[a]	2.40±0.10[a]	57.50±0.29[b]

Values are means (±SD) of 3 replicates per treatment

[ab]Means with different superscripts in the same row were significantly different ($p \leq 0.05$)

Table 2: Minerals content (mg/100 g) of wheat and lentil flours

	Parameter					
Cultivars	Ca	Mg	Fe	P	Na	K
Wheat flour	16.21±0.10[b]	19.13±0.10[b]	4.54±0.10[b]	118.12[b]±1.00	2.29±0.02[b]	107.21±0.1[b]
Lentil flour	118.20±0.01[a]	4.03±0.09[a]	5.32±0.11[a]	226.12[a]±2.05	63.53±0.1[a]	650.51±0.15[a]

Values are means (±SD) of 3 replicates per treatment

[ab]Means with different superscripts in the same row were significantly different ($p \leq 0.05$)

Table 3: A Proximate Composition of Biscuit made of wheat-lentil composite flours

	Parameter					
Biscuit	Moisture	Ash	Protein	Fat	Fiber	Carbohydrates
0% LF: 100 WF	3.15±0.15[b]	0.34±0.01[c]	12.11±0.10[c]	2.11±0.10[c]	0.07±0.05[d]	82.22±0.12[a]
5% LF: 95 WF	3.20±0.20[b]	0.70±0.21[c]	12.87±0.11[c]	3.14±0.07[b]	0.12±0.10[c]	77.11±0.31[b]
10% LF: 90 WF	3.12±0.12[b]	1.05±0.16[b]	13.91±0.13[b]	3.61±0.17[a]	0.70±0.14[b]	74.41±0.10[c]
15% LF: 85 WF	3.41±0.01[a]	1.55±0.03[a]	15.52±0.31[a]	3.75±0.15[a]	1.27±0.25[a]	71.30±0.14[d]

Values are means (±SD) of 3 replicates per treatment

[ab]Means with different superscripts in the same row were significantly different ($p \leq 0.05$). LF: Lentil flour, WF: Wheat flour

Table 4: Minerals content (mg/100 g) of Biscuit made of wheat-lentil composite flours

	Parameter					
Biscuits	Ca	Mg	Fe	P	Na	K
0% LF: 100 WF	16.21±0.10[d]	19.13±0.10[a]	4.54±0.10[b]	118.12±1.00[d]	2.29±0.02[c]	107.21±0.1[d]
5% LF: 95 WF	16.79±0.01[c]	19.12±0.09[a]	4.82±0.11[b]	134.42±2.05[c]	2.93±0.03[c]	131.31±0.15[c]
10% LF: 90 WF	17.50±0.01[b]	19.14±0.01[a]	5.40±0.01[a]	172.31±0.01[b]	3.56±0.01[b]	165.43±0.01[b]
15% LF: 85 WF	19.20±0.01[a]	18.70±0.01[b]	5.90±0.01[a]	194.11±0.01[a]	4.65±0.01[a]	289.31±0.01[a]

Values are means (±SD) of 3 replicates per treatment

[ab]Means with different superscripts in the same column were significantly different ($p \leq 0.05$). LF: Lentil flour, WF: Wheat flour

Table 5: Sensory evaluation of various treatments assessed by panelists

	Hedonic scores				
Biscuits	Color	Taste	Flavor	Texture	Overall acceptability
0% LF:100 WF	7.30±0.08[b]	8.60±0.06[bc]	7.80±0.03[a]	6.86±0.05[c]	8.33±0.04[b]
5% LF:95 WF	9.46±0.09[a]	9.06±0.08[a]	8.73±0.07[ab]	8.60±0.08[a]	9.13±0.05[a]
10% LF:90 WF	6.26±0.04[c]	8.86±0.04[b]	7.60±0.06[b]	7.20±0.06[b]	7.90±0.03[c]
15% LF:85 WF	5.80±0.02[d]	6.66±0.01[c]	5.30±0.04[c]	6.80±0.02[c]	6.30±0.01[d]
$LSD_{0.05}$	0.2365*	0.5854*	0.4532*	0.9081*	0.4687*
SE±	0.0254	0.0876	0.0348	0.0975	0.0754

Means with different superscripts in the same column were significantly different ($p \leq 0.05$). LF: Lentil flour, WF:Wheat flour

