Minufiya J. Agric. Res. Vol. 33 No.1: 53 - 70 (2008)

EDIBILITY EVALUATION OF LUFFA (*Luffa aegyptiaca*) SEEDS CULTIVATED IN NORTH EGYPT I- CHEMICAL COMPOSITION, OIL CHRACTERISTICS AND PROTEIN FUNCTIONALITY

M. A. Korish

Food Technology Dept., Fac. Agric., Kafr El-Sheikh Univ., Kafr El-Sheikh, Egypt.

(Received: Dec. 12 , 2007)

ABSTRACT: ***Chemical analysis and functional properties of Luffa aegyptiaca seeds meal and its oil characteristics were investigated in order to determine the possibility of using them for human consumption. The chemical analysis showed that, luffa seeds contain high percentage of both crude protein (39.15%) and lipid (41.19%), as well as considerable amount of ash (4.66%). On the other hand, they have low level of both carbohydrate (12.39%) and crude fibre (2.61%). Results of physico-chemical properties of the extracted oil were comparable with the most commonly known vegetable oils. The fatty acids composition characterized with the predominance of the unsaturated fatty acids (78.4%) versus saturated fatty acids (21.6%). The investigated functional properties of the seeds meal, showed that it possess great potential for use in many food products and formulations. The amino acid analysis showed that, all essential amino acids values were higher than those recommended by the WHO/ FAO for adults except sulfur containing amino acids.***

Keywords: ***Luffa seeds, Composition, oil characteristics, functional properties***

INTRODUCTION

In the near future, food production could fail to keep peace with increases in the demand for food by growing populations in many developing countries, if present trends continued. This "food gap" difference between developing world production and demand will be more than double, making some of the world's poorest people even more vulnerable to hunger and possible famine, according to a new report by the International Food Policy Research Institute (1997).Thus, in developing countries there is a need for vigorous nutritional research with the view to discover new feeding materials and affordable food sources for both humans and livestock (Yusuf *et al*., 2007). In the same context, the utilization of food processing by-products and waste, as well as under-utilized agricultural products becomes ultimate demand. Such utilization would contribute to maximizing available food resources and result in the production of various new products and thereby avoid waste disposal problems (Ajayi *et al*, 2007).

Luffa aegyptiaca **is tropical and subtropical annual climbing plant. Previously, it was cultivated in a small scale in Egypt for using its mature sponge fruits for personal hygiene products and to make household cleaning products. Recently, it was cultivated in order to export its sponge hence, the sponge was used for many industrial purposes such as an immobilized materials in many microbial industries, filters, insulation, and packing materials, craft shows often exhibit dolls, hats, toys, and other decorative items made from luffa sponges (Saeed and Iqbal, 2006 and Ganguly *et al*, 2007). A rising demand for luffa products, a desire for new, high-value crops, and high price of sponge have stimulated interest in cultivating large acreages of luffa sponge gourds. As described above, the sponge was only utilized while the seeds are discarded as a waste.**

In Egypt, there is a little information on the compositional analysis of the luffa fruit's seeds and physicochemical properties of the seeds oil and protein, therefore, the aim of this study was to provide data for utilization of under-utilized Luffa seeds as food for human consumption. To achieve this goal the proximate analysis, amino acids and fatty acids composition of luffa seeds were determined and its oil and protein were characterized. Hence information pertaining to nutritional, antinutritional and safety characteristics of under-utilized seeds will be a basic necessity, prior to consumption, the next study will be to nutritional evaluation.

MATERIALS AND METHODS

Sample preparation

Luffa seeds (10kg) were obtained from a private farm located in Behera governorate. The seeds of luffa were dehulled manually, ground with blender "moulinex model 570, France" to a fine powder and stored in sealed plastic bags at 4 ^{o}C in a refrigerator till further analysis.

Chemical analysis

Moisture, ash, crude lipid, crude fibre and nitrogen contents were determined according to AOAC (2000). Nitrogen content was converted to crude protein via multiplying by 6.25 while total carbohydrate was calculated by the difference.

Estimation of energy value

The caloric value estimation was done by summing the multiplied values for crude protein, crude lipid and carbohydrate (excluding crude fibre) by their respective factors (4, 9, and 4 kcal/mol) as described by Ekop (2007).

Analysis of mineral elements

Minerals called (Sodium, potassium, calcium, magnesium, iron, copper, zinc and manganese were determined using an Atomic Absorption

Spectrophotometer (Perkin–Elmer model 703, USA) as described by Onyeike and Acheru (2002). The total phosphorus was determined colorimetrically according to (APHA, 1995).

Estimation of physico-chemical properties of the extracted seeds oil

The values of iodine, peroxide, saponification, acid and unsaponifiable matters were determined according to the recommended method of AOAC (2000) and refractive index was determined at 25 ^{o}C using Abbe refractometer. The specific gravity was determined using a Pycnometer following the method described by Pearson (1982).

Fatty acid analysis

The fatty acids composition of luffa seeds oil were determined following the method of Garces and Mancha (1993) using GC Model, Shimadzu-8A, Equipped with FID detector.

