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Full Length Research Paper

Utilization of Some Cereals and Legumes in Preparing High Nutritional Value Products

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Abstract

The investigation aimed to evaluate formulas from cereals (quinoa seeds, flaxseed and sesame seed), legumes(chickpeas, fenugreek, peanut) and other ingredients (bee wax, chocolate, date, butter, honey, milk, sugar, wheat germ, palm pollen and dry yeast) for its chemical, nutritional and economical aspects compared with commercial product(sinker) the chemical composition resulted in highest value of ether extracted for F2 (26.213± 0.13) while all lowest value was found for F1(19.99±0.16) similar results was found concerning crude fiber which ranged from the (2.42± 0.025 to 4.05± 0.02 for F1 and F5 respectively. Crude protein showed the highest value regarding F1 (29.07± 0.01) meanwhile the F6 formulas showed a protein contents of 9.77 ± 0.26, and the other formulas showed a slight variation between them which ranged from 14.08± 0.015 to 15.77± 0.02 (F2 to F5). ash content slightly varied according to the formula . Total carbohydrates ranged from 52.91± 0.13 (F6) to 41..51± 0.33(F1).The data reveal that the formulas are a good source of protein and energy as a supplement to gain weight. Formula (F1) had the highest concentration of potassium, magnesium, calcium and phosphors (949.7± 5,174±7.6, 8.22±0.4, 249.4±4.5 and 630.6±4.1 mg/100g) but F6 was the lowest in the concentration of all mineral contents determined except that of sodium and zinc (246.0±1 and 2.5±0.06 mg/100g). Iron concentration in the tested formula covered (120.87±0.72 RDA% male or female) compared with the commercial F6 which covered (11.67±0.22 RDA% male or female). The commercial formula (F6) is the best source of vitamin A,B1 and B2, while F6 is the lowest source of vitamin C. Data showed that F1 is a good source for vitamin C (3.8 mg/100g).Essential amino acids (EAA) contents of formula (F1) had the highest value than F6 "commercial control" 38.24vis 35.12 mg/16gm N) respectively. While formula 2, 3, 4 and 5 had EAA contents of (29.74,31.37,31.80and 30.60 mg /16 g N) respectively. Non-essential amino acids were more 50% than essential amino acids.Dry matter digestibility decreased with increasing fiber content on the tested formulas, crud protein digestibility decreased with increasing fat content and limiting lysine and sulphurcontaing amino acids (SAA) chemical score of tested formulas. ω6/ ω3 ratio increased with increasing flaxseed percentage in tested formulas. Total saturated fatty acids (TSFA) of tested formulas didn't exceed recommended allowances for adolescent. Formulas F2 and F3 had the highest values of overall acceptability. Overall acceptability score showed the same values for formulas F1, F4, F5 and commercial F6 (80.1, 80.9, 80.5 and 80.0) respectively .the results revealed that all formulas with or without flaxseed showed highly scavenging potential against DPPH radical and the date is considered a good preservative as on the antioxidant activity and flaxseed content of formulas when compared to that without flaxseed formulas. Adding honey and date without flaxseed showed a good effect on the rheological properties (Forces, N) of formulas when compared to the with flaxseed formulas. It could be found that the low cost of all formulas under study compared to those commercial product (F6).It could be concluded that, remarkable benefits could be obtained by using these proposed formulas especially in malnutrition general case.

Key words: *Cereals, legumes, nutritional value, antioxidants, Recommended Daily Allowances (RDA), chemical composition, vitamins minerals, fatty acids, amino acids, rheological properties, cost.*

Introduction

Malnutrition, defined as over-nutrition and under-nutrition or underweight, is a serious public-health problem that has been linked to a substantial increase in the risk of mortality and morbidity. Women and young children bear the brunt of the disease burden associated with malnutrition, (WHO, 2004 and UNICEF 2006).

FAO/WHO (2010) reported that undernourishment exists when caloric intake is below the minimum dietary energy requirements (MDER); which is defined as the amount of energy needed for light activity and to maintain a minimum acceptable weight for attained height. EDHS (2003-2014) reported that prevalence of under-nutrition in children <5 years old was as follow: stunting which reflect chronic malnutrition, raised from 15.6 % to 21.5% respectively. Wasting which reflect acute malnutrition raised by double from 4% in 2003. All Date varieties served as a good source of natural antioxidants and could potentially be considered as a functional food or functional food ingredient (Al-Farsi *et al*., 2005), where Date fruit extract had strong antioxidant and ant mutagenic properties (Vayalil, 2002). Selenium, believed to help in preventing cancer and important in immune function, was also found in Dates. Also, Dates contained twenty three types of amino acids and at least six vitamins including a small amount of Vitamin C and Vitamins B1 thiamine, B2 (riboflavin), nicotinic acid (niacin) and Vitamin A (Al-Shahib and Marshall,

