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Food Science and Nutrition Technology
ISSN: 2574-2701

The Nutritional Value of Improving Dried Lentil Soup

Sohair T El-Hadidie*

Department of Crops Technology Research, Food Technology Research Institute of Agriculture Research Centre, Giza, Egypt

***Corresponding author:** Sohair T El-Hadidie, Department of Crops Technology Research, Food Technology Research Institute of Agriculture Research Centre, Giza, Egypt, Email: Sohairelhadid@yahoo.com

Research article

Volume 4 Issue 5
Received Date: August 23, 2019
Published Date: September 24, 2019
DOI: 10.23880/fsnt-16000192

Abstract

The main objective of this investigation is to prepare a quick and high quality lentil soup characterized with nutritional value in the form of powder from formulated dried soups. Dried soup mixtures formulated by lentil, mushroom, egg powder and dried sweet whey at different ratio. Three formulas were prepared and compared with lentil soup only for organoleptic properties, color, rehydration ratio, proximate analysis and energy, total phenolic compounds, antioxidant activity, amino acids profile and water activity during storage at room temperature. The organoleptic evaluation of different dried soup mixtures showed that the control lentil soup (M1) recorded the highest score (46.05) followed by died whey soup (M4) (45.05). Color measurements indicated significantly increases in lightness, redness and yellowness values. The M4, M2and M3 formulas, recorded the highest value respectively. The rehydration ratio resulted in significant increase for control, and those containing mushroom and egg powder (M1, M2, and M3), main while the presence of dried whey showed significant decrease. The chemical composition indicated that the M3 formula had the highest protein content followed by M2 and M4 compared with control. Fat and fiber content in the different soup mixtures had no significant differences as well as total carbohydrates which had the highest values in M4 followed M1, M2 and M3, respectively. The obtained results revealed that different dried lentil soup mixtures may contain a sufficient amount of minerals (Fe, Zn, Ca, and Se) to cover the human mineral requirements and also a good source of phenolic acids and antioxidant activity. The major essential amino acid in the different mixtures (M2,M3 and M4) soups was leucine which found in high amounts followed by lysine and valine compared to the control (M1) .The major non- essential amino acids were glutamic, aspartic and arginine acids followed by serine, alanine and proline which were nearly, similar all different soups mixtures. The water activity of different soups mixes increased with progressive the storage period with the type of packaging materials. The overall increase was laid safe limits was aw=o.6. From the obviously results it could be recommended that the lentil, mushroom, egg and whey powders could be a common new and successful ingredient to use in preparing a novel generation of healthy food products. The formulas from these ingredients increased the nutritional value, antioxidant activity and the amino acids. Finally, high quality and nutritional properties of different lentil soups mixtures were in order of M3 M2 and M4, comparable by M1 as a control.

Keywords: Lentil; Dried Soup; Mushroom Powder; Whole Egg Powder; Whey Powder; Antioxidant; Amino Acids

Introduction

The formulation of value- added products are now the main target of the consumers. Because it can supply the nutritional value as well as delicious test to consumers [1]. Soup is, often, served as the starter, first course or entree before the main meal as it stimulates appetite and provides quick nourishment, which is mainly responsible forth, improvement of appetite and gastrointestinal responses [2].

Dried soup powders have an advantage of protection from enzymatic and oxidative spoilage and flavor stability at room temperature over long periods of time (6–12 months). In addition, they are ready for reconstitution in a short time for working families, hotels, hospitals, restaurants, and institutional use as well as to military rations. Moreover, they exert light weight for shipping and availability at all time of the year [3].

Lentils are part of the Leguminosae (Papilonaceae, Fabaceae) family, the Lens genus and Seeds can be fried and seasoned for consumption; flour is used to make soups, stews purees, and mixed with cereals to make bread and cakes, and as a food for infants [4]. Lentil is an affordable source of dietary protein in many parts of the world, especially in South Asia where plant-based diet is a staple food. It is equally popular in Sub-Saharan Africa, West Asia, North America, Middle East, Europe and Australia [5]. Lentil is a highly nutritious legume with an ample quantity of carbohydrates and good amount of proteins, minerals, vitamins, phytochemicals and fibers [6]. Lentils are an excellent source of protein and also rich in important vitamins, minerals, soluble and insoluble dietary fiber. Lentil is a potential source of bioactive components such as phytosterols and tocopherol [7]. The fiber and carbohydrate contents of lentil seeds were 3.7–3.8% and 66.6–68.2%, respectively. Lentil seeds are composed of about two-thirds carbohydrates and 24–30% proteins. Both the starch and protein fractions of lentil offer a new source of novel ingredients [8]. Also Mendil, et al. [9] reported that an edible dried mushroom had 56.8% carbohydrate, 25.0% protein, 5.7% fat and 12.5% ash contents. Whey is usually dried to extend shelf life and reduce the cost of transportation [10]. Also Whey is by product rich in lactose, proteins, vitamins and minerals. The average content of whey dry residue is: 70% lactose, 14% proteins, 9% minerals, 4% fats and 3% lactic acid [11]. Moreover, mushrooms are recognized as a good source of amino acids which play an important role in their flavors [12].

