ISSN : 0974 - 7508 Volume 12 Issue 1

Natural Products

An Indian Journal

Full Paper

NPAIJ, 12(1), 2016 [001-007]

Proximate composition and nutritive evaluation of *helianthus annuus*(sunflower seed)

C.Enyeribe, J.Obadahun, O.B.Agho, A.I.Okele*,

[1]Department of Science Laboratory Technology, Nigerian Institute of Leather and Science Technology, (NILEST) P. M.B 1034 Zaria, (NIGERIAN)

E-mail: Walislove4real@yahoo.com

ABSTRACT

The continuous increase in population growth, inadequate supply of protein and a harsh economic situation has led to malnutrition among people in developing countries including Nigeria. Therefore, information on new sources of food will be of value in dealing with the problem. Proximate and chemical composition of pulverized Helianthus annuus seeds has been determined. The dried matured seeds were obtained from Institute for Agricultural Research, (IAR) Ahmadu Bello University Samaru, Zaria. The methods of AOAC (1980) and Dutcher, et al; (1951) were used in this work. The extraction of the Helianthus annuus oil was extracted using n-hexane at 60ºC using 30g of the pulverized Helianthus annuus seeds. Results from the analyses show that carbohydrate (39.40%), protein (28.28%) and lipid (19.80%) are the major nutrients. Other which were present in lower percentages or minor constituents include moisture (5.03%), ash (4.02%) and crude fibre (3.50%). Results from chemical characterization of the oil showed saponification value of 184.12 mgKOH/g, acid value of 5.89 mgKOH/g, iodine value of 127.75 g/100g oil and peroxide value of 1.61 meq/ Kg oil. Thus from this findings Helianthus annuus seeds can be adopted in both human and animal nutrients diets as a supplement.

KEYWORDS

Helianthus annuus seed;
Nutritive potentials;
Chemical composition.

INTRODUCTION

The quality of food is based on the natural composition, that is, the balance between the nutrient and the anti- nutrient composition. The need for analysis is as a result of lack of data the chemical composition of most food and the effect this has on its value to the consumer. Proximate composition is a partitioning of the composition in food into six categories based on the compounds. The proximate composition was developed to provide a top level and very broad classification of food components. The analysis consist of the analytical determination of moisture, ash, crude fat (ether extract), crude protein and crude fibre. Nitrogen- free extract (NFE) is more or less representing sugars and starches; it is calculated by difference rather than measured by analysis. The saponification value is a measure of alkali required to saponify a definite weight of fat. The saponification value is an indication of the av-

Full Paper

erage molecular weight of fat. The term is often used to describe the hydrolysis of any ester by an alkali[1]. Fats may contain a proportion of free fatty acid, especially after deterioration has started and the acid value is a measure of these. Thus, acid value is a measure of total acidity of the lipid, involving contribution from all the constituent fatty acids that make up the glyceride molecule. It was further shown that better information on the acidity of glycerides should be obtained from the acid value, which takes into account the contribution of all the constituent fatty acid in the oil or fat, and that this parameter is the preferred quality control parameter used by paint manufacturers to monitor the concentration of acids in resins[2][3]. The generally accepted method of expressing the degree of carbon to carbon unsaturation of a fat, oil or derivative is as iodine value[4]. Fat dissolved in chloroform will react and take up iodine if it has any double or unsaturated bond in it. Since all the double bond will take up iodine, this uptake is an indication of the degree of unsaturation of the fat. The iodine value is defined as the grams of iodine that add to 100g fat[5]The peroxide value is an indication of the presence or absence of rancidity in the oil. The term, rancidity is used to describe development of objectionable flavours and odours[6].

METHODOLOGY

Sample collection and preparation

Sample were collected from Institute for Agricultural Research, (IAR) Ahmadu Bello University Samaru, Zaria and the seeds were identified at the Herbarium section, Department of Biological sciences, Ahmadu Bello University Samaru, Zaria. The seeds were cleaned thoroughly, and all foreign matter were removed seeds was then wrapped in a polythene bag. The analyses were carried out at Nigerian Institute of Leather and Science Technology (NILEST),Samaru, Zaria. The *Helianthus annuus* seeds were dehulled manually, cleaned and stored in glass sample bottles in a refrigerator until required for analysis.

Extraction of *Helianthus annuus* Oil

30g of the debarked *Helianthus annuus* seeds was grinded manually using a laboratory pestle and mortar which was then wrapped on a thimble and placed into the soxhlet extractor using 300-cm^3 of hexane as solvent for the extraction at 60°C. The extraction was run for 6 hours and the solvent was recovered using a rotary evaporator.

Chemical characterization of *helianthus annuus* oil

Determination of saponification value (A.O.A.C, 1980)

2g of the oil was weighed into a 250cm^3 conical flask and 25cm^3 of freshly prepared 0.5M ethanolic-potassium hydroxide solution was added, the conical flask was attached to a reflux condenser and heated on a water-bath for 1 hour with frequent sharking. 1cm^3 of 1% phenolphthalein solution was added and the hot excess alkali was titrated with 0.5M hydrochloric acid. A blank titration was carried out also.