4.54, 2.29 and 107.21 mg/100 g for Ca, Mg, P, Fe, Na and K respectively. This values showed significant variatons from the results obtained by Cordain (1999) who found that minerals content of wheat flour were 29.0, 126, 288, 3.19, 2 and 363 mg/100 g Ca, Mg, P, Fe, Na and K respectively. The minerals content of lentil seeds flour were 118.20, 4.03, 226.12, 5.32, 63.53 and 650.51 mg/100 g for Ca, Mg, P, Fe, Na and K, respectively. The results of mineral composition of lentil seed flour are comparable with the results reported by El-Mahdy *et al.* (1985). The results of mineral profile of lentil seed flour revealed that legumes may provide sufficient amounts of minerals to meet the human mineral requirement (recommended dietary allowance, RDA) (NRC, 1980). However, excess of one mineral (e.g., K) may be antagonistic for others to be absorbed and utilized properly. For this reason, ratios of the mineral constituents are important for good nutrition. These ratios in lentil seeds flour show imbalance between the potassium content and other minerals. Since plants have greater potash requirements than do animals and humans (Khalil, 1994), Mineral supplementation can be used as an alternative approach to correct this imbalance. The mean Ca: P ratio in lentil seed, being 0.7, reveals a high concentration of phosphorus compared to calcium. This ratio should not be less than 1.0.

Chemical composition of biscuit samples produced from composite flours: A significant difference ($p \leq 0.05$) was obtained between control and lentil flour supplemented biscuits for parameters regarding proximate composition Table 3. Results of the chemical analysis of biscuits revealed that protein content of the biscuits, prepared from lentil flour blends, was significantly higher ($p \leq 0.05$) than the protein content of control biscuit (12.11%). The average daily protein intake for a normal human individual should be 56-80 g/day (0.8 g/kg body weight/day), while for infants it should be 2-3 g/kg body weight and children require extra 4-5 g proteins daily for their healthy growth and development (Awan, 2007). This fact suggests that biscuits supplemented with lentil flour may be useful as food supplements for the alleviation of protein malnutrition in vulnerable groups. Lentils are rich in protein (20-30%), complex carbohydrates and dietary fiber and are an excellent source of a large range of micronutrients. With regard to the other chemical parameters, it was observed that the addition of lentil seeds flour resulted in an increase in ash content of biscuits up to 1.55% and crude fibre content up to 1.27%, while crude fat content was found to be 3.75% (15% of lentil flour level). Biscuit made with 100% wheat flour contained 3.15% moisture which was increased to 3. These results confirm the previous results of Eissa *et al.* (2007). This was also consistent with Sharma and Chauhan (2002) when wheat flour was substituted with 15% lentil flour.