Functional characteristics of luffa seeds meal

Protein solubility

Protein solubility was determined according to Vinay and Kanya, (2008) while water absorption capacity was estimated as described by Sosulski (1962). Oil absorption capacity was also determined using 1g of sample and refined corn oil according to Sosulski *et al*, (1976). Emulsion capacity and stability were determined following the methods of Neto *et al*., (2001). Foaming capacity and stability were also determined according to Coffman and Garcia (1977).

Amino acids analysis

Amino acids of the seed flour were analyzed using Beckman Amino Acid Analyzer 119 CL following the method described by Adeyeye and Afolabi, (2004).

Protein digestibility

The protein digestibility of luffa seed flour was estimated according to Akeson and Stahmann (1964). Percentage digestibility of the protein flour was calculated following the equation:

***in vitro* digestibility (%) = 100 × (Protein in digest) ÷ Protein in defatted flour)**

The protein digestibility corrected amino acid score (PDCAAS) of EAA was calculated based on EAA requirements for adults (WHO/FAO, 1991) PDCAAS = Amino acid content in food protein / Amino acid content of reference pattern × digestibility of test protein

Estimation of anti-nutrients

Estimation of tannins

Total tannins contents of luffa seeds meal was determined according to the method described by Ranganna (1995) where, phytates content was estimated according to Thompson and Erdman (1982).

All determinations in this work were done in triplicates and results were expressed as averages on dry weight basis.

RESULTS AND DISCUSSION

Proximate analysis of luffa seeds

The results of proximate analysis of luffa seeds were compared with sunflower seeds as conventional edible oil seeds in Table (1). The results indicated that luffa seeds contain higher crude protein (39.15 %) than that of sunflower seeds (19.2%). The high protein content in luffa seeds emphasizes their value as a good potential source for low cost protein. According to (FND, 2002) adults, children, pregnant and lactating mothers required 34 - 56 g, 13 – 19 g, 71 g and 71g of protein daily respectively. Assuming complete protein absorption, about 87- 143g, 33 -48g, 181g and 181g of luffa seeds provide their daily protein requirement respectively.

The luffa seeds contain about 41.19 % crude lipid, this value was about similar to those reported for both sunflower and groundnut seeds (40.8%) (Onyeike and Acheru, 2002) and about the double yield of soy bean (18.3 – 21.53 %) (Vasconcelos *et al*., 1997). Ash content of luffa seeds (4.66 %) was closely similar to those reported for lupin seeds (Sujak *et al*., 2006) and lower than those found in sunflower seeds 5.10% NRC. (2001)

The seeds contain 2.61% crude fibre and 12.39 % total carbohydrates, thus luffa seeds contain lower amounts of both total carbohydrates and crude fibers comparing with other seeds.

These results indicated that the seeds could be serving as a good source of edible oil, plant protein and minerals. In addition it contains a moderate amount of total carbohydrates and crude fibers.

Table (1): Proximate chemical composition of luffa seeds compared with sunflower seeds (g/100g based on dry weight).

Parameters	Luffa seeds	*Sunflower seeds
Dry matter	95.29	91.80
Crude protein	39.15	19.20
Crude lipid	41.19	41.90
Crude fibre	2.61	22.50
Ash	4.66	5.10
Carbohydrate	12.39	11.30

*Source: NRC. (2001)

Mineral analysis

The results of the mineral content of luffa seeds were compared with that of sunflower seeds as shown in Table (2) the results revealed that, the content of all determined minerals was higher than those of sunflower seeds except for phosphorus which it was lower.

Calcium, an important mineral required for bone formation and neurological function, was found in luffa seeds at high level (610.10mg/100g).Considering that WHO/FAO recommends an intake of 400 – 500 mg per day of calcium for adults and 1200 mg per day until the age of 24 years (WHO/FAO, 1973), a modest serving of approximately 67 – 85 g of luffa seeds per day would satisfy for the requirement of adult daily calcium and 200g for children. Thus luffa seeds could be serving as a good source for calcium which is need for bone formation.

Luffa seeds contain large amount of manganese (98.68mg/100g) comparing with sunflower seeds (Table 2) and an adequate serving would satisfy recommended daily allowance of manganese which is a microelement essential for human nutrition, it acts as activator of many enzymes and it is important mineral in connection with circulatory diseases such as ischemic heart disease and calcium metabolism in bone (Ishida *et al.,* 2000).

The study shows that luffa seeds contain moderate amount of sodium (88.60mg/100g), which is a macronutrient and constitutes 2 percent of the total mineral content of the body. It is vital in maintaining the body fluid volume, osmotic equilibrium and acid-base balance (Ishida *et al.,* 2000).