Calculation

$$\text{SAPONIFICATION VALUE} = \frac{(B - A) \times 28.05}{\text{weight of sample}}$$

Where; A = volume of HCl required for sample; B = volume of HCl required for blank.

Determination of acid value (A.0.A.C,1980)

2g of the oil sample was weighed into a 250cm^3 conical flask. 50cm^3 of solvent mixture (1:1) of 95% ethanol and diethyl ether were added and the solution was titrated with 0.1M potassium hydroxide using 1cm^3 1% phenolphthalein solution as indicator until pick colouration persisted.

Calculation

$$\text{ACID VALUE} = \frac{\text{Titre (ml)} \times 5.61}{\text{Weight of sample used}}$$

Determination of iodine value (A.O.A.C, 1980)

2g of the oil was weighed into a 250cm^3 conical flask. 10cm^3 of carbon tetrachloride was added to dissolve the oil.20cm^3 of wij's solution was added and the content of the flask allowed to stand in the dark for 30 minutes, after which 15cm^3 of 10% KI solution and 100cm^3 of water were added. The solution was titrated with 0.1 M sodium thiosulphate

Full Paper

solution using starch as an indicator. A blank titration was carried out using 10 cm^3 of carbon tetrachloride.

Calculation

$$\text{IODINE VALUE} = \frac{(B - A) \times 1.269}{\text{Weight of sample used}}$$

Where; A = volume of sodium thiosulphate required for sample; B = volume of sodium thiosulphate required for blank.

Determination of peroxide value (A.O.A.C.,1980)

0.5g of the oil was weighed into 250cm^3 conical flask. 10cm^3 of chloroform and 15 cm^3 of acetic acid were added and the mixture stirred after which 1cm^3 of (10 % w/v) potassium iodide was added. The flask was stoppered and shaken for one minute. The flask was placed in the dark for five minutes and 75cm^3 of water was added. The iodine liberated was titrated with standard thiosulphate solution until yellow colour is almost gone, 0.5cm^3 of starch (1%) solution was added and the titration continued until blue colour disappeared. Blank determination was carried out.

Calculation

$$\text{Peroxide value} = \frac{(\text{meq / Kg oil}) = (V0 - V1) \times C}{\text{Weight of sample}}$$

Where; V_0 = volume of sodium thiosulphate required for blank; V_1 = volume of sodium thiosulphate required for sample; C = concentration of sodium thiosulphate.

Proximate analysis

Determination of moisture content of the seeds (A.O.A.C., 1980)

The crucible was dried in an oven at 80°C for 20 minutes, cooled in a dessicator and Weighed (w_1)g. 5g of sample was placed in the crucible and reweighed (w_2)g, the crucible with the sample was then dried in the oven at 105°C until a constant weight was obtained after successive cooling in dessicator and weighing. It was finally transferred from the oven to the dessicator to cool and then quickly weighed (w_3)g.

Calculation

$$\%\ \text{MOISTURE CONTEN} = \frac{W2 - W3 \times 100}{W2 - W1}$$

Determination of ash content of the seeds flour.(A.O.A.C., 1980)

The crucible was dried by holding in the bunsen flame for about two minutes, then transferred into a dessicator to cool before weighing (w_1)g. 2g of the sample was weighed inside the crucible (w_2)g,. The crucible with the sample was then heated gently in a bunsen burner in a fume cupboard until the smoke ceased, transferred to the muffle furnace, preheated at 550°C. The heating continued until all the carbon has been burnt away (usually 24-48 hours). The crucible was taken out with a pair of tong and immediately covered and placed in a dessicator to cool before weighing (w_3)g.

Calculation

$$\%\ \text{ASH CONTENT} = \frac{W3 - W1 \times 100}{W2 - W1}$$

Determination of lipid content (A.O.A.C., 1980)

5g of the powdered dry sample was placed in a thimble of known weight (W_1)g, thimble and sample was weighed as (w_2)g, and placed into a Soxhlet extractor. 300cm^3 of petroleum ether (40-60°C) was used as solvent for the extraction. The gentle heating was done on an electrically controlled heating mantle. The process was allowed to continue for 6 hours before the thimble with the content was removed, dried in an oven at 50°C for 30 minutes, cooled in a dessicator and reweighed (w_3)g. the extracted oil and solvent in the flask was distilled and evaporated on a water-bath until all the solvent evaporated and the oily lipid left in the flask.