2003).Flaxseed is the richest source of α –linolenic acid (18:3n-3), soluble and insoluble fiber, and mammalian lignan precursor secoisolariciresinoldiglucoside (SDG). The major nutritional components of flaxseed include oil, viscous lignin rich fibers (mucilage), protein and minerals (Faseehuddin and Basavaraj 2007). Legumes are recommended for better glucose control in persons with diabetes. Chickpea (*Cicer arietinum* L.) is an important pulse crop grown and consumed all over the world (Jukanti *et al*., 2012) Chickpeas are rich in dietary fiber and polyunsaturated fatty acids.(Pittaway *et al*., 2008).Nuts are rich sources of multiple nutrients and phytochemicals associated and their consumption is associated with health benefits, including reduced cardiovascular disease risk. Nuts may be included in the diet, in moderation, to enhance palatability, nutrient quality, and chronic disease risk reduction without compromising weight loss or maintenance. (Mattes *et al*., 2008 and Mattes and Dreher, 2010).Nuts are foods with a high energy density, due in part to its small water content. It also present a low saturated fat content (<7%) but a high unsaturated fat contribution (40-60%). It represent one of the richest sources of dietary fiber, which is basically of the insoluble type. Nuts have shown a positive effect of nut intake on lipid profile with significant reductions in total and LDL cholesterol levels and small or null effects on the HDL fraction (Megías-Rangil *et al*., 2004). Nuts are an important source of many vitamins, minerals, monounsaturated and polyunsaturated fatty acids when nuts were added to an existing diet without controlling for energy intake, body weight increased, although to a lesser extent than theoretically predicted. There is limited evidence on the effect nut consumption has on type 2 diabetes, although available evidence indicates that nuts as part of a healthy diet do not cause weight gain and can have a positive influence on the fatty acid profile of a person with diabetes.(Natoli and McCoy,2007) . Nuts lower total and LDL cholesterol and the LDL: HDL ratio in healthy subjects or patients with moderate hypercholesterolaemia, even in the context of healthy diets. Nuts have a unique fatty acid profile and feature a high unsaturated to saturated fatty acid ratio, an important contributing factor to the beneficial health effects of nut consumption. Additional cardioprotective nutrients found in nuts include vegetable protein, fiber, α-tocopherol, folic acid, magnesium, copper, phytosterols and other phytochemicals. (Sabate and Wien, 2010).Quinoa (Chenopodium quinoa Willd.), which is considered a pseudocereal or pseudograin, has been recognized as a complete food due to its protein quality (James 2009, Jancurova *et al*., 2009 and João *et al*., 2010). Quinoa seed are a complete food with high-nutritional value due mainly to their high content of good quality protein (Abugoch *et al*., 2008 and Abugoch *et al*., 2009). It has remarkable nutritional properties; not only from its protein content (15%) but also from its great amino acid balance (James 2009) with higher lysine (5.1-6.4%) and methionine (0.4-1.0%) contents (Bhargava *et al*., 2005; Jacobsen 2003and Jancurova *et al*., 2009). FAO reported that quinoa seeds have high quality proteins and higher levels of energy, calcium, phosphorus, iron, fiber and B-vitamins than barley, oats, rice, corn or wheat (Tapia, 2000 and James 2009). Also, it contains polyphenols, phytosterols, and flavonoids with possible nutraceutical benefits (Li and Zhang, 2001; Tomotake *et al*., 2007; Gorinstein *et al*., 2008; Kalinova and Dadakova, 2009 and James 2009).

The Holly Quran and Sunnah indicated the importance of honey. Alla says in the Quran "And from its bellies comes a syrup that varies in colors and it is a cure for people and this is a prodigy for those who think" (Al-Nahl 69). Prophet Mohamed said "stick to the two cures; honey and the Quran" (assured by IbnMaja and Al-Hakem) Ali smaeil, 1999). Honey is one of the best sources of sugar that provides the body with energy quickly without side effects and for prolonged periods of time (Ehab and Mahamed 2010).Wheat germ is available as a separate entity because it is an important source of vitamin E. (Cornell, 2003andKumar *et al*., 2011) Wheat germ has only one half the glutamine and proline of flour, but the levels of alanine, arginine, asparagine, glycine, lysine and threonine are double (Cornell 2003), oil is rich in essential fatty acids (Ali *et al*., 2013).

Objective:

The main objective of the present study is it evaluates formulas from cereals and legumes forit compare chemical composition, nutritive and economic value with commercial product.

MATERIALS AND METHODS

Materials

Quinoa seeds, chickpeas, fenugreek, flaxseed, Peanut, sesame seed, were obtained from crop research institute, agriculture research center Giza Egypt. Other ingredients: bee wax, chocolate, date, butter, honey, milk, sugar, wheat germ, palm pollen and dry yeast was obtained from the local market, Giza, Egypt. All chemical used in this study were analytical grade.

Methods:

Preparation of quinoa meal

Quinoa flour was prepared according to Margarita, *et al.* (2010).Quinoa seed were washed with water 1:10 (w/w). at 55- 60ºC (with agitation) during one hour Then, drying was carried out at 60ºC using a convective dryer and ground using a cyclone sample mill into meal that could pass through a 60-80 mesh screen.

Organoleptic evaluation of formulas

Products formulas quality were organoleptical evaluated the scores for its general color=20, taste=20, sweetness=20, flavor=20, chewiness=20 and overall acceptability=100. Ten panelists from the staf of Food Technology Research Institute, Agriculture Research Center Giza, Egypt, were asked to evaluate these attributes by using these scores where Products formulas served to panelist then the results were statistically analyzed.

Chemical composition of produced formulas

Moisture, ash, ether extract, fiber and crude protein were determined according to the methods described in the A.O.A.C. (2005). Moreover, total carbohydrates were determined by difference

Determination of energy:

Laboratory determination of energy according to operating instruction manual for parr 1261 iso-operibol bomb calorimetric **(**1997**).**Also, calculated from protein, fat and carbohydrate (CHO).

Determination of minerals

Ash content was measured by calcinations, overnight at 550ºC in a muffle furnace, to constant weight (A.O.A.C, 2005).The obtained ash was dissolved in HCL(0.1N) and Sodium, potassium, magnesium, iron, calcium, phosphors and zinc were determined using atomic absorption spectrophotometer (Perkin Elmer model 3300, Merck hydride system USA).

Determination of vitamins

HPLC was used for fractionation of vitamin A (retinol) according to the method described by Leth and Jacobsen, (1993)Vitamin B_1 (Thiamine), B_2 (riboflavin) and Vitamins C determined according to the method described by Bogner (1992) and Romeu-Nadal *et al*. (2006) respectively .

Determination of fatty acids profile

Fatty acid profile of formulas were esterified into their corresponding FAMEs using methanoleic NaOH and BF3 with methanolic (Boron triflouride) as described by A.O.A.C. (2005).

Determination of amino acids

Amino acids content of Produced formulas determined according to the method described by A.O.A.C. (2005).

Chemical prediction of protein quality indexes

Chemical estimation

Protein quality assessment of the studied formulas were performed using amino acids profile and using egg amino acid pattern as reference protein (Mitchel and Block 1946 and Sarwar *et al.*, (1985) and human pattern of amino acid requirements (FAO/WHO 2007) suggested pattern of amino acid requirements for human adolescent 11-18 Year. of Amino acid score was calculated as follows:

$$\text{Amino acid score} = \frac{\text{mg of amino acid in 1 gm tested protein}}{\text{amino acid in requirement pattern}} \times 100$$

Essential Amino Acid Index (EAAI %)

Essential Amino Acid Index was Performed by Mente *et al.*, (2002) using the amino acid pattern of whole egg protein according to Hidvégi and Békés (1984) as reference protein and follows formula: expressed by the amino acids results were expressed as µmoles of amino acid per gram of flour samples (µmole / g) and as grams per 100 g determined amino acid for reference egg protein.