Mushroom species are good sources of proteins and carbohydrates. Several minerals content and amino acids have also been detected as a favorable food stuff making it potentially useful in many food formulations. The species of mushroom which cultivated in Egypt (*Agaricus bisporus* and *Pleurotus ostreatus*) have high content of total polyphenols with a high antioxidant activity. Sustainable use of different species of nutrient rich mushrooms also has the potential to be transformed into an "export item" that can bring in economic benefits for the betterment of rural communities [13].

Mushrooms are edible fungi which have been used as an antibiotic drug since ancient times. The crude protein content of cultivated mushrooms is generally high (20-44% of dry matter) but the fat content is low 3- 7% of dry matter [14]. Mushrooms are a low calorie food usually eaten raw or cooked to provide garnish to a meal. Mushroom species are good sources of proteins and carbohydrates. Several minerals content and amino acids have also been detected as favourable, making it potentially useful in many food formulations. Raw dietary mushrooms are a good source of B vitamins, such as riboflavin, niacin and pantothenic acid, and the essential minerals selenium, copper and potassium. Fat, carbohydrates and calorie content are low, with a little amount of vitamin C [15].

Eggs are a rich source of protein and several essential nutrients, particularly vitamins D, B12, selenium and choline. Emerging evidence suggests that eating egg are associated with satiety, weight management and better diet quality. In addition, antioxidants found in egg yolk may help prevent age-related macular degeneration [16]. Drying of whole egg into powder form to facilitate its easy handling and transportation [17].

The egg industry has become competitive due to advances in technologies and commercial standards. To provide a better quality product to consumers at a lower price has been driving technological innovations in the egg industry [18].

Schmier, et al. [19] found that egg yolk contains specific antioxidant nutrients that support eye function. Thus, the overall health benefits of foods must be considered when formulating dietary advice. Micronutrients found in significant amounts in eggs may contribute to health, i.e. vitamin D, vitamin B12, choline, folate, selenium, lutein and zeaxanthin. Vitamin D seems to slow cell ageing and may help prevent Cardiovascular, diabetes, autoimmune diseases and certain cancers [20], while vitamin B12 may delay the cognitive decline and protect against Alzheimer's disease [21].

Whey powder (WP) is mainly used for the production of animal feed, because it is an inexpensive source of high quality proteins and carbohydrates. However, because of the high nutritional value of whey powder, it could be used in the food industry as an additive in the production of many products including the confectionery industry, bakery, dairy products, baby food, meat products and production of beverages, soups, sauces, toppings and cream. Properties of food products that may be affected by using WP are very diverse, such as improving sensory properties [22]. Whey powder has many different varieties including acid whey, demineralized whey, and sweet whey [23]. Whey protein helps to reduce body fat and build the lean body mass; and it helps to improve the memory loss under stress. In addition to these, some of the top benefits of whey protein may include: it provides immunity support, increase muscle mass, boost metabolism, and helps to improve overall health [24].

Soups are generally consumed for health as well as nutritive benefits particularly in patients whose intake of solids is poor due to several obstructive or pathological reasons. Under those circumstances, soups are the best source to supply health protective compounds and to circumvent the nutritive deficiency. Incorporation of antioxidant-rich ingredients into the soup will further boost the product market as the present trend is focused on marketing of processed food products providing health benefits [25].

People are passing hectic life due to urbanization. They do not have enough time to cook foods and are becoming habituated to consume fast foods and something like that. Most of these foods are junk foods due to high sugar, fat, salt content and low nutrient value in terms of protein, fiber, vitamin and mineral content [26].

The present study was aimed to easy prepare and supplement different dried lentil soup mixtures which contained, mushroom, eggs and whey powder to give three mixtures soup powders compared with ordinary lentil soup as a control sample. Chemical, rheological and sensorial properties were evaluated to assess the nutritional and technological quality of the resultant mixtures and soups.

Materials and Methods

Materials

Lentil seeds were obtained from Legumes Research Department, Field Crops Research Institute, Agricultural Research Center, Giza, Egypt.

Oyster mushroom (*Pleurotus ostreatus*) was obtained from Food Technology Research Institute, Agricultural Research Center, Giza, Egypt. The mushroom was cleaned and washed with tap water then dried in an electric oven at 40±1°C. Dried mushroom was milled and passed through a 0.28 mm sieve to give fine powder after that it was packed in polyethylene bags, and kept in a refrigerator at 4± 1ºC till use.

Dried Sweet whey powder (TURKEY) was obtained from ARAB Co., for Food Additives, Ahmed Orabi -Egypt.

Dried whole eggs were purchased from Allied Chemical Group- ACG, Industrial Zone, 6th October, Giza.

Fresh carrot, tomato, onion, garlic, celery, black pepper, turmeric and salt were purchased from a local market in Cairo- Egypt.

Packets multilayer high barrier sachets from Flexi Pack Company 6th October, Giza.

All chemicals used in the present study were of an analytical grade and purchased from Sigma Chemicals (St. Louis, MO).

Methods

Preparation of Different Dried Soup Mixtures: The ingredients of the different soup mixture contained fresh carrot, tomato, onion, garlic, celery, black pepper, turmeric and salt were separately mixed then added to lentil, mushroom powder, whole egg powder and whey powder to give a control lentil soup only considerably as M1 compared with three soup mixtures namely M2, M3 and M4 as shown in Table 1.