Mineral composition of biscuit samples produced from composite flours: Micronutrient malnutrition ("hidden hunger") now afflicts over 40% of the world's population and is increasing especially in many developing nations. Today, deficiencies of iron and iodine are of most concern to the nutrition community and health care officials although other nutrient deficiencies, including zinc, selenium, calcium and magnesium may be prevalent in some global regions. The consequences of malnutrition create immense economic and societal costs to nations. Micronutrient malnutrition greatly increases mortality and morbidity rates, diminishes cognitive abilities of children and lowers their educational attainment, reduces labor productivity, stagnates national development efforts, contributes to continued high population growth rates and reduces the livelihood and quality of life for all those affected (Welch and Graham, 1999). The nutritional benefits of pulses have long been recognized. However, intensive work recently carried out on lentil within global mineral bio fortification efforts has highlighted its superior nutritional profiles: lentils are a rich source of highly bioavailable minerals and other micronutrients and are naturally low in phytates. Lentils could be an ideal crop for micronutrient bio fortification. They are a rich source of protein as well as essential minerals. The statistical results pertaining to the effect of lentil supplementation in wheat flour on macro minerals contents like sodium (Na), potassium (K), calcium (Ca) and magnesium (Mg) of biscuit samples are shown in Table 4. The results indicate that supplementation of lentil flour (LF) into wheat flour (WF) significantly affected the contents of macro minerals of composite flours used for biscuit making. The results presented in Table 4 indicate that supplementation of lentil flour (LF) in biscuit wheat flour in different biscuit composite flours resulted in a significant improvement of Na content in composite flours. The highest Na content (4.65 mg/100 g) was found in 15% biscuit sample. The Na content increased significantly ($p \leq 0.05$) from 2.29 mg/100 g (0% LF) biscuit to 4.65 mg/100 g (5% biscuit supplemented LF). The potassium content was found significantly higher in lentil flour as compared to wheat flour. The K content in 100% wheat flour biscuit was recorded 107.21 mg/100 g, which increased to 131.31, 195.58 and 289.31 mg/100 g due to supplementation of 5, 10 and 15% of LF in biscuit wheat flour, respectively. The results regarding calcium content of different biscuit revealed that Ca content was found significantly ($p \leq 0.05$) higher in lentil flour as compared to wheat flour. The Ca content in 100% wheat flour biscuit was recorded 16.21 mg/100 g, which increased to 16.79, 17.50 and 19.20 mg/100 g due to supplementation of 5, 10 and 15% of LF in biscuit wheat flour, respectively. The results regarding the magnesium content of different biscuit samples indicated that significantly ($p \leq 0.05$) the lowest magnesium content (19.31 mg/100 g) was found in 0% LF biscuit while 15% LF supplemented biscuits had significantly the highest Mg content (19.70 mg/100 g). The increase in magnesium content was also observed due to supplementation of lentil flour in biscuit flours. The results regarding the phosphorus and iron content of different biscuit samples indicated that the amount of both element significantly ($p \leq 0.05$) increased with increasing in substitution levels of lentil flour. Generally the results further indicated that with the increase in level of supplementation significantly improved the macro-mineral content of biscuit samples produced from different composite flours. The results obtained were comparable with Pasha *et al.* (2011) who study the effect of supplementation of wheat flour with mungbean. He stated that, mineral analysis of cookies showed that sodium, potassium, iron, magnesium, zinc and manganese content were significantly affected by the addition of mungbean flour. The results showed that mungbean flour has higher minerals content than wheat flour. Also the results are in agreement with those reported by Venderstoep (1981) and Ghavidel and Prakash (2007).

Amino acid composition of biscuit samples produced from composite flours: The nutritional quality of a protein can be measured by a variety of criteria, but in