The results indicated that, luffa seeds contain considerable amount of phosphorus (92.81mg/100g). Shills and Young (1988) brought the concept of Ca/P ratio into light, because modern diets which are rich in animal proteins and phosphorus tend to promote the loss of calcium in urine. If Ca/P ratio is lower than 0.5, high amount of calcium may be loss in urine, resulting a decrease in the calcium levels of bones. Nieman *et al.,* (1992) stated that good food source for calcium, if Ca/P ratio is more than one and poor if the ratio is less than 0.5. luffa seeds gave a Ca/P value (4.2) which indicates that it is a good source of minerals required for bone formation.

Iron is an essential trace element for hemoglobin formation, normal functioning of the central nervous system and in the oxidation of carbohydrates, proteins and fats (Adeyeye and Otokiti, 1999). It was recommended that 1.00mg/day of iron is suitable for adults to maintain the daily balance of intake and excretion (Ishida *et al.,* 2000). The results of Table (2) indicate that luffa seeds contain high level of iron (18.31mg/100g) which is a good source of iron to maintain daily balance.

Data of Table (2) indicated that, luffa seeds contain large amount of potassium (987.7 mg/100g) comparing with sunflower seeds (720 mg/100g). Whereas high levels of potassium in diets are beneficial for those suffering from hypertension and those who suffer excessive excretion of potassium through the body fluids (Siddhuraju *et al.*, 2001), thus luffa seeds are

beneficial for good health. A K/Na ratio in diet is an important factor in prevention of hypertension and arteriosclerosis, since K depresses and Na enhances blood pressure (Yoshimura *et al.,* 1991). The calculated K/Na ratio in the luffa seeds was high (11.14), thus it is recommended, for lowering blood pressure levels. The seeds also contain considerable amounts of other elements such as magnesium, zinc and copper that are fetal for human metabolism (Ishida *et al.,* 2000).

Table (2): Mineral content profile of luffa seeds compared with sunflower seeds.

Element	Luffa seeds (mg/100g)	*Sunflower seeds (mg/100g)
Calcium (Ca)	610.10	210
Manganese (Mn)	98.68	1.5
Sodium (Na)	88.60	20
Phosphorus (P)	92.81	350
Iron (Fe)	18.31	4.7
Potassium (K)	987.7	720
Zinc (Zn)	8.99	5.4
Magnesium (Mg)	391.2	250
Copper (Cu)	2.2	1.6
Ca/P	4.2	0.6
K/Na	11.14	36

*Beauchemin, (2005).

Physico- chemical properties of luffa seeds oil

As shown in Table (3) crude luffa seed oil was a clear liquid at room temperature having a green-yellowish color and pleasant odor. It had a specific gravity and refractive index, as 0.920 and 1.4612 respectively. These values are within the range of the most commonly known vegetable oils (Person, 1976).

The acid value of luffa seeds oil was estimated to be 1.96 mgKOH/g oil, this value is within the allowable limits for edible oils hence the acid value of edible oil should not exceed 4.0 mg KOH/g oil (Akintayo, 1997).The lower acid value of luffa seeds oil suggests that the oil could be a good edible oil that will store for a long period without deterioration. This suggestion in agree with the findings of Dosunmu and Ochu, (1995) they reported that the low acid value (1.81 mg KOH/g) of *Chryosophyllum albidum* seeds oil enhanced its shelf life. The determined iodine value of the oil under study was 83.23 mg/100g, this implies that the oil within the nondrying oils group, since the

drying oils have an iodine value above 100mg/100g (Person, 1982). It also indicated that it contains high level of unsaturated fatty acids which are nutritionally favor.

The peroxide value of the luffa seeds oil was found to be 1.89 mEq/kg oil. Peroxide value is a good indicator for oil deterioration where fresh oils have value less than 10 mEq/kg. Ranced taste of most oils appears at 20-40 mEq/kg oil (Person 1982). In addition, oils with high peroxide value are unstable and become rancid (Ojeh, 1981).According to the Codex Alimentarius Commission, (1982) stipulated a permitted maximum peroxide level of not more than 10 mEq/kg oil, the peroxide value of the luffa seeds oil was far below 10 mEq therefore it may be suitable as an edible oil and could have long shelf life.

Saponification value of luffa seeds oil was 186.27 mg/g. indicating that the oil has moderate molecular weight (Agatemor, 2006) and could place oil among the edible oils of plants origin group (Person, 1976).

The percentage of non-saponifable matters of luffa seeds oil was 0.77. This value as was as low the values recorded for conventional edible oil (Ritter, 1990). Unsaponifiable matters of oils are usually containing high content of sterols which are essential for more growth and reproduction (Ritter, 1990).

Table (3): Physicochemical characteristics of crude oil extracted from luffa seeds.

