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Utilization of Flaxseeds and Dates for Producing Functional Formulae

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Abstract:

Flaxseeds are known since ancient times as a high nutritional and healthy value, although the methods of consumption or food processing are limited. The study aims to maximize the benefit of the whole flaxseed as well reduce anemia rates, which have increased in recent times by preparing some formulae contained the dates substituted with whole flaxseed flour at levels 0%, 10%, 15%, 20%, 25% and 30%. Skimmed milk powder, corn starch and vanilla were added with fixed rates for all mixtures. The chemical composition and food energy per 100 grams of formulae were determined as compared to recommended daily allowances (RDAs) for children aged 7-10 years.Sensory evaluationof formulae was estimated during different storage periodsat 4°C. The results showed an increase for nutrients content for the all suggested formulae with increasing replacement rates of whole flaxseeds flour. Also, all formulae recorded varying degrees of the sensory acceptance. Consumption 100g of the formula D supplies 20.37% of energy, 31.71% of protein, 17.40% of fiber, 27.95% of calcium and 36.70% of iron from the RDAsfor children aged 7-10 years. The results revealed that utilization of whole flaxseeds and dates have a potential role in producing high nutritional value formulae which could be assisted in the prevention of anemia.

Key words: Dates, Agwa, Flaxseeds, Anemia, Functional formulae

Introduction:

Functional foods are not pills or capsules but are consumed as a part of a normal every day diet. Epidemiological studies randomized clinical trials carried out in different countries have demonstrated numerous health effects related to functional food consumption such as heart health, reduction of cancer, blood pressure, diabetic mellitus, osteoporosis and anemia (**Raghuvear et al., 2009**).

Anemia is lead to human inability to work and production. In Egypt, anemia prevalence among preschool children in 25.2% and among mothers of surveyed children to be 14.8% in the meantime. Moreover,the food consumption study showed that 14% of mothers and 52.5% of the children used to get less than 75% of the Recommended Dietary Allowances (RDA) (**Hussein, 1996**). Iron deficiency anemia was found to be prevalent in different parts of Egypt, particularly in rural areas (**Aly, 1999**and**Amira, 2010**).

Flaxseed (linseed,*Linumusitatissimum* L.), an edible oil seed/grain and one of the oldest arable crops, was recently acknowledged as a functional food (**Moraes et al., 2010**)and gained much attention because of its unique nutrient components such as alpha-linolenic acid (ALA; 50-62% of flaxseed oil, or 22% of whole flaxseed)(**Bozan and Temelli, 2008).**Linolenic acid can be converted into eicosapentanoic acid (EPA) and decosahexanoic (DHA) which are precursors to anti-inflammatory and anti-atherogenic prostaglandins (**James et al., 2000**),polysaccharides and lignans (range: 0.2-13.3 mg/g flaxseed)which have antioxidant activity (**Xue et al, 1992**) and therefore may also be of benefit in the prevention ofcancer (**Giovannucci et al., 1995**). Lignans from flaxseed may be linked to hepatoprotection against injury through an increase in reduced glutathione (**Hemmings and Barker 2004**). These components may prevent or reduce the risk of various important diseases such as diabetes, lupus nephritis, arteriosclerosis, chronic vasculardiseases (CVD)and hormone dependent types of cancer (**Bilek and Turhan, 2009**and**Williams et al., 2007**).

Also, dates are known for their nutrition value. The importance of the date in human nutrition comes from its rich composition of carbohydrates, minerals, dietary fiber, vitamins, fatty acids, amino acids and protein but their sugars make them a first class food. In addition to, the date has potential in various aspects of the human biological such

controlling diseases and enhancing metabolism of the human body. Polysaccharides isolated from dates presented an anti-tumor activity (**Ishurd and Kennedy 2005**).

The objective of this study was to maximize the benefit of the whole flaxseeds and dates for producingfunctional formulae with high nutritive value at different substitution rates and study of sensory evaluation and the impact of the storage of these products on the organoleptic properties.

Materialsand methods

Materials:

Dates (*Phoenix dactylifera*), skimmed milk, corn starchand vanillawere obtained from local market, Giza, Egypt.Whole flaxseeds (*Linumusitatissimum*L.) were obtained from Agricultural Research Center, Oil CropsResearch Department, Giza, Egypt.