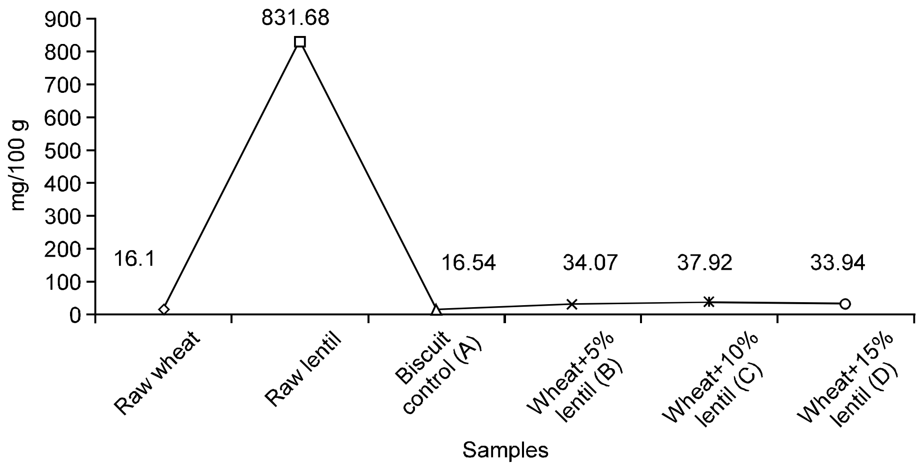

Fig. 1: Lysine content of raw materials and biscuit samples

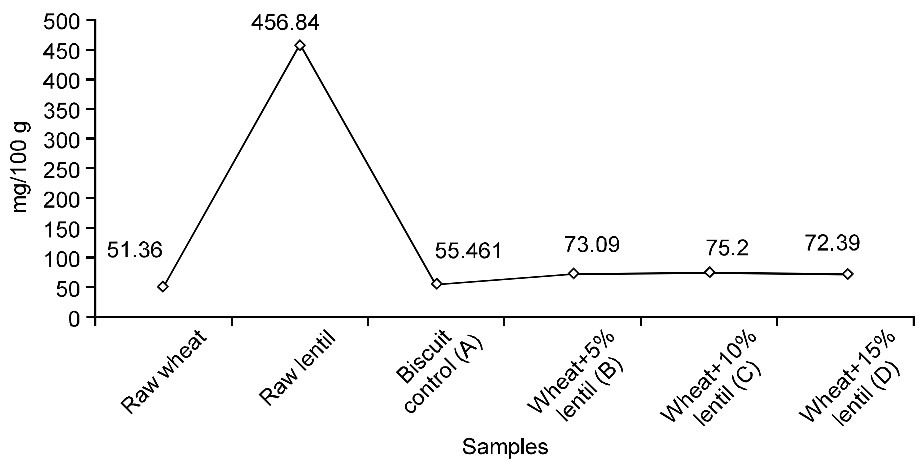

Fig. 2: Threonine contents of raw materials and biscuit

essence, it is the relative amounts and the balance of essential amino acids in the dietary protein that determine its nutritional value. In comparison with meat, plant protein is much more economical to produce; but when used as a source of dietary protein for humans and monogastric livestock, most plant proteins are nutritionally incomplete due to their deficiency in several essential amino acids (EAAs). Deficiency in certain amino acids reduces the availability of others present in abundance. In general, cereal proteins are low in Lys (1.5-4.5% vs. 5.5% of WHO recommendation), tryptophan (Trp, 0.8-2.0% vs. 1.0%) and threonine (Thr, 2.7-3.9% vs. 4.0%). Because of this deficiency, these EAAs become the limiting amino acids in cereals. It is thus of economic and nutritional significance to enhance the EAAs in plant proteins (Bicar *et al.*, 2008). Strategies that have been used to address protein deficiencies include food diversification (FAO, 1997), fortification of food with indispensable amino acids, supplementation with good quality protein, improvement of protein quality by plant breeding and genetic engineering and minimizing the damage to the nutritional value of protein during food processing and storage (Friedman, 2004). With reference to the recommended daily allowances (Barasi, 1997) of humans as well as of monogastric domestic animals and poultry, the amino acid composition of legumes is unbalanced, 80% of their proteins being specific storage proteins. Protein quality is affected by essential amino acid composition, amino acid imbalance, digestibility and biological availability of the amino acids and by the antinutritional activity of some components of the seeds (Deshpande and Damodaran, 1990). In general, legumes are rich in lysine, but deficient in sulphur containing amino acids (methionine and cystine). However, with a small increase in one of these two amino acids, tryptophan would become the next limiting amino acid in legume seeds. Amino acids content of lentil seeds was higher than biscuit flour. Methionine content was the lowest one. Result agreed with Bhatty *et al.* (1976) who analyzed six lentil varieties and stated that, the major amino acids were glutamic acid, aspartic acid, arginine, leucine and lysine; the minor amino acids were methionine, cystine and tryptophan. Because of the lower concentrations of the latter amino acids, lentil proteins gave a chemical score of 35, a protein score of 46 and an essential amino acid index of 63, relative to egg protein. Also the Results obtained agreed with the those reported by Friedman *et al.* (1991). Supplementation of biscuit wheat flour by lentil seed flour elevated protein content as well as protein quality (essential amino acid profile). The results obtained are in agreement with Stark *et al.* (1975) who reported that fortification of wheat flour with soy proteins increased protein quality by improving amino acids profile. Lysine and threonine contents of biscuit samples, lentil seeds flour and biscuit produced from their blends are shown in Fig. 1 and 2. Supplementation of biscuit wheat flour with lentil seeds flour showed a significant increase in lysine and threonine contents in 10 and 15% supplemented biscuit samples. The results obtained for both amino acid were comparable with Awadelkareem *et al.* (2008), who stated that Supplementation of sorghum flour with soy protein concentrate (SPC 0 showed a significant increase in lysine and threonine contents of meal prepared from their blends. Also the results obtained agreed with those reported by Bhatty *et al.* (2000) and Hussain and Basahy (1998). The improvement in biscuit protein quality is in agreement with Kadam *et al.* (2012) who stated that d the combination of grain with legume proteins would provide a better overall balance of essential amino acids.