Cleaned, washed lentil seeds and cutting fresh ingredients were mixed then added spices and cooking on heater at 100°C for 20 min with continuous stirring and thoroughly blended in a planetary mixer (Moulinex, France) for 3 min. Finally soups mixtures were dried in electric oven at 70°C for 2 hr then at 50°C overnight till drying. The dried different soup mixtures were milled to give a fine powder and sieving through 0.28 mm sieve. The different soups mixtures powder was packaged under vacuum in multilayer high barrier bags for gases and moisture then storage at room temperature until use.

Ingredients	M1 Control))	M2	M3	M4
Lentil	70	60	60	60
Mushroom powder	---	10	---	---
Whole egg powder	---	---	10	---
Whey powder	---	---	---	10
Fresh carrot	10	10	10	10
Fresh tomato	10	10	10	10
Fresh onion	3	3	3	3
Fresh garlic	3	3	3	3
Fresh celery	1	1	1	1
Turmeric	1	1	1	1
Salt	1.5	1.5	1.5	1.5
Black pepper	0.5	0.5	0.5	0.5

Table 1: Ingredients of different soup mixtures (g/100g).

Proximate analysis of raw materials and energy of the dried different soup mixtures:
Moisture, ash, total fat, fiber and crude protein were determined according to AOAC [27]. Moreover, total carbohydrates were determined by difference.

Energy value (kcal/100g) of the different dried soup mixtures was calculated using the following equation as reported by James [28].

Energy value = [(% of carbohydrate x 4) + (% of protein x 4) + (% of fat x 9)]. All results were recorded as the mean value of 3 replicates.

Organoleptic Evaluation of the Different Dried Soup Mixtures: The different soup mixtures were organoleptically evaluated after dissolving in a hot water (10 g dried soup mixtures/65 ml water) for its sensory characteristics, i.e., taste, flavor, color, thickness and, dissolution rate and overall acceptability. The evaluation was carried out by ten panelists according to the method of Wang, et al. [29]

Color Measurement Of Different Dried Soup Mixture: The color of the dried soup mixtures was measured according to the method outlined by Mc-Gurie [30] using a hand-held Chromameter (Model CR-400, Konica Minolta, Japan).

Rehydration Ratio (RR) of Different Dried Soup Mixtures: Rehydration ratio was performed according to Krokida & Marinos-Kouris [31]. A given (2 g) of the dried soup mixtures were rehydrated in 20 ml distilled water in a water bath at a constant temperature, which was agitated at a constant speed (100 rpm). The samples were taken from the bath after 10 minutes and weighted after being blotted with tissue paper in order to remove the excess solution. Rehydration ratio was defined as the ratio of weight of rehydrated samples to the dry weight of the sample.

Determination of Minerals: Minerals content as calcium, zinc, iron and selenium were determined in the different dried soup mixtures determined using Atomic Absorption Spectrophotometer (Perkin Elmer model 3300, Merck hydride system USA) according to the methods of AOAC [27].

Determination of Total Phenolic Compounds (TPC) of Different Dried Soup Mixtures: The total phenolic content was colorimetrical determined according to the Folin-Ciocalteu procedure [32].

Determination of Antioxidant Activity of Different Dried Soup Mixtures: Determination of Free Radical Dpph Scavenging Activity: Free radical scavenging capacity of extracts was determined using the stable DPPH method according to Hwang & Do Thi [33] using spectrophotometer (6405 UV/VIS –Jenway- England) the absorbance was measured at 517 nm against a blank of pure methanol after 60 min of incubation in a dark condition. Percent inhibition of the DPPH free radical was calculated by the following equation:

Inhibition (%) = 100 × [(A control-A sample)/A control]

Where: A control is the absorbance of the control reaction (containing all reagents except the test compound).

A sample is the absorbance with the test compound.

The concentration of sample providing 50% inhibition (IC50) was calculated using linear regression analysis.

Determination of Amino Acids Profile of Different Dried Soup Mixtures: Amino acids content quantity was determined using amino acids analyzer Biochrom 30 using the instruction manual according to AOAC [34].

The Chemical Score of Different Dried Soup Mixtures: The chemical score was calculated according to FAO/WHO [35].

Chemical score %= (Essential amino acid of crude protein)/ (Essential amino acid of FAO/WHO) ×100.

The Biological Value of Different Dried Soup Mixtures: Biological value of soup mixtures was calculated according to Eggam, et al. [36] as follows:

Biological value % = 39.55 + (8.89 × lysine) (g/100g protein).

Storage Dried Soup Mixtures: Packed dried soup mixtures in multilayer high barrier bags contain three layers (PET \ P\ AL\PE) under vacuum method and stored at room temperature 30±5ºC for nine months then opened one bag every three months to measure the water activity (aw).

Water Activity (Aw) of Different Dried Soup Mixtures during the Storage Period: The water activity (aw) of the different dried soups mixtures was measured during storage period using Rotronic Hygrolab 3CH-8303, Switzerland as mentioned by Cadden [37].

Statistical Analysis: The obtained data were exposed to analysis of variance (ANOVA). Duncan multiple range tests at (P ≤ 0.05) level was used to compare among means values [38].