In-vitro dry, organic matter and crude protein digestibility

In vitro analysis for dry, organic matter, and crude protein digestibility have been done according to (Coles *et al.*, 2005)

Determination of antioxidant activity of formulas by (DPPH test):

The free radical scavenging activity of different Formulas weremeasuredbythe2,2-diphenyl-1picrylhydrazil(DPPH)methodaccording to (Kekuda *et al.*, 2010). The scavenging activity was calculated using the formula:

DPPH scavenging activity%= (Ablank–Asample/Ablank) x100

Texture profile analysis products formulas

Samples texture measurements were carried out according to (Bourne 2003) with universal testing machine (Cometech, B type, Taiwan) .provided with software. An Aluminum 25 mm diameter cylindrical probe was used in a ‘‘Texture Profile Analysis’’ (TPA) double compression test to penetrate to 50% depth, at 1 mm/ s speed test. Firmness (N), gumminess (N), chewiness (N), adhesiveness (N.s), cohesiveness, springiness and resilience were calculated from the TPA graphic. Both, springiness and resilience, give information about the after stress recovery capacity. But, while the former refer s to retarded recovery, the latter concerns instantaneous recovery (immediately after the first compression, while the probe goes up)

Statistical analysis

The collected data of Formulas and organoleptic evaluation were statistically analyzed using Anova by the least significant differences (L.S.D) at the 5% level of probability procedure according to the method of Snedecor and Cochran (1980).

RESULTS and Discussion

Sensory evaluation of formulas

The selected cereals (Quinoa seeds), legumes (Chickpeas, Fenugreek, Flaxseed, Peanut, Sesame Seed) and some raw materials (Bee Wax, Chocolate, Date, Fat,, Honey, Milk, Nuts, Sugar, Wheat germ ,palm pollen and dry yeast) in preparing high nutritional value Formulas were organoleptic ally evaluated to assess the consumer acceptability of these new brands of products. The samples were evaluated for color, taste, sweetness, flavor, chewiness and overall acceptability as presented in Table (1). Color often the first sensory quality by which foods are judged. It is a major parameter in sensory evaluation of products as the perception of color influences a taster's reception of a product. It is necessary to appreciate the synergy effect between the sensory responses of sight and taste of different types of formulas. Therefore, color is an important attribute in the assessment of the quality and the consumer acceptability of formulas produced from the different raw materials under investigation. Comparing the different samples of formulas regarding their colors; showed that formula F2 scored the highest value (19.0) followed by formula F4 and F3 (18.3and 18.1). MeanwhileF5 and Com. /F6 had the seam score (17.5) and F1scored the lowest value (17.4). This observation may be attributed to the attractive brown color (chocolate color) of formulas (F2 to F4) which is highly accepted by the consumers.

Flavor of formulas gives not only a generic identity but also its unique character. Flavor is the most important characteristic that gives a formula its final overall distinctive sensory properties of taste and smell. This character of the sensory profile is responsible for pleasing and attracting the consumer. The results given in Table (1) showed that the consumer preference of the flavor of formulas were in the order of F2>F4>F5> Com./F6>F1. Data indicated that the highest score value of flavor (19.0) was recorded for formulas F2, while those of F4, F5, Com./F6 and F1 were 18.0, 17.8, 17.5 and 17.3, respectively. Consumer's acceptance showed no significant differences between F3, F5, Com./F6 and F1 formulas regarding their flavors.

Sweetness is probably the most important feature of formulas. The taste of classic formulas is largely defined by its sweet taste from sucrose. The sweet taste or what we called sweetness considerably affects the consumer acceptability of formulas. The quality of the flavor of a formula can be affected due to an interaction between sweeteners and aroma compounds. Sensory evaluation data showed that sweetness and taste of formulas samples showed the same trend observed for the flavor property. As shown in Table (1), sweetness and taste high score values were (18.90) and (18.9) and (18.0); (18.1) F2 andF4 respectively. Taste score values almost showed the same values. The observed low values of sweetness and taste recorded for F5, Com./F6 and F1. Meanwhile, no significant differences could be observed between F1, F5 and Com./F6 formulas in respect of taste and sweetness.

Chewiness quantity is an important sensory property of formulas. The results obtained are presented in Table (1). It was observed that F1 formulas scored the highest value of chewiness (18.0). Data indicated that score values of chewiness quantity in F1 and F2 formulas were (19.0) and (18.8), respectively. No significant differences were observed between F3, F4,F 5 andCom./F6 formulas.

Data indicated that the formulas F2 and F3 resulted in the highest values of overall acceptability. Overall acceptability score values showed the same values for formulas F1, F4, F5 and Com./F6 (80.1, 80.9,80.5 and 80.0) respectively.

Table 1: Sensory evaluation of formulas.

Formulas	Color (20)	Flavor (20)	Taste (20)	Sweetness (20)	Chewiness 20	Overall acceptability 100	Category
Formula1	$17.4^{B*}\pm0.63$	$17.3^{B}\pm1.05$	$17.7^{B}\pm1.25$	$17.5^{B}\pm1.5$	$18^{A}\pm0.81$	$80.1^{B}\pm0.87$	good
Formula2	$19^{A}\pm1.05$	$19^{A}\pm0.94$	$18.9^{A}\pm1.30$	$18.9^{A}\pm0.73$	$18.8^{A}\pm0.91$	$90.6^{A}\pm0.69$	Very good
Formula3	$18.1^{A}\pm1.52$	$17.7^{B}\pm1.41$	$17.4^{BC}\pm1.71$	$17.8^{B}\pm1.39$	$17.2^{B}\pm0.91$	$90.0^{A}\pm0.68$	Very good
Formula4	$18.3^{A}\pm1.33$	$18^{B}\pm0.94$	$18.1^{A}\pm0.87$	$18^{B}\pm0.66$	$17.7^{B}\pm0.82$	$80.9^{B}\pm0.87$	Good
Formula5	$17.8^{B}\pm0.69$	$17.8^{B}\pm0.66$	$17.5^{B}\pm0.73$	$17.3^{B}\pm1.05$	$17.2^{B}\pm1.22$	$80.5^{C}\pm1.15$	Good
Formula6**	$17.5^{B}\pm0.69$	$17.5^{B}\pm0.73$	$17.2^{B}\pm0.91$	$17.7^{B}\pm0.35$	$17.3^{B}\pm1.05$	$80.0^{C}\pm0.48$	Good
L.S.D	0.84	0.789	0.925	0.85	0.88	0.767	

Rheological properties of the formulas

Rheological properties (Forces, N) of formulas compared with commercial formulas were measured by Texture Profile Analysis'' (TPA) assay. Texture Profile Analysis'' (TPA) (Forces, N) is an important rheological properties of formulas. The results obtained are presented in Table (2). It was observed that F2 formulas scored the lowest value of forces (5.12 ±0.0081N). Data indicated that score values of forces in F3 and F4 formulas were (6.65±0.0047 N), (6.69 ±0.0081 N) and 6.66 ±0.008 respectively. No significant differences were observed between F3, F4 andF5 formulas. Data indicated that the formulas F6 commercial product formulas showed to the highest values of Forces, N, 8.5 ±0.0081 N

It could be mentioned; they found that all formulas without flaxseed showed highly forces. Adding honey and date without flaxseed a good effective on the rheological properties (Forces, N) of formulas when compared with that without flaxseed formulas.