Methods:

Preparation of ground dates (Agwa): Dates werewashed with tap water, cut up and disarm seeds. Dates were soaked in warm water (60-70°C) for 1 hour and then were filtered from water and macerated usingBraun G1500 meat grinder to form ahomogenized date paste (Agwa) and heated in water bath at 70-80°C with stirring for 20 min. and stored in glasses jar in refrigerator at 4°C until used.

Preparation of whole flaxseeds flour: Whole flaxseeds were soaked in warm water (40-50°C) for 4 hours. Then, flaxseeds were dried by heating in electric air oven at 50°C for 6 hours.Flaxseeds weregrinded by UPX cyclone mill to pass through 60 mesh. Then, whole flaxseeds flour wasstored in dark jar in refrigerator at4°C until used.

Preparation of Agwa-flax formulae: Six blends were prepared as follow:76.65g date paste, 11.50g skimmed milk, 11.50g corn starch and 0.35g vanillin, substitution ground dates with whole flaxseeds flour at levels 0%, 10%, 15%, 20%, 25% and 30% in samples no.A, B, C, D, E and F, respectively. These formulae are shown in Table (1).

Procedures: For making Agwa-flax formulae, date paste and corn starch were heated for 3min. with stirring. Whole flaxseeds flour was added gradually to the starch–date mixture. Then, vanillin was added. The produced Agwa-flax mixture was formed to medium-sized balls and then allowed to cool for about 15 min before sensory evaluation and packing for storage at 4°C.

Table (1):The formulae composition of Agwa-flax (g /100g).

Ingredients	Formulae					
	A	B	C	D	E	F
Date	76.65	68.99	65.15	61.32	57.49	53.65
Flaxseeds	-	7.66	11.50	15.33	19.16	23.00
skimmed milk	11.50	11.50	11.50	11.50	11.50	11.50
Corn starch	11.50	11.50	11.50	11.50	11.50	11.50
Vanilla	0.35	0.35	0.35	0.35	0.35	0.35

A: Formula contained ground date (Agwa) without any substitution.
B: Formula contained Agwa substituted with 10% whole flaxseeds flour.
C: Formula contained Agwa substituted with 15% whole flaxseeds flour.
D: Formula contained Agwa substituted with 20% whole flaxseeds flour.
E: Formula contained Agwa substituted with 25% whole flaxseeds flour.
F: Formula contained Agwa substituted with 30% whole flaxseeds flour.

Chemical analysis: The protein, fat, ash and fiber contentswere determined (on dry weight basis) as described in **AOAC (2000).**Calcium (Ca) and Iron (Fe) contents were determined by using the Atomic Absorption Spectrophotometer as described in **AOAC (2000).** The carbohydrates as Nitrogen free extract (NFE) calculated by difference[100 – (fat + protein + ash + fiber)].Approximate calorific value products were calculated using the appropriate factor as described by **FAO/WHO (1973).**

Sensory evaluation of formulae: The quality of formulae was evaluated by twenty panelists from the staff of Food Technology Research Center (FRTI), AgriculturalResearch Center (ARC), Giza, Egypt. Tested samples wereevaluated for color, odor, taste,texture**,** general appearance by ten grades and overall acceptability (%). The evaluation was accomplished according to the method of **Fathia(1998**).

Statistical analysis: Results were expressed as the mean ± SD. The obtained data werestatistically analyzed using the SPSS-PC statistical package software, version 11.0. One-way analysis (ANOVA) was used. The difference among groups means were tested using the least significant difference (L.S.D.) at $p<0.05$ according to **Duncan (1996).**

Results and discussion:

Chemical composition of raw materials (Date, whole flaxseeds flour, skimmed milk and corn starch):

Thedata in Table (2) revealed that skimmed milk contain the highest value of total protein (35.16%) followed bywhole flaxseeds flour (19.29%). On the other hand, the results confirmed that whole flaxseeds flour contain the highest fat value (42.16%)as compared with date, skimmed milk and corn starch which recorded (1.08%), (1.07%) and (0.30%), respectively. These proportions coincide with those reported by**Gutiérrez et al., (2010)**. Moreover, **chung et al., (2005)** reported that flaxseed grain and flaxseed paste contain about 21% and 34% protein, respectively and may varies with the genetic and environmental factors.