Oil characteristic	Value
Refractive index	1.4612
Specific gravity (g/ml)	0.920
Acid value (mg KOH/g)	1.96
Iodine value (mgI/100g)	83.23
Peroxide value (mEq/kg)	1.89
Saponification value (mg KOH/g)	186.27
Unsaponfable matters (%)	0.77

Fatty acids

The fatty acids composition of oil is useful chemical feature. Many of the chemical tests for oil identity mainly related to their fatty acids content (Pritchard, 1991). Results of Table (4) imply that fatty acids composition of both luffa seed oil and sunflower oil were approximately similar. The composition of luffa seeds oil was characterized by unsaturated fatty acids which constitutes about 78% of the total fatty acids. The predominant unsaturated fatty acid was linoleic (58 %) followed by oleic (19.65%). On the other side, palmitic (14.91%) and stearic (6.4 %) were the major saturated

fatty acids. The high content of unsaturated fatty acids in luffa seeds oil led to raise the nutrional value of the oil, since the high level of saturated fatty acids might be undesirable because of the linkage between saturated fatty acids and atherosclerotic disorders (Reiser, 1973). In addition high ratio of linoleic acid the essential fatty acid supported the use of luffa seeds oil as edible (DeFoliart, 1992). Behenic acid (antinutrional fatty acid) which was found in the luffa seed oil by Badami and Daulatabad, (1967) was not detected in our investigated sample.

Table (4): Fatty acids composition of luffa seeds oil compared with sunflower oil.

Fatty acid	Luffa seeds oil %	*Sunflower oil %
Myristic acid (C 14:0)	00.29	ND
Palmitic acid (C16:0)	14.91	5.0 – 7.6
Palmitoleic acid (C 16:1)	00.58	ND
Stearic acid (C18:0)	06.41	2.7 – 6.5
Oleic acid (C18:1)	19.65	14.0 – 39.4
Linoleic acid (C18:2)	58.17	48.3 – 74.0
Linolenic acid (C18:3)	ND	ND
Total saturated %	21.61	10.9
Total unsaturated %	78.39	87.85

*Source: Codex, (2005). ND = not detected

Functional characteristics

Water holding capacity

Results of Table (5) reveal that the luffa seeds meal had high water holding capacity (396.55 %). Intrinsic factors affecting water-binding capacity of food proteins include amino acid composition, protein conformation and surface polarity/ hydrophobicity (Barbut, 1999). The water absorption capacity of luffa seeds was greater than those reported for soybean flour 130% and sunflower flour 107.1 % (Dairo *et al*., 2007). This result suggested that luffa seeds meal can be use in the making of viscous foods and backed products especially in human diets (Dairo *et al*., 2007).

Oil absorption capacity

Oil absorption capacity of luffa seeds meal was (97.76 %) which was higher than that of soybean meal (84.4%) as reported by (Lin *et al*., 1974). Retention of liquid in seeds flour is an index indicating the ability of protein to absorb and retain water and/or oil which in turn influences the texture and mouthfeel of foods particularly in comminuted meats, meat analogues and backed products (Okezie and Bello, 1988).

Table (5): Functional properties of luffa seeds meal.

Functional properties	Percentage (%)
Water absorption capacity	396.55
Oil absorption capacity	97.76
Emulsion capacity	56.33
Emulsion stability	49.25
Foaming capacity	31.1
Foaming stability	11.29
Least gelation concentration	7.46
Protein digestibility	92.13

The emulsion capacity and stability of luffa seeds flour were found to be 56.33% and 49.25% respectively. Emulsification of protein is loosely related to the conformation of proteins and interaction of adsorbed molecules at the oil/water interface (Vinay and Kanya, 2008).
These results denoted that the potential use of luffa seeds meal for the stabilization of fat emulsion such as in the production of mayonnaise, milk products, commuted meats and salad dressings (Adeyeye, 2004).

Foaming capacity and stability

The luffa seeds protein showed considerable foaming formation and stability (31.1% and 11.29 % respectively) but lower than those described for soybean flour 70 % and sunflower meal 230% (Ogunsipe, 2000). In case of the formation of foam, water molecules surround air drops, and air is the non-polar phase. The amphipathic character agents that work at air- water interfaces to prevent bubble coalescence (Vinay and Kanya, 2008). According to the above results, the foaming properties of luffa seeds meal may be recommended its use as airiting or whipping agents.

Gelation capacity concentration

The least gelation concentration of luffa seeds meal showed value of 7.46%, this value was higher than that of soybean meal 6.93% (Ogunsipe, 2000). According to this result, luffa seeds may be utilized in preparation of food products like custard, ice creams, sausages and other bakery products.

Protein solubility profile

Protein solubility is the most important functional property because it influences other functional properties (Vinay and Kanya, 2008).
Protein solubility profile of Luffa seeds was characterized by variable solubilities with varying pH values in both the acidic and alkaline regions.

The maximum solubility was found at pH 1 (26.18%) and the other at pH 10 (39.91%) with isoelectric points (minimum solubility) at pHs 4.0 and 12.0 (Fig.1). The occurrence of two isoelectric points implies that there are two possible types of proteins in luffa seeds. These results were closely similar those of *Bilphia sapida* pulp and seeds (Akintayo *et al.*, 2002).