Results and Discussion

Chemical Compositions of Raw Materials

Moisture, protein, fat, crude fiber and ash contents were of the tasted raw materials and the results are reported in Table 2. From the result, it could be noticed that the egg is contained the highest amount of protein and fat (38.12 and 14.53%) followed by mushroom and lentil which considered a good source of protein (25.55 and 21.62%, respectively). Eggs are a rich source of vitamins, fats and minerals Egg is as well as an important animal protein, it contains all the essential amino acids needed for human body and it is suitable for persons for all ages Concerning, lentil, mushroom and whey protein, they characterized by a high value of total carbohydrates (69.75%, 56.56% and 76.84%, respectively) [39-41]. The obtained results are agreed with Kaur & Sandhu [42] who found that the lentil seeds had ash and fat content of 2.5–2.8% and 1.7–1.9%, respectively. The protein content of the lentil seeds varies from 23.6 to 25.1%, indicating that lentil seeds could be a valuable protein supplement in food products.

Sample	Moisture	Crude protein*	Fat*	Ash *	Fiber*	Total Carbohydrates*
Lentil	10.25^{a}±0.083	21.62^{c}±0.076	3.40^{c}±0.26	2.63^{c}±0.12	2.60^{b}±0.01	69.75^{b}±0.54
Mushroom powder	9.99^{b}±0.089	25.55^{b}±0.31	4.29^{b}±0.19	8.32^{a}±0.07	5.28^{a}±0.08	56.56^{c}±0.52
Whole egg powder	2.19 ^{d}±0.07	38.12^{a}±0.08	14.93^{a}±0.45	0.96^{d}±0.06	0	45.99 ^{d}±0.23
Whey powder	4.45^{c}±0.132	14.15^{d}±0.064	1.47^{d}±0.15	7.54^{b}±0.04	0	76. 8 4^{a}±0.40

Table 2: Chemical compositions of the tasted raw materials (g\100g).
*Determined on dry weight basis. Values are mean of three replicates followed by ± SD, the number in the same column followed by the same letter are not significantly different at 0.05 levels.

In conclusion, from the aforementioned data, the chemical composition can be arranged in the following descending order according its significance: protein content showed that the descending order was whole egg powder (38.12%)> mushroom (25.55%)> lentil (21.62%)> whey powder (14.93 %). Fat: whole egg (14.93%)> mushroom (4.29%)> lentil (3.4%)> whey powder (1.47%). Ash: mushroom powder (8.32%)> whey powder (7.54%)> lentil (2.63%)> whole egg (0.96%). Total carbohydrates: whey powder (76.84%)> lentil (69.75%)> mushroom (56.56%)> whole egg powder (45.99%).

Organoleptic Evaluation of Different Dried Soup Mixtures

All the products were palatability accepted with respect to color but were insignificantly differed in between with respect to taste and flavor. Thus taste and flavor were over riding factors influencing overall acceptability. The results in Table 3 showed the sensory evaluation values of dried different soup mixtures and it could be noticed that lentil soup (M1 as control) recorded the highest score 46.05 of the quality attributes in turn the overall acceptability followed by whey protein soup (M4) was 45.05. These results may be due to the color of lentil and whey formula (M1 and M4) recorded 9.40. Total carbohydrates were recorded highest content in M1 and M4 soups (69.75 and 76.84 %, respectively) than other soups which affects thickness. Formulas (M1 and M4) resulted high thickness (9.00 and 8.80, respectively) followed by mushroom and eggs powder soup 8.80 and 8.35 respectively. The statistical analysis showed no significant differences between organoleptic characteristics and soup mixtures except that of dissolution and over all acceptability. This may be due to the carbohydrates composition of the ingredients. Sensory evaluation is considered to be a valuable tool in solving problems involving food acceptability. It is useful in product improvement, quality maintenance and more important in new product development [43].

Mixtures soup	Taste (10)	Color (10)	Flavor (10)	Thickness (10)	Dissolution (10)	Overallacceptability (50)
M1	9.00^{a}±0.47	9.40^{a}±0.52	9.30^{a}±0·67	9.00 ^{a}±0.47	9.35 ^{a}±0.47	46.05 ^{a}±2.11
M2	8.30 ^{a}±0.95	9.10^{a}±0.88	8.50a ±1.72	8.80 ^{a}±0.67	9.00 ^{ab}±0.67	43.70^{b}±3.34
M3	8.55 ^{a}±0.76	8.70^{a}±0.95	8.50^{a}±1.08	8.35 ^{a}±0.75	8.20^{b}±1.48	42.30^{b}±3.34
M4	8.90^{a}±1.197	9.40 ^{a}±0.84	8.95 ^{a}±1.38	8.80^{a}±0.92	9.00 ^{ab}±0.78	45.05 ^{ab} ±4.18

Table 3: Organoleptic evaluation of different dried soup mixtures.
Values are mean of ten replicates followed by ± SD, the number in the same column followed by the same letter is not significantly different at 0.05 levels. (M1) control dried lentil soup, (M2) dried lentil soup+ mushroom powder, (M3) dried lentil soup +egg powder, (M4) dried lentil soup+ sweet whey powder.