Table 2: Rheological properties of theformulas.

Formulas	FORCES (N)
Formula2	5.12 ±0.0081
Formula3	6.65 ±0.0047
Formula4	6.69 ±0.0081
Formula5	6.66 ±0.0081
Commercial Formula6	8.5 ±0.0081

The chemical composition of the formulas:

The chemical compositions of the products / Formulas were determined and the obtained results are shown in Table (3).Data indicated that dry matter (DM gm) of formulas F_1 and F6 had higher percentage(96.72±0.03 and 92.83±0.02) but decrease of dry matter (DM gm) percentage of F3 to F5(90.71±0.01, 90.14±0.02,91.08±0.03 to 88.84±0.03) respectively. Formulas F3, F4 and F5 had higher contents of ether extract and fiber (24.15±0.16, 25.78±0.14, 26.02±0.13and 3.25±0.01, 3.72±0.0153, 4.05±0.02) respectively. These results are in agreement with that found by Singh *et al.,* (2011) who found that flaxseed provides oil rich in omega-3. Meanwhile, F1 had higher protein content 29.07+0.01%, than that of all the formulas. These results indicate that the protein and ash content registrant the higher level in F1 than the other formulas and commercial formula (F6) (29.07±0.01, 15.77±0.02, 14.08±0.0153, 14.61±0.02, 15.74+0.026, and 9.77+0.027) and (3.73±0.013, 2.31±0.012, 2.22±0.022, 2.08±0.021, 2.02±0.012 and 2.15±0.011) respectively. Data showed that the commercial formula (F6) had highest value of total carbohydrate (52.91± 0.13%)than that of all formulas which am assented in 41.51±0.33, 47.29±0.22,46.45±0.32, 41.58±0.34, 44.32±0.31 for F1,F2,F3,F4 and F5respectively. The results showed that the calculated RDA in (Table 3) covered about (11.73±0.058 and 11.08+0.07% or15.57±0.0769 and14.68+0.09) for crude fiber according to the formula respectively. Meanwhile RDA% of crude protein covered about 67.63±0.023 or 72.68±0.025% due to F1 but decreased of by adding flaxseed to F3 to F5).The obtained data are agreement with that founded by Cunnane and Thompson (1995).

The fiber fractions such as cellulose, hemicellulose and lignin and plant protein could exert certain physiological effects as reduction of cholesterol and hypoglycemic agents (EL- Hadidy, 2004).Who showed that the processing of the flaxseed for human consumption will be more effective and recommended that incorporate of flaxseed or flaxseed components into cereal foods. Lastly Martinchik *et al.,* (2012) recommended that the consumption of 50g/day of flaxseed showed no adverse effects in humans and that is agreement with our data because the high level of using flaxseed as a supplement in F5 (about 30 g/500 g formulas).From the above-mentioned results, one could be concluded that adding flaxseed increased fat, fiber and RDA% of Crude Fiber meanwhile decreased protein and ash contents RDA%.

Table 3: Chemical composition of theformulas:

Items	F1	F2	F3	F4	F5	F6*
Dry matter	96.72±0.03	90.71±0.01	90.14±0.02	91.08±0.03	88.84±0.03	92.83±0.02
Moisture	3.27±0.11	9.28±0.12	9.85±0.11	8.92±0.13	11.15±0.11	7.16±0.10
Ether extract	19.99±0.16	21.63±0.17	24.15±0.16	25.78±0.14	26.02±0.13	24.17±0.11
Crude Fiber	2.42±0.025	3.71±0.006	3.25±0.01	3.72±0.0153	4.05±0.02	3.82±0.02
Male RDA*%	7.03±0.073	10.76±0.01	9.42±0.029	11.73±0.058	10.80±0.0443	11.08±0.07
Female RDA %	9.33±0.097	14.28±0.02	12.5±0.0385	15.57±0.076	14.33±0.0588	14.70±0.09
Crude Protein	29.07±0.01	15.77±0.02	14.08±0.015	14.61±0.020	15.74±0.0265	9.77±0.26
Male RDA%	67.63±0.023	36.62±.046	32.75±0.035	33.97±0.048	36.58±0.0615	22.72±0.26
Female RDA %	72.68±0.025	39.37±0.05	35.20±0.033	36.52±0.052	39.32±0.0661	24.42±0.26
Ash	3.73±0.013	2.31±0.012	2.22±0.022	2.08±0.021	2.02±0.012	2.15±0.011
Total carbohydrates**	41.51±0.33	47.29±0.22	46.45±0.32	41.58±0.34	44.32±0.31	52.91±0.13
Male RDA%	31.93±0.34	36.37±0.30	35.72±0.34	34.09±0.32	31.98±0.35	40.70±0.33
Female RDA %	31.93±0.34	36.37±0.30	35.72±0.34	34.09±0.32	31.98±0.35	40.70±0.33
Energy calculated	471.95±5.22	461.8±6.65	472.46±5.22	486.1±6.78	505.92±4.55	496.95±53.33
Male RDA%	17.38±0.35	17.00±0.95	17.40±0.22	17.90±0.21	18.63±0.22	18.30±0.15
Female RDA %	21.26±0.25	20.811±0.85	21.29±0.23	21.90±0.22	22.79±0.22	22.39±0.19
Energy determined	496.25±20.55	478.66±15.34	480.46±13.34	506.00±23.34	525.40±15.34	513.50±1934

*RDA: Recommended Dietary Allowances (2011).