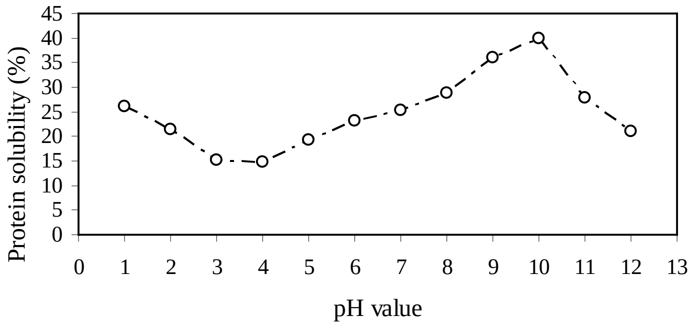

Fig (1): Protein-pH solubility profile of luffa seeds defatted meal.

Estimation of energy value

The caloric value of luffa seeds kernel was 453.3 Kcal/100g. Thus it was suggested to use the luffa seed meal as veritable source of energy in human nutrition.

In Vitro protein digestibility

The digestibility percentage of luffa seeds protein in the hydrolyzate after digestion was 92.13 %. The high value of protein digestibility might be related to the low content of enzyme inhibitors as in lablab bean (Osman, 2007).

Amino acid composition

As shown in Table (6) percentages amino acids content of luffa seeds protein were higher than those found in sunflower seed protein. Only seventeen amino acids were detected in the protein hydrolyzate from twenty amino acid which are commonly presented as components of proteins (McDonald *et al.*, 1995), this may be attributed to the destruction of the other amino acids during the acid hydrolysis (Wathelet, 1999). Glutamic acid (17.3%) and arginine (12.19%) were found to be the major nonessential amino acids while leucine (6.18%) and aromatic acids (phenylalanine and tyrosine, 5.9%) were the predominance essential amino acids.

Table (6): Amino acid composition (g/100 g) of luffa seeds compared with sunflower seeds.

Amino acid	Luffa seeds	*Sunflower seeds
Asparatic	5.96	1.63
Threonine	2.35	0.68-0.71
Serine	3.15	0.84
Glutamic	17.31	4.35
Proline	2.89	0.93
Glycine	4.38	0.98
Alanine	4.07	0.53
Cystine	0.11	0.34
Valine	3.94	0.95
Methionine	1.67	0.33
Isoleucine	3.55	0.75
Leucine	6.18	1.23
Tyrosine	2.43	-
Phenylalanine	3.47	0.89
Histidine	4.76	0.46
Lysine	2.45	0.71
Arginine	12.19	1.79
Total	81.54	

***Source: Kepler *et al* (1982)**

To evaluate the nutritional quality of luffa seeds protein, the percentage of the essential amino acids were compared with those of the amino acids reference patterns profile established for both adults and preschool children (children 2–5 years old) by (WHO/FAO, 1991) Table (7). The comparison imply that, all essential amino acids of luffa seed protein were higher than those recommended by the WHO/ FAO for adults except for sulfur containing amino acids (Methionine and Cystine) which were lower, as are most vegetable proteins. In the respect of of preschool children, lysine, theronine, sulfur containing amino acids, lucine and aromatic amino acids were lower than that of the standard requirement. The limiting amino acids were sulfur containing amino acids (Methionine and Cystine) for adults. However, lysine was the most limiting amino acid for preschool children.

Table (7): Amino acid score for luffa seeds protein.

Essential amino acid	Amino acid content (g/100g protein)	Reference 1	Reference 2	Score 1	Score 2	PDCAAS 1	PDCAAS 2
Isoleucine	3.55	2.8	1.3	127	273	117	252
Leucine	6.18	6.6	1.9	94	353	87	299
Lysine	2.45	5.8	1.6	42	153	39	141
Theronine	2.35	3.4	0.9	69	261	64	240
Valine	3.94	3.5	1.3	113	303	104	279
Tryptophan	ND**	1.1	0.5	ND	ND	ND	ND
Methionine + Cystine	1.78	2.5	1.7	71	105	65	97
Phenylalanine + Tyrosine	5.9	6.3	1.9	94	311	87	287
Histidine*	4.76	1.9	1.6	251	251	231	275

*Essential for children, PDCAAS1=Protein digestibility corrected amino acid score for children, PDCAAS2=Protein digestibility corrected amino acid score for adults, ND = Not detected, Reference 1 = FAO reference pattern protein for Preschool children, Reference 2 = FAO reference pattern protein for Adults, Score1= Amino acid score for preschool, Score2 = Amino acid score for adults

Antinutritional factors

Table (8) display that the level of phytic acid (0.078mg/g) was far below than those found in some commonly consumed cereals such as Wheat (9.3mg/g); Maize (10.2mg/g) and legumes cowpea (4.2mg/g), soybean (14.3mg/g) (Hidvegi and Lasztity, 2002)

Table (8): Antinutrient content of luffa seeds.