Color and Rehydration Ratio (RR) of Different Dried Soup Mixtures

Color measurements of the different dried soup mixtures are presented in Table 4. The results indicated that lightness (L*) values increased significantly for the dried soup mixture except that of M2which recorded the lowest value , where M4 recorded the highest value followed by M3. The redness (a*) values of the dried soup mixture were significantly increased in M2 and M1 followed by M3. Regarding yellowness (b*) values of dried soup mixtures significant increase where, M3 recorded the maximal (b*) value, in contrast M1 recorded the minimal (b*) value. Color is one of the most important quality attributes of food products.

The rehydration properties, rehydration rate, and rehydration capacity are important characteristics of many products, related to their later preparation for consumption [44]. The rehydration capacity was used as a quality characteristic of the dried product. Velić, et al. [45] expressed the rehydration rate (RR) [46]. When the dried foods reconstituted, it must show acceptable textural, visual, and sensory characteristics, while the rehydration time is minimized [47].

The results in the same table represents the rehydration ratio (RR) of the dried soup mixture which proved that the RR of lentil, mushroom and egg powder (M1, M2 and M3) were significantly higher (2.35, 2.10 and 2.08, respectively) compared with whey powder (M4) which significantly recorded the lowest value (1.93). These results are agreed with Jokić, et al. [44] who mentioned that the products with a high rehydration capacity are tastier and retain their fresh appearance.

Mixtures soup	Color			Rehydration ratio (%)
	*L**	*a**	*b**	
M1	77.40[c]±0.19	-1.11[b]±0.12	25.18[c]±2.89	2.35[a]±0.02
M2	72.68[d]±0.38	2.52[a]±0.15	31.16[b]±0.11	2.10[b]±0.02
M3	79.37[b]±0.67	-1.51[c]±0.10	40.66[a]±0.66	2.08[b]±0.03
M4	83.06[a]±0.09	-2.8[d]±0.08	39.88[a]±0.88	1.93[b]±0.03

Table 4: Color measurements of different dried soup mixtures and Rehydration ratio (%).
L (lightness with L = 100 for lightness, and L = zero for darkness), a [(chromaticity on a green (−) to red (+)], b [(chromaticity on a blue (−) to yellow (+)], 90° = yellow, 180° = bluish to green and 270° = blue scale. Values are mean of three replicates followed by ± SD, the number in the same column followed by the same letter are not significantly different at 0.05 level.

Chemical Composition and Minerals Content of Different Dried Soup Mixtures

The chemical compositions of dried soup mixtures were determined and the results are reported in Table 5. The obtained results revealed that, the protein content of the four dried soup mixtures powders were significantly. It ranged from 22.10 to 27.25%. The lentil soup powder contained egg powder M3 showed significantly the highest protein content (27.21%) compared with other soups, M1 (22.10%), M2 (24.25%), and M4 (23.26%), whereas M1control soup (22.10%) showed the least protein content. The protein content of M3 soup each 100g provide 48.59% daily intake protein (based on 56g/day) for a male but 59.15% for female (based on 46g/day) for 19-50 year. Egg supplies a large amount of complete, high quality protein and provides significant amounts of several vitamins and minerals.

Fat and fiber content of the different soup mixtures showed non-significant differences .total carbohydrates resulted in highest amount in whey mixture (65.06 %) followed by control lentil formula, mushroom and egg powders mixture formulas were 64.79, 61.69, and 58.94%, respectively, with significant differences due to the additive material .

The coefficient used in the equation for calculation of the calorific value does not take care of the portion of energy that is lost due to incomplete digestion and absorption and other physiological processes [48]. From the result in the same table it could be noticed that the calorific value of different soup mixtures was found to be in the same order in relation to several soups based on lentil, mushroom, egg powder and whey protein powder which showed a values of 392.29, 386.42, 397.88 and 390.99 kcal/100 g, respectively. These results indicated that the mushroom had lower energy than other formulas be caused the mushroom characterized rich amounts of fiber, ash and low in fat content. Also the highest energy value in egg formula may be due to that the mixture had contained 5.92 % fat content.

Mixtures soup	Moisture	Crude protein	Fat	Ash	Fiber	Carbohydrate	Energy kcal/100 g
M1	3.86 [b]±0.44	22.10 [c]±1.52	4.97 [a]±0.47	5.34 [b]±1.02	2.80 [a]±0.65	64.79 [b]±0.098	392.29 [b]±0.62
M2	4.58 [a]±0.13	24.25 [b]±0.38	4.74 [a]±0.14	6.3 4 [a]±0.25	2.98 [a]±0.33	61.69 [c]±0.055	386.42 [d]±0.60
M3	3.09 [c]±0.08	27.21 [a]±0.57	5.92 [a]±0.04	5.46 [b]±1.18	2.47 [a]±0.26	58.94 [d]±0.03	397.88 [a]±0.94
M4	4.49 [b]±0.10	23.26 [b]±0.60	4.19 [a]±0.02	5.20 [c]±0.58	2.29 [a]±0.17	65.06 [a]±0.19	390.99 [c]±0.49

Table 5: Chemical composition of different dried soup mixtures on dry weight basis (g /100g).
*Determined on dry weight basis. Values are mean of three replicates followed by ± SD, the number in the same column followed by the same letter are not significantly different at 0.05 levels. (M1) control dried lentil soup, (M2) dried lentil soup+ mushroom powder, (M3) dried lentil soup +egg powder (M4) dried lentil soup+ sweet whey powder.