Sensory evaluation of biscuit samples: The sensory evaluation of biscuit for various sensory attributes such as color, flavor, taste, texture, overall acceptability. Mean squares for sensory evaluation are presented in Table 5. The results indicated that the quality characteristics of biscuit scores differed significantly due to various treatments of biscuit. It is obvious from the results that biscuit prepared from 5% lentil flour got the highest color score 9.64 followed by biscuit made from wheat flour and 10% lentil flour which obtained 7.30 and 6.26 scores for color, respectively Minimum score was obtained by biscuit containing 15% lentil. Decrease in color scores was observed with increase in the level of lentil flour. Mean scores for taste of biscuit prepared form different flour samples showed that the highest taste score 9.06 gained by 5% lentil flour followed by biscuit made from wheat flour an 10% lentil flour which obtained 8.60 and 7.60 scores for taste, respectively. Observed decrease in taste scores of biscuit containing 15% lentil. The mean scores for flavor of biscuit prepared from different treatments revealed that biscuit prepared from 5% lentil flour obtained the highest flavor score 8.73 followed by 10% lentil flour 7.60 and 15% obtained the lowest score 5, 30 showed significant differences from biscuit made from wheat flour. The mean scores for texture of biscuit prepared form different treatments. Highest texture score 8.60% was assigned to 5% lentil flour followed by 10% lentil flour and 15% lentil flour which obtained 7.20 and 6.80 scores, respectively. Lowest texture score 6.86 was obtained by biscuit from wheat flour. Means for total biscuit scores, sum of all sensory attributes. There was significant difference ($p \leq 0.05$) between the samples. It was found that biscuit prepared from 5% lentil flour acquired the highest total biscuit scores 9.13% followed by biscuit made from wheat flour and 10% which attained 8.33 and 7.90 scores, respectively where as 15% lentil flour got the lowest total biscuit scores 6.30. The results of the sensory evaluation of the biscuits prepared from the different treatments of the composite flour are according to the findings of Gambus *et al.* (2003) who reported increasing the levels of flaxseed flour, matric flour, caw pea flour in the biscuit which resulted in significant decrease in the sensory attributes of the biscuits. The results are agreed with Serrem *et al.* (2011) reported that substitutions of defatted-soy flour into wheat bread and biscuits were associated with beanny flavour, aroma and after taste. Beany flavours are commonly associated with food legumes (Okoye and Okaka, 2009).

Conclusion: Keeping in view all the above results, it could be concluded that the addition of lentil flour in the range of 5-10% results in favorable biscuit products These combinations also improved the chemical composition, mineral and amino acid content properties of biscuit. The results of this study suggested a great potential of lentil flour in baking industry to provide new value-added nutritious products for consumers especially in developing and resource poor countries.

ACKNOWLEDGMENTS

The author would like to thank all colleagues who contributed to this study. The quality of this research work was greatly enhanced by the gracious assistance of Mr Ismail soker, biochemistry and food science. I do grateful to prof Abdoelmoneium for his collaboration during preliminary investigations.

REFERENCES

AACC, 2000. Amarican Association of Cereal Chamists. Approved Methods. 10th Edn. St Paul. MN: American Association of Cereal Chemists Inc.

Amjad, I., A.K. Iqtidar, A. Nadia and M.S. Khan, 2006. Nutritional quality of important food legumes. Food Chem., 97: 331-335.

Anjumi, R.G.O., S.M. Macedo, M.G.A. Korn, M. Fernandantel, E.B. Roy and S.C. Ferriea, 2008. Mineral Compostion in Wheat Flour Consumed in Brazilinan Cities. J. Braz. Chem. Soc., 19: 935-942.

AOAC, 1984. Official Methods of Analysis. 14th Edn., Association of Official Analytical Chemists, Washington, DC., USA., pp: 522-533.

Awadelkareem, A.M., A.I. Mustafa and El A.H. Tinay, 2008. Protein, mineral content and amino acid profile of sorghum flour as influenced by soybean protein concentrate supplementation. Pak. J. Nutr., 7: 475-479.

Awan, J.A., 2007. Elements of food and nutrition. Faisalabad: Unitech Communication.

Barasi, M.E., 1997. Human nutrition. A health perspective. New Yourk, Oxford University Press, pp: 328.

Bhatty, N., A.H. Gilani and S.A. Nagra, 2000. effect of cooking and supplementation on nutritional value of gram (*Cicer arietinum*). Nutr. Res., 20: 297-307.