**Total carbohydrates were calculated by difference

Mineral composition of formulas

Micronutrient deficiency is a common public health problem, specifically for vulnerable groups (infants, childhood, adolescent, pregnancy and lactation) in many low and middle income countries. For example, anemia, vitamin A and zinc deficiency are serious threats for previous group's development. Mineral contents of studied formula and its percentage from recommended dietary allowance of adolescent aged 12-18 year were presented on Table (4).First products/ formula (F1) had the highest concentration of potassium, magnesium, calcium and phosphors (949.7± 5,174± 7.6, 8.22± 0.4, 249.4±4.5 and 630.6±4.1 mg/100g) butF6 showed the lowest concentration of all mineral contents except that of sodium and zinc (246.0±1 and 2.5 0.06mg/100g). Bernacchia *et al*., (2014) resulted that flaxseed are very good source of minerals as calcium, magnesium, phosphorus and potassium (236, 431, 622 and 831 mg/100g flaxseed respectively).Date considered of rich source of Fe, K. So, flaxseed responsible of increasing previous minerals in formulas 3 to 5 which have, 10%, 20% and 30% flaxseed respectively. 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, and 35% of children 6-18 years were anemic (National Nutrition Institute, 2006). Iron concentration in the tested formula ranged from 4.11±0.20 to 9.85±0.8mg/ 100gm dry matter and it cover about to 11.67 ±0.22 to120.87 ±0.72 % of daily iron requirement.

Calcium contents ranged from 145± 1.3 to 249.4 ± 4.5 mg/ 100 gm dry matter in tested formula, and it cover 13.18±0.45 % to 22.67±0.22 respectively of daily calcium requirement for adolescents. According to Cesar *et al*., (2008) bone mass in elderly people results from the rate of mineral loss and the mass accumulated during skeletal growth, which in turn depends on dietary calcium and vitamin D status. Konishi *et al.* (2004) found that abrasion of quinoa seeds (for saponin elimination) caused specifically a decrease in calcium content. On the other hand, they found that the distribution of minerals in quinoa seeds revealed that phosphorus and magnesium were localized in embryonic tissue, while calcium and potassium were present in the pericarp Kiaus *et al*., (2012) resulted that multi micronutrient fortified milk and cereal products can be an effective option to reduce anemia on children and adolescence in developing countries. On the basis of our data the evidence for functional health outcomes is still inconclusive. Al-Faris, (2014) studied the nutritional content and biological effects of three local prepared formulas. Formula (1) contained mixed nuts; formula (2) contained moghat, honey and royal jelly, while formula (3) contained honey, fenugreek and royal jelly. In conclusion, these findings indicate that these local formulas may not be safe, and further studies are required to understand the consequences of a long term consumption of these formulas.

Table 4: Mineral composition of formulas

Mineral	Concentration (mg/100g) on dry matter					
	F1	F2	F3	F4	F5	F6
Na	174± 7.6	92±5.4	102 ± 1.6	100 ±4.5	94.8 ± 5.0	246.0±1
Male R DA%	11.60±0.22	6.19±0.33	6.81±0.52	6.67±0.22	6.32±0.11	16.4±1.0
Female RDA%	11.60±0.22	6.19±0.33	6.81±0.52	6.67±0.22	6.32±0.11	16.4±1.0
K	949.7± 5	623.6±2.1	655.48± 5	573.9± 3	615.3± 3	323.0 ±0.5
Male R DA%	20.65±0.72	13.56±0.33	14.25±0.11	12.48±0.15	13.38±0.22	7.021±0.44
Female RDA%	20.65±0.72	13.56±0.33	14.25±0.11	12.48±0.15	13.38±0.22	7.021±0.45
Mg	174± 7.6	114.8±3.4	114.7±2.3	106.3±3.1	122.5±4.6	72.0±2.8
Male R DA%	64.44±0.28	42.54±0.52	42.48±0.22	39.36±0.11	45.35±0.72	26.67±2.7
Female RDA%	69.60±0.22	45.95±0.11	45.88±0.45	42.51±0.33	48.98±0.52	26.67±2.7
Fe	8.22± .4	9.85 ± .8	4.11± .2	7.82± .5	8.1± 1.2	0.7± 0.01
Male R DA%	120.87±0.72	144.80±0.22	60.41±0.15	114.93±0.33	119.12±0.72	11.67±0.22
Female RDA%	120.87±0.72	144.80±0.22	60.41±0.15	114.93±0.33	119.12±0.72	11.67±0.22
Ca	249.4±4.5	160.4±4.1	162.9±3.1	149.1±2.7	145± 1.3	93.0±4.9
Male R DA%	22.67±0.22	14.58±0.45	14.81±0.73	13.55±0.11	13.18±0.45	8.45±0.22
Female RDA%	22.67±0.22	14.58±0.45	14.81±0.73	13.55±0.11	13.18±0.45	8.45±0.23
P	630.6±4.1	308.7±3.2	321.7±5.0	296.5±2.4	326.4±3.1	190.0±1.5
Male R DA%	59.78±0.4	29.26±0.33	30.49±0.5	28.10±0.23	30.94±0.61	18.19±1.0
Female RDA%	59.78±0.4	29.26±0.33	30.49±0.5	28.10±0.23	30.94±0.61	18.199±1.0
Zn	0.98±0 .03	1.0±0 .02	1.02± 0.08	1.0± 0.02	1.01± .02	2.5±0.06
Male R DA%	12.81±0 .03	13.26±0 .02	13.34± 0.08	13.06±0 .01	13.24± .02	32.67±0.04
Female RDA%	13.71± 0.03	14.18±0 .02	14.27± 0.08	13.97± 0.01	14.17± .02	34.96±0.03

Vitamins contents in formulas.

Data in Table (5) shows the vitamins contents of the different formulas. These results indicate that the commercial formula (F6) is the best source of vitamin A,B1 and B2 , and lowest source of vitamin C(196 UI, 2.7, 3.1 and 0.5 mg/ 100g)) respectively . Data reveal that vitamin C were higher in F1compared with six formulas (3.8 mg/ 100g).Meanwhile the other formulas resulted in similar Vitamin C content (2.51 mg/ 100g) except that of F6 which showed the lowest value (0.5 mg/ 100g). Vitamin B1 and B2resulted in higher value for F6 (2.7 and 3.1 mg/ 100g) and F1 had the lowest value (0.72 mg/ 100g). From these results it could be reported that F6 was the best because of the fortification made by the factory which was slightly decreased in Vitamin A, VitaminB1 and B2 and increment in Vitamin C. Our data are in agreement with that found by Rubilar *et al.*, (2010) who showed that the vitamin content in flaxseed is very low as it is (vitamin A zero , vitamin B1 0.06 and vitamin B2 0.06 mg/ 100g) and thus explains the results in our table. vitamin C data shows that our formulas are very higher as a source of this vitamin compared with the commercial formula (F6) it supplies the adolescent by 0.98 Male and 1.05 Female% from RDA daily. Finally vitamin B2 data shows that the RDA% for the adolescent is higher in F1 (115.79 to137.50 % comparison with the other formulas expected that of which showed da value (326 to 387.5 %).