Elements, in macro and micro amount, are necessary for biological processes and perform a vital role in metabolic functions, normal growth and development Physiologically, the most important macro and micro minerals help in maintenance of pH, osmotic pressure, nerve conductance, muscle contraction, energy production and almost all other aspects of biological life [49,50]. So the higher content of calcium in (M2) 45.16, (M3)50.54 and (M4)70.58 compared with (M1)20.46, these results reveal that iron serves metabolic and enzymatic functions and zinc, is essential for normal growth, development [51,52]. Iron deficiency is the major causes of iron deficiency anemia. Baseline survey data on iron deficiency anemia in Egypt 2010, reported that 47% of women aged 20 - 50 years, 40% of children less than 5 years of age and35% of children 6 - 18 years were anemic [53]. From the present results, it could be found that all treatments may covered the Fe daily intake mean while the formula covered 6.83 to 21.8% of Zn, 2.6 to 8.82% Ca, and 24.75 to 51.03% Se from the daily intake. It could be concluded that one can different dishes besides lentil rich in the above mentioned mineral to cover its RDA. *Pleurotus ostreatus* fungus forms an edible mushroom that possesses important nutritional and medicinal properties. Selenium (Se) is essential to human diets and it is in the soil, and consequently in food [54]. This data agreed well with those reported by Manjunathan, et al. [55] who found that the level of iron varied from *A. polytricha* with 16.3 mg/g to *M. rhodocus* with 85.6 mg/g. The content of selenium (mg/100g), ranged from negligible level s in *P. ostreatus* (8.7) to very high levels in *A. bisporus* (12.4) Selenium is of fundamental importance to human health. It is an essential component of several major metabolic pathways, including thyroid hormone metabolism, antioxidant defense systems, and immune function. There is strong evidence that Selenium has a protective effect against some forms of cancer [56]. Calcium is an essential nutrient that is necessary for many functions in human health. Calcium is the most abundant mineral in the body with 99 % found in teeth and bone. Only 1% is found in serum [57]. Calcium contents of different mixtures lentil soup ranged between 45.16 to 70.58 mg/ 100g. It covered 5.65% to 8.82%, respectively of daily calcium requirement for old scent (Table 6).

Mineral	M_1	M_2	M_3	M_4	RDA*
Iron	$9.17^c \pm 0.02$	$10.57^a \pm 0.06$	$9.91^b \pm 0.20$	$7.68^d \pm 0.12$	10
Zinc	$2.97^b \pm 0.17$	$3.07^b \pm 0.61$	$2.45^c \pm 0.20$	$3.27^a \pm 0.20$	15
Calcium	$20.46^d \pm 0.43$	$45.16^c \pm 0.18$	$50.54^b \pm 0.08$	$70.58^a \pm 0.72$	800
Selenium	$13.61^c \pm 0.05$	$28.07^a \pm 0.08$	$20.23^b \pm 0.10$	$19.40^b \pm 0.28$	55

Table 6: Minerals content of different dried soup mixtures (mg/100g dry weight).
Values are mean of three replicates followed by ± SD, the number in the same row followed by the same letter are not significantly different at 0.05 levels. (M1) control dried lentil soup, (M2) dried lentil soup+ mushroom powder, (M3) dried lentil soup +egg powder (M4) dried lentil soup+ sweet whey powder.
*RDA: Recommended Dietary Allowances FAO/WHO/UNU, 2011.adults19 - 50 years.

Total Phenols and Antioxidant Activity of Different Dried Soup Mixtures

The data in Figure 1 shows total phenols and antioxidant activity of dried soup mixtures. The results indicated that M2 and M3 contained total phenols higher than M4 (937.92, 847.62 and 777.08 μg/g, respectively), Generally, it may be due to both M2 and M3 containing that dried mushroom and dried whole egg which were in the line with finding of Edet [58] who reported that the edible mushroom (*Pleurotus ostreatus*) is very rich in a variety of photochemical such as alkaloids, glycosides, saponins, tannins, flavonoids, reducing compounds and polyphenols. Also egg-yolk proteins have been demonstrated to exhibit in vitro antioxidant activity [41]. Consumers recognize these products are safe and healthy for consumption. Also Figure 2 showed antioxidant activity of different soup mixtures investigated by DPPH method. The results showed that these different soup mixtures can be considered as high antioxidant capacity; soup mixture (M2) showed the highest antioxidant activity. These results are agreed with Sudha, et al. [59] who found that the edible mushroom (*Pleurotus eous*) is rich in antioxidant capacity from various extracts. The relationship between total phenols and antioxidant activities showed high correlations between them Antioxidant potentials are correlated with their phenolic contents and hence phenolic concentrations [60].

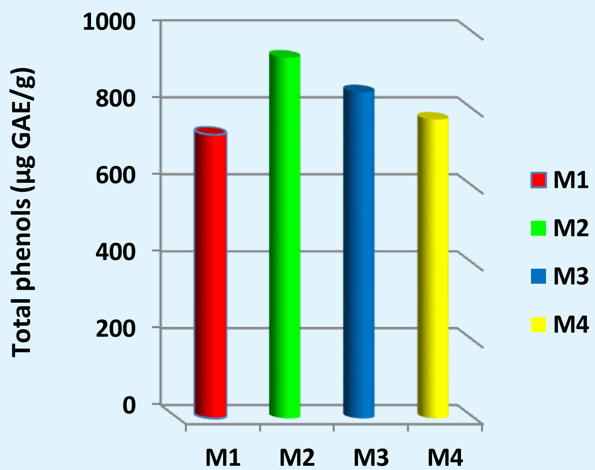

Figure 1: Total phenols of different dried soup mixtures.