Parameter	Composition
Phytic acid (mg/g)	0.078
Phytate (mg/g)	0.022
Tannin (%)	0.32

Phytate and Tannins

As shown in Table (8) phytate content of luffa seeds was 0.022 (mg/g). This value was lower than those of cowpea (20mg/g) (Oboh *et al*., 2003). Phytate is a complex salt of calcium and magnesium and phytate phosphorus accounts for the total phosphorus in the luffa seeds. Phytate is a very stable and potent chelating food component such as divalent minerals and prevent their absorption (Oboh *et al*., 2003). On the other hand, it has been shown to have anticancer and antioxidant activity. It forms an iron chelate that suppresses lipid peroxidation by blocking iron-driven hydroxyl radical generation (Sudheer *et al*., 2004).

Tannins are complex polyphenolics. The tannins bring about antinutritional influence largely by forming complexes and thus precipitating dietary proteins and digestive enzymes (Oboh and Akindahunsi, 2003). The tannin content of the luffa seeds meal was 0.32 %, this value is far below the recommended deleterious dose of 0.75 -0.95 % (Aletor, 1993).

AKNOLEDGMENT

I am grateful to Prof. Dr. Mohamoud S. Gouda for his help during writing this manuscript.

REFERENCES

Adeyeye, E. I. and M. K. O. Otokiti (1999). Proximate composition and some nutritionally valuable minerals of two varieties of *Capsicum annum*. (Bell and Cherry peppers). Discovery and Innovation, 11: 75-81.

Adeyeye, E. I. and E. O. Afolabi (2004). Amino acid composition of three different types of land snails consumed in Nigeria. Food Chemistry, 85: 535-539.

Agatemor, C. (2006). Studies of Selected Physicochemical Properties of Fluted Pumpkin (*Telfairia occidentalis* Hook F.) Seeds Oil and Tropical Almond (*Terminalia catappia* L.) Seeds Oil. Pakistan Journal of Nutrition, 5: 306-307.

Ajayi, I. A., R. A. Oderinde, B. O. Ogunkoya, A. Egunyomi and V. O. Taiwo (2007). Chemical analysis and preliminary toxicological evaluation of *Garcinia mangostana* seeds and seeds oil. Food Chemistry, 101: 999–1004.

Akeson, W. R. and M. A. Stahman (1964). A Pepsin pancreatin digest index of protein quality evaluation. Journal of Nutrition, 83: 257–261.

Akintayo, E. T. (1997). Chemical composition and physicochemical properties of fluted pumpkin (*Telfairia occidentalis*) seeds and seeds oils. Rivista Italiana Sostanze Grasse, 74: 13–16.

Akintayo, E. T., E. A. Adebayo and L. A. Arogundade (2002). Chemical composition, physicochemical and functional properties of akee (*Bilphia sapida*) pulp and seed flours, Food Chemistry 77: 333-336.

Aletor, V. A. (1993). Allelochemical in plant foods and feeding stuffs: 1. Nutritional, biochemical and physiothalogical aspect in animal production. Vet. Hum. Toxicology, 35: 57-67.

AOAC, (2000). Association of Official Analytical Chemists. Official methods of analysis of AOAC international (17th ed.). Methods no 934.01, 988.05, 920.39, 942.05, 962. 9 . Arlington, VA, USA.

APHA, (1995). Standard methods for examination of water and waste water (pp. 113–114), 19th ed., American Public Health Association, USA (Method 4500-P E), 4.

Badami, R. C. and C. D. Daulatabad (1967). Component acids of Lufffa seeds oils. Journal of the Science of Food and Agriculture, 18: 445 – 446.

Barbut, S. (1999). Methods of testing protein functionality. G. M. Hall (Ed.), New York: Blackie Academic and Professional.

Beauchemin, K. (2005). Personal communication. Rum. Nutr., Ag. And Agriculture -Food Canada Research Ctr., Lethbridge, Alberta, Canda.

Coffman, C. W. and V. V. Garcia (1977). Functional properties and amino acid content of protein isolate from mung bean flour. Journal of Food Technology, 12: 473–484.

Codex Alimentarius Commission (1982). (I st ed.) Recommended internal standards edible fats and oils (vol. Xi). Rome: FAO/WHO.

Codex Alimentarius Commission, (2005). Standard for named vegetable oils. CODEX-STAN 210 (Amended 2003, 2005).

Dairo, F. A. S., P. A. Aye and T. A. Oluwasola (2007). Some functional properties of luffa gourd (*Luffa cylindrica* L., M. J. Roem) seeds. Journal of Food, Agriculture and Environment 5: 97-101.

DeFoliart, G. R. (1992). Insect as Human Food. Elsevier Science (Publishers), pp: 395-399.

Dosunmu, M. I. and C. Ochu (1995). Physicochemical properties and fatty acid composition of lipids extracted from Nigeria fruits and seeds. Global Journal of Pure Applied Science, 1: 45–50.

Ekop, A. S. (2007). Determination of Chemical Composition of *Gnetum africanum* (AFANG) Seeds. Pakistan Journal of Nutrition 6: 40- 43.

FND, (2002). Food and Nutrition Board, Institute of Medicine. National Academy of Sciences. Dietary Reference Intake for Energy, Carbohydrate, Fibre, Fat, Fatty Acids, Cholesterol, Protein and Amino Acid (Micronutrients). Available on the internet at www.nap.edu.