Table 5: Vitamin contents in formulas:

Vitamins	Concentration (mg/100g)*					
	F1	F2	F3	F4	F5	F6
Vitamin A UI	60.9	124.9	124.4	121.9	119.6	169UI
Male RDA%	11.3	23.2	23.1	22.6	22.2	31.44
Female RDA%	13.4	27.6	27.4	26.9	26.4	37.34
Vitamin C	3.8	2.5	2.5	2.51	2.47	0.5
Male RDA%	7.45	4.90	4.90	4.92	4.84	0.98
Female RDA%	8.00	5.26	5.26	5.28	5.20	1.05
Vitamin B1	0.72	0.45	0.48	0.5	0.52	2.7
Male RDA%	84.71	52.94	56.47	58.82	61.18	317.6
Female RDA%	90.00	56.25	60.00	62.50	65.00	337.5
Vitamin B2	1.1	0.31	0.33	0.35	0.42	3.1
Male RDA%	115.79	31.58	31.58	44.21	31.58	326.31
Female RDA%	137.50	37.50	37.50	52.50	37.50	387.5

Amino acids pattern of different formulas

Table (6) showed that the total EAA of the prepared formulas resulted in 38.24, 29.74, 31.8, 30.6, and 35.15 for F1, F2, F3, F4, F5, Fand F6 respectively. A slight variation between EAA of the tested formulas was found due to the ingredient of each ones .Some amino acid cause hypocholesterolemic effect such as arginine, lysine, methionine and glycine, and hence they are of almost importance (Mortiaetal., 1997).This results agreed with (Naemah *et al*., 2014).Quinoa considers good source of some essential amino acids such as lysine and methionine (Jancurova *et al*., 2009).

Non-essential amino acids (NEAA):Data on table (6)recorded the mean values of total non-essential amino acid in tested formula the results showed that F1 had higher value than all tested formulas(F2,F3,F4,F5and F6,(56.65 ,47.32,48.49,49.05,48.47and 44.8 gml16 gm N) respectively.

Protein quality assessments of tested formula: FAO/WHO (2011) reported that calculating amino acid score pattern was based on the amount of the first limiting amino acid, and it aimed to suggest the requirement pattern of amino acids to evaluate the quality of dietary protein for each age group according FAO/WHO/UNU (2007) expert council based on previous human studies. Calculating chemical score was compered according to scoring pattern gm/g protein requirement for adolescent 11- 18 Y. The calculation of protein quality parameters are presented in table (7) which revealed that the lowest score obtained for the indispensable amino acids in a protein of tested formula, that of the most limiting amino acid would indicated a first approximation of its efficiency of utilization by adolescent, allowing a correction of the protein requirement for the quality of dietary protein. Leucine, Lysine as a sulfer containing amino acids and iso- leucine were first, second and third limited AA in test formula. Leucine was the first limiting amino acid 119.86, while Lysine was the first amino acid from F2: F5, finally sulfer containing amino acid was the first limiting in F6, this agree with Millward, (2011) who emphasize that leucine and lyseine are the most abundant amino acids in growth requirement. While sulfuric is one of AA required for maintenance.

Essential amino acid index (EAAI) estimates protein quality based on the content of all essential amino acids compared with egg reference amino acid. It is a rapid method to evaluate an optimize the amino acid content of food formulations (Suzanne, 2010). Presence of high concentration of quinoa, date, chickpea in F1 were responsible of increasing the value of essential amino acid index (EAAI) 63% followed by Commercial formula F6 55.29% while F2 recorded the lowest EAAI 46.29%.

Table 6: Amino acids pattern of different formulas.

E.A.A. profile	Essential amino acids gm / 16 gm N					
	F1	F2	F3	F4	F5	F6
Essential amino acids						
Tyrosine	3.87	3.12	3.16	3.32	3.18	3.79
Phenyl alanine	5.01	4.05	4.35	4.40	4.16	4.07
Aromatic AA	8.88	7.17	7.51	7.71	7.34	7.86
Leucine	7.19	5.80	6.25	6.09	5.75	7.21
Lysine	6.05	3.55	3.79	3.99	3.79	5.18
Valine	5.64	4.49	4.70	4.80	4.65	5.45
Iso- Leucine	3.96	3.49	3.58	3.38	3.24	3.79
Threonine	3.77	2.93	2.95	3.04	3.06	3.14
Cysteine	1.1	0.94	1.12	1.15	1.16	0.92
Methionine	1.66	1.37	1.47	1.62	1.59	1.57
sulfer AA	2.77	2.31	2.60	2.77	2.75	2.50
Total E.A.A	38.24	29.74	31.37	31.80	30.60	35.12
Non Essential amino acids						
Glutamic	17.54	13.90	14.04	14.01	14.63	16.91
Aspertic	8.95	7.36	7.79	8.19	7.71	6.38
Argenine	7.91	6.86	7.23	7.17	7.04	3.14
Proleine	4.59	4.68	4.70	4.40	3.98	6.84
Alanine	5.73	4.74	4.91	5.07	4.96	3.60
Serine	4.75	3.80	3.51	3.72	3.79	3.70
Glycine	4.59	3.87	4.07	4.19	4.22	2.13
Histidine	2.60	2.12	2.25	2.30	2.14	2.13
Total N. E.A.A	56.65	47.32	48.49	49.05	48.47	44.82

Table 7: Protein evaluation of tested formula:

Items	F1	F2	F3	F4	F5	F6
EAAI(%)	63.08	46.29	50.44	52.21	50.07	55.29
Amino acid score (CS)*						
First	Leucine	Lysine	Lysine	Lysine	Lysine	Sulferaa
	119.86	75.61	80.63	84.93	80.73	108.49
Second	Sulfer AA	Leucine	Leucine	Leucine	Leucine	Lysine
	120.26	96.63	104.09	101.49	95.88	110.12
Third	Lysine	Sulfer AA	Sulfer AA	Iso-Leucine	Iso-Leucine	Leucine
	128.78	100.29	112.89	112.76	108.12	120.15

*Amino acid score (CS) Chemical score was calculated as a percentage of the FAO/WHO/UNU, 2007.