(M1) control dried lentil soup, (M2) dried lentil soup+ mushroom powder, (M3) dried lentil soup +whole egg powder, (M4) dried lentil soup +sweet whey powder

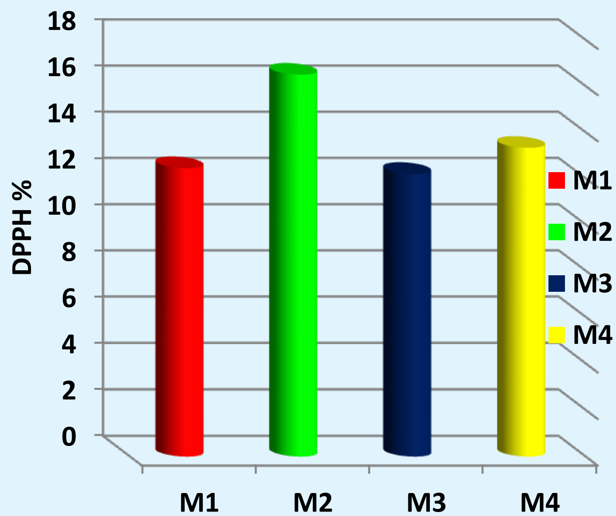

Figure 2: Antioxidant activity of different dried soup mixture.

(M1) control dried lentil soup, (M2) dried lentil soup+ mushroom powder, (M3) dried lentil soup + whole egg powder, (M4) dried lentil soup+ sweet whey powder.

Amino Acid Profile of Different Dried Soup Mixtures

Amino acids of food product are important indicators of protein quality. The essential amino acids are necessary for tissue maintenance and required for growth of all body Results presented in Table 8 showed essential and non-essential amino acids contents of different dried soup mixture samples. The total amino acids were 84.68, 94.52, and 97.79 and may be due to the different amounts of protein in a different recipe for soup. Results indicated that M1 sample had the lowest total levels of all amino acids, while improved sample (M4 and M3) showed higher levels of the essential amino acids, when compared with recommended values of FAO/WHO/ (2007) for adults. The results showed that the major essential amino acid leucine in the different soup from M1, M2, M3 and M4 were found high amounts (6.47, 7.42, 7.54 and 7.69 g/100g protein, respectively). Also M3 (7.07) and M4 (7.13) recorded the higher content of lysine than M1 (6.08) and M2 (6.26). These results illustrated that the formulae containing whey and eggs powders had the highest amino acids profile. Furthermore result showed that the sulfur amino acids (Cysteine+Methionine) in M3, M2 and M4 had higher contents compared to M1 (as control) .Also M3recorded the highest value in sulfur amino acids followed by M2 then M4 these values covered limiting [35]. Since lentil proteins are rich in lysine and limited in sulfur-containing amino acids, Methionine, Cysteine and Tryptophan, lentil proteins need to be nutritionally complemented with other sulfur amino acid-rich proteins such as those found in grains [61]. The results showed that the total EAA amounted in 34.42 g/100g protein for the traditional lentil soup (M1). Due to addition of mushroom (M2) egg powder (M3) and whey powder (M4), the EAA increased to about 1.09, 1.22 and 1.18 times as that of M1.

The egg protein could be a very well complement protein sources that are high lysine, (cysteine+methionine) total sulfur amino acids and threonine. Egg considered a good source of sulfur-containing amino acids (eggs can make a significant contribution to a healthy diet). A medium-sized egg provides 78 kcal yet contains 6.5 g protein [62].

E.A.A	**M1**	**Chem. score M1**	**M2**	**Chem. score M2**	**M3**	**Chem. score M3**	**M4**	**Chem. score M4**	**FAO/ WHO**
Lysine	6.08	104.83	6.26	107.93	7.07	121.89	7.13	12193	5.8
Theronine	3.42	100.58	3.48	102.35	4.84	142.35	3.93	115.58	3.4
Cysteine+ Methionine	1.85	74	2.5	100	3.19	127.6	2.4	96	2.5
Valine	5.6	160	6.11	174.54	6.3	180	6.44	184	3.5
Isoleucine	3.75	133.92	4.12	147.14	4.42	155	4.34	155	2.8
Leucine	6.47	98.03	7.42	112.42	7.54	114.24	7.69	116.51	6.6
Tyrosine	2.8	45.9	3.03	49.67	3.29	53.93	3.52	57.7	6.1
Phenylalanine	4 .45	70.63	4.71	74.76	5.28	83.8	5.2	82.53	6. 3
Total EAA	34.42		37.63		41.93		40.65		
Biological value (%)	93.6		95.2		102.4		102.94		
Limiting score AA	45.9 Tyrosine		49.67 Tyrosine		53.9 3 Tyrosine		57.70 Tyrosine		
Non- EAA	**M1**		**M2**		**M3**		**M4**		
Glutamic	14.76		16.44		15.61		15.86		
Aspartic	9.77		11.31		10.97		12.16		
Proline	3.54		4.25		3.91		4.47		
Alanine	4.61		4.75		5.33		5.07		
Glycine	3.51		3.57		3.88		4.02		
Serine	4.57		5.88		5.51		4.51		
Arginine	7.21		8.37		8.08		9.54		
Histidine	2.26		2.35		2.57		2.46		
Total Non- EAA	50.23		56.92		55.86		58.0 9		
Total amino acids	84.65		94.55		97.79		115.79		