Chemical composition of formulae:

Table (3) shows the chemical composition of different Agwa-flaxformulae (on the dry weight basis). Generally, the results illustrated that addition of whole flaxseeds flour increased in nutrients contents ofAgwa-flaxformulae and this increase was proportional to the percentage of the added whole flaxseeds flour due to the richness of flaxseeds in different nutrients. The addition of whole flaxseeds flour increased in the total protein and the fatcontents of the fortified formulae from 7.71% to 10.04% and 4.15% to 10.48%, respectively, depending on the added percentage of whole flaxseeds flour. Similarly, the increases in the fiber (from 4.01to 4.68%)and total energy (from 393.75 to 421.68 kcal./100g) were pronounced in case of adding whole flaxseeds flour.

Calcium and iron contents in formulae:

The data in Table (4) shows calcium and iron contents for Agwa-flax formulae fortified with different levels from whole flaxseeds flour(on the dry weight basis). Moreover, results indicated that Agwa-flax formula F has the highest values for calcium and iron (236.40 and 4 mg/100g), respectivelycompared to flaxseeds flour free Agwa formula Ahas the lowest values for calcium and iron (198 and 3 mg/100g), respectively. Results illustrated that the increasing in calcium and iron contents of Agwa-flax formula was related to the increase of levels of substitution with whole flaxseeds flour.Based onthe RDAs, it is clear that flaxseed flour could beimportant in contributing to the overall daily dietary intake of protein and essential elements whosedeficiency is widespread in Egypt.

Calcium is very essential in muscle contraction, oocyte activation, building strong bones and teeth, blood clotting, nerve impulse, transmission, regulating heart beat and fluid balance within cells. The requirements are greatest during the period of growth such as childhood, during pregnancy, when breast feeding. Long term of calcium deficiency can lead to osteoporosis in which the bone deteriorates and there is an increased risk of fractures. Eating a well-balanced diet can provide all the necessary nutrients and help prevent calciumdeficiency (**Pravina et al., 2013**).Iron deficiency is one of the leading risk factors for disability and death worldwide, affecting an estimate of two billion people (**WHO, 2001**). The high prevalence of iron deficiency in the developing world has substantial health and economic costs, including poor pregnancy outcome, impaired school performance, and decreased productivity (**Zimmermann and Hurrel, 2007**).

Percentages ofthe Recommended Dietary Allowances (RDA%) provided from 100g of formulaefor children aged7-10 years old:

RDA% for energy, protein, fiber, calcium and iron provided from 100g of formulae for children aged 7-10 years old were shown in Table (5). It could be observed that all values of RDA% for energy,protein and other minerals increased with increasing the percentages of whole flaxseeds flour. Results illustrated that fortification with whole flaxseeds flour increased in nutrients content and energy. Moreover, FormulaF fortified with 30% whole flaxseeds flour has the highest % RDA of energy (21.08), protein (35.86), fiber (18.72), Ca (29.55) andFe (40.00) for children aged 7-10 years oldas recommended by **Food and Nutrition Boord (1989)** and **WHO (1995)**.

Sensory evaluationofformulae during different storage periods:

Table (6) shows the sensory evaluation for different formulaesubstituted with whole flaxseeds flour. Generally, all Agwa-flax formulae were acceptable with different significantly degrees by the sensory evaluation. Formula Ahad the highest overall acceptability (90.00%), forward to formula B which had 89.50% without significantly differences. Furthermore,formula A and B had the highest taste score (9.00). The color score was decrease with increasing percentage of substitution with flaxseeds, this result may be due to the color of whole flaxseeds flour which has dark brown color.Similarly, sensory acceptable cookies can be prepared by supplementing20% flax in foods as an ingredient (**Hussain et al., 2006**). The results of the present study

are inconformity with the workof **Frank and Sarah (2006)** who foundthat addition of 15% flaxseed flour caused negatively affects for color of supplemented products.Moreover, the data in Table (6) show the sensory evaluation of the different formulae fortified with whole flaxseeds flourduring storage for 12 months at4°C.Generally,the resultsrevealed thatthere weresignificantly changes for tastes and overall acceptance scores during the storage period of formulae. This may be due to the high level of fat contents or nutty flavor of flaxseed flour. These results are consistent with **Kaur et al., (2013**) who reported that flaxseed can be used toimprove the nutritive value of some products as well as for improving sensoryproperties.