Garces, R. and M. Mancha (1993). One-step lipid extraction and fatty acid methyl esters preparation from fresh plant tissues. Analytical Biochemistry. 211: 139–143.

Ganguly, R., P. Dwivedi and R. P. Singh (2007). Production of lactic acid with luffa sponge immobilized *Rhizopus oryzae* RBU2-10. Bioresource Technology. 98: 1246-1251.

Hidvegi, M. and R. Lasztity (2002). Phytic acid content of cereals and legumes and interaction with proteins. Periodica polytechnica Ser. Chem. Eng. 46: 59–64.

International Food Policy Research Institute, (1997). Food Gap Widening in Developing Countries- One in Four Children Worldwide Will be Malnourished in 2020.

Ishida, H., H. Suzuno, N. Sugiyama, S. Innami, T. Todokoro and A. Maekawa, 2000. Nutritional evaluation of chemical component of leaves stalks and stems of sweet potatoes (*Ipomoea batatas* poir).Food Chemistry. 68: 359-367.

Kepler, M., G.W. Libal and R.C. Wahlstrom (1982). Sunflower seeds as a fat source in sow gestation and lactation diets. Journal of Animal Science. 55:1082-1086.

Lin, M. J. Y., E. S. Humbert and F. W. Sosulski (1974). Certain functional properties of sunflower meal products. Journal of Food Science, 39: 368–370.

McDonald, P., R. A. Edwards, F. D. Greenhalgh and C. A. Morgan (1995). Animal Nutrition. 5th ed. Publishers: Prentice Hall, London, pp: 101-122.

Neto, V. Q., N. Narain, J. B. Silvia and P. S. Bora (2001). Functional properties of raw and heat-processed cashew nut (*Anacardium occidentale* L.) kernel protein isolate. Die Nahrung, 45: 258–262.

Nieman, D. C., D. E. Butterworth and C. N. Nieman (1992). Nutrition, WmC. Brown Publishers. Dubugye, USA, pp: 237-312.

NRC, (2001). Nutrient Requirements of Dairy Cattle (Seventh Revised Edition). National Academy Press, Washington D.C., USA, 298.

Oboh, G., A.A. Akindahunsi and A.A. Oshodi, 2003. Dynamics of phytate-zinc balance of fungi fermented cassava products (gari and flour). Plant Foods for Human Nutrition, 58: 1-7.

Oboh, G. and A.A. Akindahunsi, 2003. Biochemical changes in cassava products (flour and gari) subjected to *Saccharomyces cerevisiae* solid media fermentation. Food Chemistry, 82: 599-602.

Ogunsipe, M. H. (2000). Proximate composition and functional attributes of differently processed Soybean and Mucuna flour. M. Sc. Agric. Tech. The Federal University of Technology, Akure, Nigeria.

Ojeh, O. (1981). Effects of refining on the physical and chemical properties of cashew kernel oil. J. Fats Oils Technology, 1: 513–517.

Okezie, B. O. and A. B. Bello (1988). Physico-chemical and functional properties of winged bean flour and isolate compared with soy isolate. Journal of Food Science, 43: 450–454.

Onyeike, E. N. and G. N. Acheru (2002). Chemical composition of selected Nigerian oil seeds and physiochemical properties of oil extracts. Food Chemistry, 77: 431–437.

Osman, M. A. (2007). Effect of Different Processing Methods, on Nutrient Composition, Antinutrional Factors, and in-vitro Protein Digestibility of Dolichos Lablab Bean [*Lablab purpuresus* (L) Sweet] Pakistan Journal of Nutrition, 6: 299-303.

Pearson, D. (1976). The Chemical Analysis of Food. Eddinburgh: Scheckwahtong Printing Press, Churchill Livingstone.

Pearson, D. A. (1982). The chemical analysis of food. Eddinburgh: Scheckwahtong Printing Press, Churchill Livingstone.

Pritchard, J. L. R. (1991). Analysis and properties of oil seeds. In J. B. Rossel & J. I. R. Pritchard (Eds.), Analysis of oil seeds, fats and fatty foods (pp. 305–308). Oxford: Elsevier Science.

Ranganna, S. C. (1995). Handbook of analysis and quality control for fruit and vegetable products (2nd ed., pp. 9–52).Tata Mc. Graw-Hill Pup. Co. Ltd., New Delhi.

Reiser, R. (1973). Saturated fat in the diet and serum cholesterol concentration. A critical examination of the literature. American Journal of Clinic and Nutrition, 26: 524-529.

Ritter, K. S. (1990). Cholesterol and insects. Food Insects Newsletter, 3: 1-8.

Saeed, A. and M. Iqbal (2006). Immobilization of blue green microalgae on loofa sponge to biosorb cadmium in repeated shake flask batch and continuous flow fixed bed column reactor system. World Journal of Microbiology and Biotechnology, 22: 775-782.