Estimation of In-vitro human nutrient digestibility of formulas:

In vitro digestion experiment provide a useful alternative to animal and human models by rapidly screening food ingredients which provide accurate results in a short time (Coles *et al*., 2005).In-vitro digestibility of tested formulas is presented in Table (8). Crude protein digestibility (CPDinv) influenced with fat, fiber and protein contents in the diets. F6 was the highest CPDinv value (56.66%) due to increase fat, milk and cacao contents on the formula, followed by F1which recorded CPDinvof 35.14% due to increase crude protein and non- essential amino acid percentage in formula. F1 formula showed to be the, the best tested formula compared with other formulas. There was gradual decreased in CPDinv values from F2 till F5 which ranged of 31.45- 14.06%. This is explained with: Limiting lysine and SAA chemical score values which is lake nutritive values of mentioned formulas and CPDinv values, this result are in agreement with (WHO, 2011).Also, corresponding with increase the EAAI as shown in Table (7).Increasing fat contents due to presence of flaxseed which have 40% fats is the main corresponding reason for decreasing CPDinv percentage. Increase fiber contents on the diet resulted in decreasing dry matter digestibility (DMD%), and increasing holding capacity in stomach. So, the lowest DMDinv was recorded with F5 (35.16%). Commercial formula F6 reported highest dry matter digestibility (56.43%) which reflect improve digestive treatment of dry matter component. DMDinv % of formulas from 2 till 4 were semi closer.

Organic matter digestibility (OMDinv) different in all formulas, due to changes in their content ingredients. The F6 was the lowest (85%), while F2 which no flax seed was recorded the highest OMDinv (85%).

Further research is needed to find non fatty cohesion substances to improve CPDinv for the formula.

Table 8: In-vitro human nutrient digestibility :

Enzymatic	Concentration (%)					
	F1	F2	F3	F4	F5	F6
Crude Protein	29.07±0.01	15.77±0.02	14.08±0.01	14.61±0.02	15.74± 0.02	9.77± 0.02
Crude protein digestibility (CPD%)	35.14±1.9	31.45±1.06	21.62±1.11	18.53±0.98	14.04±1.21	56.66± 2.01
Dry matter digestibility (DMD %)	38.43±1.8	46.21±2.37	52.61±1.02	50.48±0.63	35.15±1.03	56.43±0.45
Organic matter digestibility (OMD%)	86.67±1.3	86.85±0.05	86.54±1.95	85.42±1.10	86.74± 0.1	85.0± 0.23

Fatty acids composition of formulas:

Dietary fats are an important macronutrient that contribute to increase energy intake in appropriate level. Combination of legumes and cereal has several potential health benefits, it had an positive effect in cardiovascular disease and type 2 diabetes, digestive disease and some type of cancer (Pittaway *et al*., 2008 and Jukanti *et al*., 2012).ω6/ ω3 ratio linoleic acid (LA), an omega-6 fatty acid, and alpha-linolenic acid (ALA), an omega-3 fatty acid considered "essential fatty acids, they are needed for growth and repair, and can also be used to make other fatty acids. ω6/ ω3 ratio varies according to countries and environmental aspects. Simopoulos (2001) reported that excessive ω6/ ω3 ratio value promote the pathogenesis of many diseases, including cardiovascular disease, cancer, and inflammatory and autoimmune diseases; A lower ratio of omega-6/omega-3 fatty acids is more desirable in reducing the risk of many of the chronic diseases (Simopoulos2004). ω6/ ω3 ratio for tested formulas were 6.16, missing, 6.50, 6.65, 7.88and 4.30 % in F1, F2, F3, F4, F5and F6 respectively. It is noticed that F4 and F5 had the highest amount of ω6 which are the main causes for increase the value ratio due to absence of flaxseed oil.

From the Table (8) a positive correlation between ω3 and ω6/ ω3 ratio due to increase quantity of flaxseed in F5 and increase amount of quinoa and sesame in F1.Fatty acid percentage of different lipid fractions in tested formula are summarized in table (8), which composed of different twenty two fatty acids. The difference between fatty acid concentration can be explained according to different ingredients concentration of tested formula. Generally; cereal (quinoa, wheat germ) and legumes (sweet chickpeas, peanut, sesame) and powder milk are the main ingredients of F1 with weight of 13% of each component and pollen seed 3.05%; while previous ingredients decreased to 9% in F2: F5 with 0%, 2%, 4% and 6% concentration of flaxseed respectively and adding honey and date. The highest concentration of total polyunsaturated fatty acid (TPUFA) was 45.48% in F1 referred to highest concentration of ω 6 (36.62%) which consider as member of essential fatty acid. linoleic acid (C18: 2n6), Oleic acid (C18:1n9) and palmitic acid (C16:0) were the main fatty acid which represent a ranged of 57.58 % to 79% from total content of fatty acids mentioned fatty acids this agree with Jukanti, *et al*., (2012) and Pittaway, *et al*.,(2008). Linoleic acid (C18: 2n6) has suppressive effect (33%) when compared with other formula. This agreed with (Lilian and abugoch 2009, Przybylski *et al*., 1994 and FAO/WHO 2008)[1].Flaxseed is considering rich source of fiber and oil (one of the richest sources of the ω-3 PUFA, Linolenic acid). (Patenaudei *et al*., 2009) studied fortified formula with 30 g flaxseed; it proved significant increase in plasma linolenic acid and decrease in triglyceride value in young age than older. Also, (Paschos *et al*., 2007) proved that flaxseed oil has significant lowering systolic and diastolic blood pressure levels in studied subjects. Oleic acid (C18:1n9) was the next abundant fatty acid in all tested sample; it amounted in 24.89% , 22.84 %, 22.89%, 26.86% , 32.25% and 32.93%in formula F1, F2, F3, F4, F5 and F6 respectively.