Economic evaluation:

The cost ofdifferent raw mixtures(per kilogram) used for producingformulaewas showed in Table (7). It could be noticed that the lowest cost (16.03 LE) was for formula F that containing 30% of whole flaxseeds flour. While the formula A that containingAgwa without flaxseeds flour had the highest cost (16.48 LE). It could be observed that, the cost of raw formulae is inversely proportional to the nutritional value of the formula. Where, Increase the nutritional value of the product accompanied by a reduction in the cost.

Conclusion:

From these results, it could be concluded that utilization of whole flaxseeds and dates for producing functional products have high contents of protein, energy, fiber, Ca and Fethat may alleviate or prevent of energy-protein malnutrition that widespread in developing countries.

Table (2): Chemical composition of raw materials (g/100g on dry weight basis).

Samples	Protein (%)	Fat (%)	Ash (%)	Fiber (%)	NFE* (%)	Food energy kcal/100g
Date	3.16	1.08	2.54	3.25	89.97	381.52
Whole flaxseeds flour	19.29	42.16	4.06	5.61	28.88	568.12
skimmed milk	35.16	1.07	5.95	-	57.82	381.55
Corn starch	0.50	0.30	1.99	10.20	87.01	352.74

Means, n= 3 *NFE: Nitrogen free extract.

Table (3): Chemical composition of Agwa-flaxformulae(g/100g on dry weight basis).

Formulae	Protein (%)	Fat (%)	Ash (%)	Fiber (%)	NFE* (%)	Food energy kcal/100g
A	6.55± 0.55^{e}	0.99± 0.05^{f}	2.87± 0.17^{a}	3.68± 0.15^{d}	85.91± 0.92^{a}	378.75± 1.55^{f}
B	7.71± 0.21^{d}	4.15± 0.15^{e}	2.90± 0.04^{a}	4.01± 0.10^{cd}	81.39± 0.50^{cb}	393.75± 0.19^{e}
C	8.29± 0.29^{cd}	5.74± 0.24^{d}	2.93± 0.20^{a}	4.18± 0.19^{bc}	78.94± 0.91^{c}	400.58± 0.32^{d}
D	8.88± 0.15^{bc}	7.31± 0.31^{c}	2.95± 0.15^{a}	4.35± 0.25^{abc}	76.51± 0.56^{d}	407.35± 0.05^{c}
E	9.45± 0.45^{ab}	8.89± 0.10^{b}	2.98± 0.08^{a}	4.45± 0.40^{ab}	74.23± 0.13^{e}	414.73± 1.42^{b}
F	10.04± 0.50^{a}	10.48± 0.48^{a}	3.00± 0.50^{a}	4.68± 0.20^{a}	71.80± 0.32^{f}	421.68± 3.60^{a}

Values are expressed as mean (n= 3) ± SD (n= 3, $p<0.05$)
Means with the same letter are not significantly different.
*NFE: Nitrogen free extract.
A: Formula contained ground date (Agwa) without any substitution.
B: Formula contained Agwa substituted with 10% whole flaxseeds flour.
C: Formula contained Agwa substituted with 15% whole flaxseeds flour.
D: Formula containedAgwa substituted with 20% whole flaxseeds flour.
E: Formula contained Agwa substituted with 25% whole flaxseeds flour.
F: Formula contained Agwa substituted with 30% whole flaxseeds flour.

Table (4): Calcium and iron contents in Agwa-flax formulae (mg/100g on dry weight basis).