Bhatty, R.S., A.E. Slinkard and F.W. Sosulski, 1976. Chemical composition and protein characteristics of lentils. Can. J. Plant Sci., 56: 787-794.

Bicar, E.H., W. Woodman-Clikeman, V. Sangtong, J.M. Peterson, S.S. Yang, M. Lee and M.P. Scott, 2008. Transgenic maize endosperm containing amilk protein has improved amino acid balance. Transgenic Res., 17: 59-71.

Bojoanska, T., H. Franeakova, M. Liskova and M. Tokar, 2012. Legumes the alternative raw materials for bread production. J. Microbiol. Biotechnol. and Food Sci., 1: 876-886.

Buerkert, A., M. Mostr, A.K. Kmar, B. Furst and K. Becker, 2001. Variation in Grain Quality of Peral millet from Sahelian West Africa. Filed Crops Res., 96: 1-11.

Chapman, H.D. and F.P. Pratt, 1982. Determination of Minerals by Titration Method. Methods of Analysis for Soils, Plants and Water. 2nd Edn., California University, Agriculture Division, USA., pp: 169-170.

Cordain, L., 1999. Cereal grains humanity double edged sword. World Rev. Nutr. and Diet., 84: 19-73.

Deshpande, S.S. and S. Damodaran, 1990. Food legumes: Chemistry and technology. In: Advances in cereal science and technology (Ed.: Pomeranz, Y.). St. Paul, Am. Assoc. of Cereal Chem., 147-241.

Duncan, D.B., 1995. Multiple range and multiple F test. Biometrics, 11: 1-42.

Eggum, B.O. and R.M. Beame, 1983. The nutritive value of seed proteins. Seed Protein Biochemistry. Genetics and Nutritive Value, 499-531.

Eissa, H.A., A.S. Hussein and B.E. Mostafa, 2007. Rheological properties and quality evaluation of Egyptian balady bread and biscuits supplemented with flours of ungerminated and germinated legume seeds or mushroom. Pol. J. Food Nutr. Sci., 57: 487-496.

El-Mahdy, A.R., Y.G. Moharram and O.R. Abou-Samaha, 1985. Influence of Germination on the Nutritional Quality of Lentil Seeds. Z. Lebensm. Unters. Forsch 181: 318-320.

FAO, 1997. Agriculture, Food and Nutrition for Africa. A Resource Book for Teachers of Agriculture. Food and Agricultural Organization of the United Nations, Rome, pp: 412.

Feillet, P., 2000. Amidon, Pentosanes et Lipides in Le Grain de ble, Feillet P; Eds, INRA Edition 147rue De l'universite 75338 Paris Cedex, 7: 57-90.

Friedman, N., 2004. Inferring cellular networks using probabilistic graphical models. Sci., 303: 799-805.

Friedman, M., D.L. Brandon, A.H. Bates and T. Hymowitz, 1991. Comparison of soybeans cultrvar and an isoline lacking the kunitz trypsin inhibitor: composition, nutritional value and effects of heating. J. Agric. Food Chem., 39: 327-335.

Gambus, H., A. Milulec and A. Matusz 2003. The Canadian muffins and hermit cookies with linseeds. Zywnosc, 10: 82-92.

Ghavidel, R.A. and J. Prakash, 2007. The impact of germination and dehulling on nutrients, antinutrients, *in vitro* iron and calcium bioavailability and *in vitro* starch and protein digestibility of some legume seeds. LWT, 40: 1292-1312.

Hefnawy, T.M.H., G.A. El-Shourbagy and M.F. Ramadan, 2012. Impact of adding chickpea (*Cicer arietinum* L.) flour to wheat flouron on the rheological properties of toast bread. Int. Food Res. J., 19: 521-525.

Hussain, M.A. and A.Y. Basahy, 1998. Nutrient-composition and amino acid pattern of cowpea (*Vigna unguiculata* L.) grown in the Gizan area of Saudi Arabia. Int. J. Food Sci. Nutr., 49: 117-124.

Ihekoronye, A.I. and P.O. Ngoody, 1985. Integrated Food Science technology for the Tropics Macmillan London, pp: 283-289.

Iqbal, A., I.A. Khalil, N. Ateeq and Sayyar M. Khan, 2006. Nutritional Quality of Important Food Legumes. Food Chem., 97: 331-335.