Shills, M. E. G. and V. R. Young (1988). Modern nutrition in health and disease. In Nutrition, D. C. Neiman, D. E., Buthepodorth and C. N. Nieman (ed), WmC. Brown Publishers Dubugue, USA, pp: 276-282.

Siddhuraju, P., K. Becker and H. P. S. Makkar (2001). Chemical composition, protein fractionation, essential amino acid potential and anti-metabolic constituents of an unconventional legume, Gila bean (Entada phaseoloides Merrill) seed kernel. Journal of the Science of Food and Agriculture, 82: 192–202.

Sosulski, F. W. (1962). The centrifuge method for determining flour absorption in hard red spring wheat's. Cereal Chemistry, 39: 344 350.

Sosulski, F. W., E. S. Humbert, K. Bui and J. D. Jones (1976). Functional properties of rapeseed flours, concentrates and isolates. Journal of Food Science, 41: 1349–1352.

Sudheer, K. M., R. B. Sridhar, B. S. Kiran, P. M. Bhilegaonkar, A. Shirwaikar and M. K. Unnikrishnan (2004). Antiinflammatory and antiulcer activities of phytic acid in rats. Indian Journal of Expermental Biology, 42:179-185.

Sujak, A., A. Kotlarz and W. Strobel (2006). Compositional and nutritional evaluation of several lupin seeds. Food Chemistry, 98: 711-719.

Thompson, D. B. and J. W. Jr. Erdman (1982). Phytic acid determination in Soybeans. Journal of Food Science, 47: 513–517.

Vasconcelos, I. M., E. A. Siebra, A. A. B. Maia, R. A. Moreina, A. F. Neto, G. J. A., Campelo (1997). Composition, toxic and antinutritional factors of newly developed cultivars of Brazilian soybean (Glycine max.) Journal of the Science of Food and Agriculture, 75: 419–426.

Vinay, B. J. and T. C. S. Kanya (2008). Effect of detoxification on the functional and nutritional quality of proteins of karanja seeds meal. Food Chemistry, 106: 77–84.

Wathelet, B. (1999). Nutritional analysis for proteins and amino acids in beans (*Phaseolus* sp.). Biotechnology, Agronomy, Society and Environmental, 3: 197-200.

WHO/FAO, (1973). Report: In: Energy and Protein Requirements. Geneva: World Health Organization; WHO Technical Report Series, No, 522.

WHO/ FAO, (1991). Report: Protein quality evaluation. Rome: FAO, Food and Nutrition paper; 51.

Yoshimura, M., H. Takahashi and T. Nakanishi (1991). Role of sodium, potassium, calcium, magnesium on blood pressure regulation and antihypertensive dietary therapy. Japanese Journal of Nutrition, 49: 53-62.

Yusuf, A. A., B. M. Mofio and A. B. Ahmed (2007). Nutrient Contents of Pride of Barbados (*Caesalpinia pulcherrima* Linn.) Seeds, Pakistan Journal of Nutrition 6: 117-121.

تقييم مدي صلاحية بذور اللوف المنزرعة في شمال مصرللأكل
١ – التركيب الكيميائي و خواص الزيت والخواص الوظيفية للبروتين

محمد عبد الرءوف قريش
قسم الصناعات الغذائية – كلية الزراعة – جامعة كفر الشيخ – مصر

الملخص العربي

هدفت الدراسة إلي تقييم كل من الخواص الكيماوية والتغذوية و الوظائفية لمكونات بذور اللوف المنزرعة في شمال مصر لمعرفة مدي إمكانية الإستفادة منها في مجال تغذية الإنسان. أوضحت الدراسة أن بذور اللوف تحتوي علي نسبة عالية من كل من البروتين ٣٩.١٥ % والليبيدات ٤٠.١٩ % كما تحتوي علي قدر مناسب من العناصر المعدنية المهمة غذائيا إلا أنها تعتبر فقيرة في كل من الكربوهيدرات ١٢.٣٩ % والألياف الغذائية ٢.٦١ %. كما أن دراسة الخواص الفيزيوكيميائية للزيت المستخلص من البذور أوضحت أن جميع القيم المتحصل عليها تقع في مدي الزيوت المرغوبة غذائيا كما تميز الزيت الناتج بإحتوائة علي نسبة عالية من الأحماض الدهنية الغير مشبعة ٧٨.٤% المفضلة غذائيا. كما أن دراسة الخواص الوظيفية لدقيق البذور اوضحت أنة يمكن إستخدامة في العديد من المنتجات الغذائية . كما أن دراسة الخواص التغذوية أوضحت أن بروتينات البذور تحتوي علي جميع الأحماض الأمينية الأساسية بنسبة أعلي من الموصي بها غذائيا من قبل كل من منظمة الأغذية والزراعة ومنظمة الصحة العالمية لتغذية البالغين فيما عدا الأحماض الأمينية الكبريتية.

من ذلك نجد أن هذه البذور تبشر بمصدر جديد غير تقليدي لكل من الزيت و البروتين ذات الخواص الجيدة تغذويا مما يسمح باستخدامها في مجال التغذية البشرية .