Ingredients	Formulae						
	A	B	C	D	E	F	L.S.D
Ca	198.00± 18.00^{a}	210.80± 10.80^{a}	217.20± 17.20^{a}	223.60± 23.60^{a}	230.00± 30.00^{a}	236.40± 36.40^{a}	43.08
Fe	3.00± 0.25^{d}	3.33± 0.33^{cd}	3.51± 0.11^{bc}	3.67± 0.17^{abc}	3.84± 0.14^{ab}	4.00± 0.10^{a}	0.36

Values are expressed as mean (n= 3)± SD (n= 3, $p<0.05$)
Means with the same letter are not significantly different.
A: Formula contained ground date (Agwa) without any substitution.
B: Formula containedAgwa substituted with 10% whole flaxseeds flour.
C: Formula containedAgwa substituted with 15% whole flaxseeds flour.
D:FormulacontainedAgwa substituted with 20% whole flaxseeds flour.
E: Formula containedAgwa substituted with 25% whole flaxseeds flour.
F: Formula containedAgwa substituted with 30% whole flaxseeds flour.

Table (5):Percentages of energy, protein, fiber, calcium and ironprovided from 100g of differentformulae compared to the Recommended Dietary Allowances (RDAs) for children aged7-10years.

***RDA%**

Formulae	**RDA Energy (2000 kcal)	**RDA Protein (28g)	**RDA Fiber (25 g)	**RDA Ca (800mg)	**RDA Fe (10mg)
A	19.04± 0.49^{d}	23.39± 0.39^{f}	14.72± 0.70^{e}	24.75± 0.75^{e}	30.00± 0.90^{f}
B	19.69± 0.55^{cd}	27.54± 0.54^{e}	16.04± 0.35^{d}	26.35± 0.35^{d}	33.30± 0.30^{e}
C	20.00± 0.18^{bc}	29.61± 0.60^{d}	16.72± 0.72^{cd}	27.15± 0.50^{cd}	35.10± 0.40^{d}
D	20.37± 0.37^{bc}	31.71± 0.70^{c}	17.40± 0.40^{bc}	27.95± 0.69^{bc}	36.70± 0.70^{c}
E	20.74± 0.60^{ab}	33.75± 0.50^{b}	17.80± 0.20^{b}	28.75± 0.50^{ab}	38.40± 0.40^{b}
F	21.08± 0.45^{a}	35.86 ± 0.85^{a}	18.72± 0.22^{a}	29.55± 0.55^{a}	40.00± 0.75^{a}
L. S. D.	0.82	1.09	0.85	1.02	1.10

Values are expressed as mean (n= 3)± SD (n= 3, $p<0.05$)

Means with the same letter are not significantly different.

A: Formula contained ground date (Agwa) without any substitution.

B: Formula containedAgwa substituted with 10% whole flaxseeds flour.

C: Formula containedAgwa substituted with 15% whole flaxseeds flour.

D: FormulacontainedAgwa substituted with 20% whole flaxseeds flour.

E: Formula containedAgwa substituted with 25% whole flaxseeds flour.

F: Formula containedAgwa substituted with 30% whole flaxseeds flour.

*RDA%= value of nutrient in sample x 100/RDA for the same nutrient in reference.

**RDA%= value of nutrient in reference.

Table (6): Sensory evaluation of Agwa-flax formulae during different storage periods.