Kadam, M.L., R.V. Salve, Z.M. Mehrajfatema and S.G. More, 2012. Development and evaluation of composite flour for Missi roti/chapatti. Food Process and Technology, 3, 1000134. DOI: 10.4172/2157-7110.1000134.

Karadavut, U.F. and Asir Genc, 2010. Relationships between Chemical Composition and Seed Yield of some Lentil (*Lens culinaris*) Cultivars. Int. J. Agric. and Biol., 1560-8530.

Khalil, I.A., 1994. Nutritional yield and protein quality of lentil (Lens culinaris Med.) cultivars. Microbiogie Aliments Nutrition, 12: 463-455.

Mohammed, I., A.R. Ahmed and B. Senge, 2012. Dough rheology and bread quality of wheat-chickpea flour blends. Indust. Crops and Prod., 36: 196-202.

NRC, 1980. Recommended Dietary Allowance (9th ed.). Food and Nutrition Board NRC. Washington, DC, USA: National Academy of Sciences.

Okoye, J.I. and J.C. Okaka, 2009. Production and evaluation of protein quality of bread from wheat cowpea flour blends. Cont. J. Food Sci. Technnol., 3: 1-7.

Özdemir, S., 2002. Edible Legumes, 71-90. Hasat Publishing, Istanbul, Turkey.

Pasha, I., S. Rashid, F.M. Anjum and M.T. Sultan, 2011. Quality evaluation of wheat-mungbean flour blends and their utilization in baked products. Pak. J. Nutr., 10: 388-392.

Pastor-Cavada, E., R. Juan, J.E. Pastor, M. Alaiz and J. Vioque, 2009. Analytical nutritional characteristics of seed proteins in six wild Lupinus species from Southern Spain, Food Chem., 117: 466-546.

Riberio, R.J.M.C. and I.M.P. Melo, 1990. Composition and nutrient value of chickpea, Options Mediterranean's Serie Seminares, 9: 107-111.

Rochfort, S. and J. Panozzo, 2007. Phytochemicals for health, the role of pulses. J. Agric. and Food Chem., 55: 7981-7994.

Serrem, C., H. Kock and J. Taylor, 2011. Nutritional quality, sensory quality and consumer acceptability of sorghum and bread wheat biscuits fortified with defatted soy flour. Int. J. Food Sci. Technol., 46: 74-83.

Sharma, H.R. and G.S. Chauhan, 2002. Effects of stabilized rice bran-fenugreek blends on the quality of breads and cookies. J. Food Sci. and Technol., 39: 225-233.

Shelton, D. and G. Martin, 2007. Wheat and Flour Testing Methods: A Guide to Understanding Wheat and Flour Quality: Version 2. U.S. Wheat Inspection, Wheat Associates.

Snedecor, G.W. and W.G. Cochran, 1987. Statistical Methods. 17th Edn., The Iowa State University Press, Ames, IA, USA., pp: 221-222.

Stark, A.L., L.D. Satterlaee and J.G. kendenick, 1975. Computer blending and laboratory evaluation of added proteins for specific functional properties. Food Prod. Dev., 9: 38 42.

Thavarajah, D., J. Ruszkowski and A. Vandenberg, 2008. High potential for selenium biofortification of lentils (*Lens culinaris* L.). J. Agric. Food Chem., 56: 10747-10753.

Thavarajah, D., P. Thavarajah, A. Wejesuriya, M. Rutzke, R.P. Glahn, G.F. Combs Jr and A. Vandenberg, 2011. The potential of lentil (*Lens culinaris* L.) as a whole food for increased selenium, iron and zinc intake: Preliminary results from a three year study. Euphytica, 180: 123-128. toast bread. Int. Food Res. J., 19: 521-525.

Venderstoep, J., 1981. Effect of germination on the nutritive value of legumes. Food Technol., 43: 83-85.

Wang, N., D.W. Hatcher, R.T. Tyler, R. Toews and E.J. Gawalko, 2010. Effect of cooking on the composition of beans (*Phaseolus vulgaris* L.) and chickpeas (*Cicer arietinum* L.). Food Res. Int., 43: 589-594.

Welch, R.M. and R.D. Graham 1999. Field Crops Res. 60: 1-10.