Table 7: Amino acids profile (g/100 protein), chemical score (%) and biological value of different dried soup mixtures. EA.A=Essential amino acids, Non- EAA= Non-Essential amino acids (g/100g sample). (M1) control dried lentil soup, (M2) dried lentil soup+ mushroom powder, (M3) dried lentil soup +egg powder (M4) dried lentil soup+ sweet whey powder.

The results in Table 8 showed that valine, isoleucine, leucine and theronine resulted in highest scoring essential amino acid in the all different soup mixtures, Meanwhile the total sulphur amino acids cysteine +methionine to be the lowest essential amino acid but recorded higher in M3 (3.19). The obtained results agreed with Mahe, et al. [63] who reported that, amino acid profiles of proteins in pulses are unbalanced. Comparing with egg protein, the indispensable sulphur-containing amino acids are at a much lower concentration. Those amino acids (i.e. methionine and cystine) are known as the most critical limiting components of the protein. This observed improved the chemical scores in all soups mixtures and the highest value was in parallel in M3 and M4. In contrast tyrosine and phenylalanine showed the low content in all dried soup mixtures which were the first and second limiting essential amino acid. The highest chemical score was found in M4 followed by M3.

From the present results in Table 8 it could be noticed that the highest content of non- essential amino acids were glutamic, aspartic and arginine acids followed by serine, alanine and proline which were nearly equal in all different soup mixture prepared from lentil, mushroom, egg powder and whey protein powder. These results are in agreement with Rozan, et al. [64] who found that the aspartic acid, glutamic acid and arginine accounted a high proportion of total lentil amino acids and that was the case with the variety of lentil which were studied, which were also low in tyrosine in all different soup mixtures. It is worth to mention that the biological value of the control was 93.60 and increased to 95.20, 102.40 and 102.94 due to the increase of some essential amino acid specially lysine.

Water Activity (Aw) of Different Dried Soup Mixtures During Storage Period

Water activity (aw) is an important means of predicting and controlling the shelf life of food products. Shelf life is the time during which a product will remain safe, maintain desired sensory, chemical, physical and microbiological properties, and comply with nutritional labeling. Water activity (aw) is a measure of water availability for the growth of various microorganisms. Water activity is a major issue in relation to the chemical stability of dry food products and has already been identified as an intrinsic factor in determining storage time [65]. Data presented in Table 9 revealed that water activity of different soup mixtures progressively increased during storage for 9 months at room temperature (30±5ºC) in a type of packaging materials (high Barrier bags for gases and moisture) but the overall increase was small. The increase in water activity was under safe limits (aw = 0.6 for soup mixes) and did not alter the quality of the soup mixes [66]. The slight increase in water activity measured during storage may be due to the gain in moisture as the storage period progressed. It was observed that the increase in water activity was constant for mushroom soup mixes and the trend of changes in water activity over the entire storage period which was almost the same for all samples. These differences between dried soup mixtures were due to their long storage life because critical water activity limits of a product at ordinary temperatures and good to use.

Storage period Sample	After 9 Months	After 6 Months	After 3 Months	Zero Time
M1	0.083c±0.001	0.101d±0.0095	0.115d±0.003	0.127d±0.002
M2	0.185a±0.004	0.200a±0.001	0.209 a±0.001	0.214a±0.002
M3	0.151b±0.003	0.161c±0.0119	0.173c±0.009	0.181c±0.005
M4	0.151b±0.003	0.182b±0.003	0.008 0.189b±	0.196b±0.006

Table 8: Water activity (aw) of different soup mixtures during the storage period.
Values are mean of three replicates followed by ± SD, number in the same column followed by the same letter are not significantly different at 0.05 levels. (M1) control dried lentil soup, (M2) dried lentil soup+ mushroom powder, (M3) dried lentil soup +egg powder (M4) dried lentil soup+ sweet whey powder.

Conclusion

From the obviously results, it could be concluded that dried lentil soup mixtures (mushroom, eggs and whey) powders revealed good nutritional and technological quality, easy cook and long shelf-life. The reconstituted soup could be relished throughout all year. Had a shelf-life of 9 months at 30±5°C when packed in high Barrier bags. Along with overall sensory quality of the soup samples, it had satisfactory sensory properties. The most valuable addition with the highest acceptability was the lentil and whey followed by mushroom and eggs powder and could be consider as 'health food'. Ingredients favor its use as a functional soup containing a good source of amino acid, phenolic and antioxidant. Further research is required to improve the nutritional quality of lentil proteins and optimize the agricultural and culinary conditions to ensure maximum utilization of the rich supply of bioactive photochemical in lentils.

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