Formulae	Storage periods (months)	Color (10)	Odor (10)	Taste (10)	Texture (10)	General Appearance (10)	Overall acceptability (%)
A	0	9.00± 0.39^{ab}	9.50± 0.39^{a}	9.00± 0.39^{abc}	9.00± 0.40^{a}	8.50± 0.39^{ab}	90.00± 2.72^{a}
	4	9.20± 0.15^{a}	9.25± 0.18^{ab}	9.00± 0.39^{abc}	8.40± 0.51^{b}	8.35± 0.27^{bc}	88.40± 1.11^{abc}
	8	9.00± 0.18^{ab}	9.45± 0.27^{a}	9.20± 0.15^{ab}	8.50± 0.29^{b}	8.35± 0.24^{bc}	89.00± 1.31^{ab}
	12	9.00± 0.39^{ab}	9.25± 0.21^{ab}	9.25± 0.19^{a}	8.50± 0.28^{b}	8.35± 0.16^{bc}	88.70± 1.14^{ab}
B	0	9.00± 0.39^{ab}	9.25± 0.36^{ab}	9.00± 0.40^{abc}	8.75± 0.17^{a}	8.75± 0.19^{a}	89.50± 1.72^{a}
	4	9.15± 0.15^{a}	9.25± 0.18^{ab}	9.00± 0.48^{abc}	8.25± 0.33^{cb}	8.45± 0.18^{ab}	88.20± 1.70^{abc}
	8	9.00± 0.39^{ab}	9.00± 0.39^{b}	8.90± 0.07^{bc}	8.30± 0.25^{cb}	8.50± 0.17^{ab}	87.40± 1.97^{bc}
	12	8.75± 0.19^{b}	9.10± 0.40^{b}	8.85± 0.13^{c}	8.30± 0.25^{cb}	8.50± 0.32^{ab}	87.00± 0.87^{cd}
C	0	8.75± 0.14^{b}	8.50± 0.28^{c}	8.75± 0.18^{cd}	8.40± 0.18^{b}	8.25± 0.18^{bcd}	85.30± 1.01^{de}
	4	8.75± 0.14^{b}	8.40± 0.18^{c}	8.50± 0.28^{d}	8.30± 0.18^{cb}	8.00± 0.18^{de}	83.90± 0.57^{ef}
	8	8.75± 0.17^{b}	8.50± 0.28^{c}	8.50± 0.28^{d}	8.50± 0.28^{b}	8.25± 0.18^{bcd}	85.00± 1.90^{ef}
	12	8.75± 0.14^{b}	8.25± 0.18^{cd}	8.75± 0.14^{cd}	8.00± 0.18^{cd}	8.25± 0.18^{bcd}	84.00± 0.67^{efg}
D	0	8.30± 0.09^{c}	8.50± 0.28^{c}	8.75± 0.14^{cd}	8.25± 0.18^{cb}	8.50± 0.28^{ab}	84.60± 1.20^{ef}
	4	8.25± 0.18^{c}	8.50± 0.27^{c}	8.75± 0.14^{cd}	8.00± 0.25^{cd}	8.25± 0.17^{bcd}	83.50± 1.30^{fg}
	8	8.25± 0.17^{cd}	8.25± 0.17^{cd}	8.50± 0.28^{d}	8.00± 0.18^{cd}	8.25± 0.17^{bcd}	82.50± 1.40^{gh}
	12	8.25± 0.18^{cd}	8.25± 0.18^{cd}	8.75± 0.18^{cd}	8.00± 0.18^{cd}	8.00± 0.17^{de}	82.50± 1.27^{gh}
E	0	8.25± 0.17^{cd}	8.00± 0.18^{ed}	8.00± 0.25^{e}	8.25± 0.18^{cb}	8.00± 0.07^{de}	81.00± 1.32^{hi}
	4	8.00± 0.25^{ed}	8.00± 0.18^{ed}	8.00± 0.25^{e}	8.00± 0.07^{cd}	7.75± 0.18^{ef}	79.50± 1.43^{i}
	8	7.75± 0.17^{ef}	8.00± 0.25^{ed}	7.50± 0.18^{f}	7.75± 0.18^{de}	7.50± 0.17^{fg}	78.00± 1.12^{ij}
	12	8.00± 0.25^{ed}	7.75± 0.18^{ef}	7.00± 0.17^{g}	7.50± 0.18^{ef}	7.75± 0.17^{ef}	76.00± 1.27^{jk}

F	0	8.00± 0.25^{ed}	7.50± 0.18^{fg}	7.50± 0.18^{f}	7.00± 0.48^{g}	7.25± 0.19^{fg}	74.50± 1.26^{kl}
	4	7.75± 0.18^{ef}	7.25± 0.17^{gh}	7.50± 0.17^{f}	7.00± 0.17^{g}	7.50± 0.18^{fg}	74.00± 0.79^{kl}
	8	7.50± 0.17^{f}	7.00± 0.18^{hi}	7.00± 0.18^{g}	7.25± 0.17^{fg}	7.25± 0.25^{fg}	72.00± 1.00^{lm}
	12	7.50± 0.17^{f}	6.75± 0.25^{i}	6.50± 0.40^{h}	7.00± 0.18^{g}	7.25± 0.18^{fg}	70.00± 1.17^{n}
L. S. D.		0.29	0.32	0.32	0.32	0.27	1.27

Values are expressed as mean (n= 3)± SD (n= 3, $p<0.05$)
Means with the same letter are not significantly different.
A: Formula contained ground date (Agwa) without any substitution.
B: Formula containedAgwa substituted with 10% whole flaxseeds flour.
C: Formula containedAgwa substituted with 15% whole flaxseeds flour.
D:FormulacontainedAgwa substituted with 20% whole flaxseeds flour.
E: Formula containedAgwa substituted with 25% whole flaxseeds flour.
F: Formula containedAgwa substituted with 30% whole flaxseeds flour.