Total saturated fatty acid (TSFA): (FAO/WHO2008)[2]recommended thevalue of saturated fatty acid intake for children and adolescent be <8%from Energy. Studied formula didn't exceed recommended value. C12:0 (lauric acid), C14:0 (Myristic acid), and C16:0(Palmetic acid) are the highest fatty acid responsible for increase saturated fatty acid in the tested formula. Palmitic acid (C16:0) was the third concentrated fatty acid it ranged from 14.54% till 26.79% in tested formula. The lowest concentration was for F1 which don't have oil. Palmitic acid increased slightly from F2, F3, F4, F5 15.4%, 15.6%, 16.77%, 16.86%) accepted that of F6 which contented highest value 26.79%). F6 contain chocolate, cocoa butter, milk fat, palm fat and milk chocolate are the main sources for increase palmitic acid

Total mono unsaturated fatty acid (TMUFA): ranged from 21.5to36.89% in tested formula it was the highest for F5 and lowest for F6.
Total poly unsaturated fatty acid (TPUFA): F1resulted the highest (45.48%), while F2 recorded the lowest percentage of TPUFA (19.88%) and continued to increase with adding flaxseed till reached 38.52% in F5, commercial formula F6 contain 26.26 % TPUFA.
ω -6/ ω -3 ratio: this ratio is commonly used to assess the nutritional value and healthiness of food lipid material for human consumption (Simopoulos, 2004). ω-6/ ω-3 ratio for tested formulas decreased with increasing concentration of flaxseed, due to increase the concentration of ω6. Reas *et al*.,(2004) recommended that ω6/ω3 ratio below 4 in human diets to prevent the development of cardiovascular disease and some chronic disease including cancer, both ω-6 and ω-3 fatty acids have been shown to have anti-inflammatory properties that are protective of atherogenic changes in vascular endothelial cells (FAO/WHO 2008)[3].

Table 9: Fatty acids composition of formulas:

Fatty acids		Total fatty acids (%)					
		F1	F2	F3	F4	F5	F6
C10:0	Capric acid	-	-	0.54	0.85	1.03	0.49
C12:0	Lauric acid	-	9.14	11.89	13.39	16.85	2.63
C14:0	Myristic acid	0.46	5.15	6.06	6.41	8.05	-
C16:0	Palmitic acid	14.45	15.4	15.6	16.77	16.87	26.79
C17:0	Heptadecanoic acid	1.59	-	-	0.19	0.25	-
C18:0	Stearic acid	3.49	6.31	6.43	6.92	7.15	0.42
C20:0	Arachidonic acid	1.07	0.51	0.63	0.83	0.95	0.47
C22:0	Behenic acid	1.45	0.44	0.57	0.71	0.81	0.17
∑TSFA		22.51	36.98	41.72	46.07	51.96	30.97
C16:1n7	-	-	-	0.17	0.21	0.37	0.53
C18: 1n9	Oleic acid	24.89	22.84	22.89	26.84	33.25	20.97
C18: 1n7	Vaccinic acid	2.98	-	-	-	-	-
C20:1n11	Eicosaenoic acid	1.48	-	0.31	0.34	1.54	-
C20: 1n9	Gadolic acid				0.24	0.74	
C22: 1n9		1.98	-	-	-	1.03	-
∑TMUFA		31.33	22.84	23.37	27.63	36.89	21.5
C18: 2n7		0.95	-	-	0.46	0.76	-
C18: 2n6	Linoleic acid	33.43	19.34	20.53	25.08	28.9	22.00
C20: 2n6		1.8	0.54	0.74±0.07	1.65	1.72	-
C22:2n 6		1.39	-	-	-	-	-
ω-6		36.62	19.88	26.73	22.00	21.27	30.64
C18: 3n3	Linolenic acid	4.87	-	2.71	4.11	6.28	3.31
C20: 3n3	-	-	-	-	-	0.84	-
C22:3n 6		0.14	-	-	-	-	-
C22:3n 3		1.07	-	-	-	-	-
ω-3		5.94	0	2.71	4.11	7.12	3.31
C22:4n 6	Docosatetraeoicacid	0.97	-	-	-	-	-
∑TPUFA		45.48	19.88	23.97	31.30	38.52	26.26
SFA:MUFA:PUFA		0.02	0.08	0.07	0.05	0.04	0.05
ω6/ ω3 ratio		6.16	-	6.50	6.65	7.88	4.30

Standard errors of mean (n=3). ∑TSFA: Total saturated fatty acids; ∑TMUFA: Total mono saturated fatty acids; ∑TPUFA: Total poly unsaturated fatty acid SFA: MUFA: PUFA: Ratio of saturated fatty acid and mono unsaturated fatty acids and polyunsaturated fatty acids; ω -6/ ω -3 ratio: Ratio of ω −6 and ω −3 fatty acids.

Antioxidant activity of the formulas:

DPPH radical-scavenging activity:

The DPPH• is considered to be a model of stable lipophilic radical. A chain reaction in lipophilic radicals was inhibited by the lipid autoxidation. Antioxidants react with DPPH•, reducing a number of their available hydroxyl groups (Xu *et al*., 2005). The method is based on the reduction of alcoholic DPPH solution shows a strong absorption band at 517 nm appearing a deep violet color. Molecules can quench DPPH free radicals (i.e. by providing hydrogen atoms or by electron donation, conceivably by free radical attack) and convert them to a pale yellow or bleached product (i.e. 2, 2diphenyl-1-hydrazine) or substituted analogous of hydrazine, resulting in a decrease in absorbance at 517 nm (Yamaguchi *et al*., 1998).Hence, the more potent in the antioxidant activity of the extract, in terms of hydrogen – atom – donating capacity. Free radical–scavenging capacities of formulas compare with commercial formulas were measured by DPPH assay at different formulas are given in Table (10). DPPH radical scavenging activities (%) were increased with adding of Date in formulas 2 to 5 formulas. In the same results antioxidant activity for formulas with flaxseed (3, 4 and 5) was higher than formulas without flaxseed (1 and 2). A high antioxidant activity was observed for formulas 5 was 59.23% and low antioxidant activity was commercial formula 6 (26.74 %).It found that all formulas with or without flaxseed showed highly scavenging potential against DPPH radical and the date a good preservative effect on the antioxidant activity and flaxseed content of formulas when compared to that without flaxseed formulas.

Table 10: DPPH radical scavenging activity of different formulas.

Formulas	DPPH radical scavenging activities (%)
Formula1	40.31±0.10
Formula2	51.42±0.20
Formula3	51.19±0.11
Formula4	53.50±0.13
Formula5	59.23±0.12
Commercial Formula6	26.74±0.22

The Economic evaluation of the Formulas

The economic evaluation of the products under the search compared to commercial products showed in Table (11).It found that 100 grams costs of formulas F1, F2, F3, F4, and F5 was 2.44. 1.947, 1.933, 1.92 and 1.907 L.E respectively compared to the commercial product (F6) which was 10.0 L.E. It could be showed that the low cost all formulas under study showed to be cheapest that of commercial cost (F6).

Table 11: The Economic evaluation of the formulas

Formulas (F).	Cost of Formulas (L.E/100 gm)
Formula1	2.44
Formula2	1.947
Formula3	1.933
Formula4	1.922
Formula5	1.907
Commercial Formula6	10.0

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