Table (7): The proximate cost of raw formulae (1kg) used for producingAgwa-flaxformulae.

	Formula*					
Raw materials(g)	**A**	**B**	**C**	**D**	**E**	**F**
Dates	766.50	689.85	651.52	613.20	574.88	536.55
Cost (LE)	7.66	6.90	6.52	6.13	5.75	5.37
Flaxseeds	-	76.65	114.98	153.30	191.62	229.95
Cost (LE)		0.61	0.92	1.23	1.53	1.84
Skimmed milk	115.00	115.00	115.00	115.00	115.00	115.00
Cost (LE)	6.90	6.90	6.90	6.90	6.90	6.90
Corn starch	115.00	115.00	115.00	115.00	115.00	115.00
Cost (LE)	0.90	0.92	0.92	0.92	0.92	0.92
Vanillin	3.50	3.50	3.50	3.50	3.50	3.50
Cost (LE)	1.00	1.00	1.00	1.00	1.00	1.00
Total cost (LE) per 1Kg	16.48	16.33	16.26	16.18	16.10	16.03

A: Formula contained ground date (Agwa) without any substitution.
B: Formula containedAgwa substituted with 10% whole flaxseeds flour.
C: Formula containedAgwa substituted with 15% whole flaxseeds flour.
D:FormulacontainedAgwa substituted with 20% whole flaxseeds flour.
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الاستفادة من بذور الكتان والبلح لإنتاج خلطات وظيفية

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الملخص العربى :

عرفت بذورالكتان منذ القدم بارتفاع قيمتها الغذائية والصحية ورغم ذلك فان طرق استهلاكها أواستخدامها في التصنيع الغذائيلا يزال محدوداً. تهدف الدراسة الي تعظيم الاستفادة من بذور الكتان الكاملة وخفض معدلات الاصابة بالانيميا - والتي ازدادت في الأونة الأخيرة- من خلال تحضير بعضالخلطات باستخدام عجوة البلح مضافا اليها بذور الكتان الكاملة في صوره دقيقبنسب استبدال ٠% ، ١٠% ،١٥% ، ٢٠% ، ٢٥% ،٣٠% ، بالاضافة الي لبن بودرة منزوع الدسم ونشا الذرة والفانيليا بنسب ثابتة لجميع الخلطات. وقد تم دراسة التركيب الكيميائي ومقدار الطاقة الناتجة لكل ١٠٠جم من الوجبات المنتجة ومقارنتها بالتوصيات الغذائية اليومية للأطفال ذوي المرحلة العمرية (٧-١٠) سنوات.كذلك فقد اجري التقييم الحسي لهذه الخلطات خلال فترة تخزينهاعلي درجه حرارة ٤° مئوية. أوضحت النتائج ارتفاع محتوي العناصر الغذائية للخلطات المعززة ببذور الكتان مع زيادة نسب الاستبدال، اضافة الي أن جميع العينات قد لاقت قبولا حسيا بدرجات معنوية متفاوتة، وأن استهلاك ١٠٠ جم من الخلطة المعززة ب ٢٠% من بذور الكتان الكاملة تمد ب ٢٠.٣٧% الطاقة ،٣١.٧١% البروتين، ١٧.٤٠% الألياف، ٢٧.٩٥% الكالسيوم ، ٣٦.٧٠% الحديد من التوصيات الغذائية اليومية للأطفالذو (٧-١٠) سنوات.

أظهرت النتائج إلي أن استخدام بذور الكتان الكاملة وعجوة البلح لإنتاج تلكالخلطات الغذائية له دورايجابيفيإنتاج وجبات عالية القيمة الغذائية والحد من الإصابةبالأنيميا.

الكلمات المفتاحية: البلح، العجوة ، بذور الكتان ، الأنيميا ، خلطات وظيفية