Calculation

$$\%\ \text{LIPID} = \frac{W2 - W3 \times 100}{W2 - W1}$$

Determination of crude protein (kjeldahl method, A.O.A.C., 1980)

2g of the dry sample was weighed into a clean dry 100cm^3 Kjeldahl flask (5g of mixed catalyst consisting of K_2SO_4 and $CuSO_4.5H_2O$ 10:1 respectively and properly mixed) 30cm^3 of conc.H_2SO_4 was

Full Paper

added and a few chips of pumice stone. The mixture was carefully digested over an electric heater in the hood initially with low flame until fretting subsided and at a higher temperature until contents was clear greenish in appearance. The digestion was continued for further 60 minutes. After cooling, the solution was transferred into 100cm^3 volumetric flask and diluted to mark with distilled water. 10 cm^3 aliquot of the diluted solution or digest was pipetted into Markham semi-macro nitrogen still and 10cm^3 of 4% sodium hydroxide solution added. The solution was distilled and the liberated ammonia was trapped in a 100cm^3 conical flask containing 10cm^3 of 40% boric acid and 2 drops of methyl red indicator was added. Distillation was continued until the pink colour of the indicator turned greenish. The content of the conical flask was titrated with 0.1M hydrochloric acid, with end point indicated by a change from greenish to pink colour. The volume of the acid used for the distillate as well as the blank was recorded.

Calculation

$$\%N = \frac{V1 - V2 \times M \times 14 \times 100 \times 100}{2 \times 1000 \times 10 \times 1}$$

Where; V_0 = volume of hydrochloric acid required for blank; V_1 = volume of hydrochloric acid required for 10cm^3 sample solution; M = molarity of hydrochloric acid; 14= atomic weight of nitrogen; 100 = total volume of digest; 100 = percentage conversion; 10 = volume of distillate; 2 = weight of sample taken in grams; 1000 = conversion to dm^3

The crude protein was calculated as: 6.25 x %N

Determination of crude fibre of the flour (A.O.A.C.,1980)

2g of the dried fat – free sample was weighed into a 500cm^3 of round bottom flask. 200cm^3 of boiling H_2SO_4 was added and a condenser fitted and brought to boiling within one minute. The boiling continued gently for 30 minutes. Distilled water was used to maintain the volume at 600cm^3 while boiling and to wash down particles adhering to the sides of the flask. The mixture was filtered through a Whatman [1]1 ashless paper in a Buchner funnel using suction pump and residue washed well with distilled water. The residue was then transferred back into the flask and 200cm^3 of boiling NaOH solution was added. The reflux condenser was replaced and mixture brought to boiling within one minute. After boiling for 30 minutes it was filtered through porous crucible and washed with boiling distilled water, 1% HCl and then again with boiling water, it was washed twice with ethanol and ether. The final residue was dried over night at 100°C. The dried residue was ashed in a crucible at 550°C in the muffle furnace for 3 hours. After cooling in a dessicator the ash was weighed. The weight of fiber was calculated by difference.

Calculation

$$\%\ \text{crude fiber} = \frac{b - c \times 100}{a}$$

Weigh of sample used =a_g

Weight of crucible plus dried sample = b_g

Weight of crucible after ashing = c_g

Determination of carbohydrate (Dutcher et' al, 1951)

The method of Dutcher et' al, (1951) was used where the total amount of carbohydrate in the sample was obtained by calculation using percentage weight difference. This involved subtracting the percentage sum of the food nutrients, % crude protein, % crude lipid, % crude fibre, and % ash from 100% dry weight.

Percentage carbohydrate was calculated using equation below:

Carbohydrate % = 100 – (crude protein + crude lipid + crude fibre + ash).

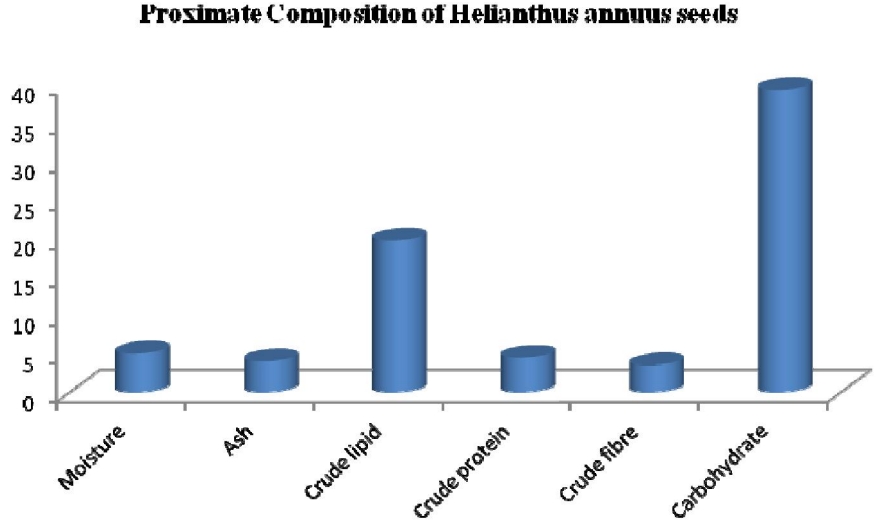
DISUSSION

The saponification value of 184mgKOH/g oil is comparable with values reported in literature for African oil bean (189.85 mgKOH/g oil[8],Cotton seed oil (189-198mgKOH/g oil), but lower than those for coconut oil (248-265mgKOH/g oil;[9]. The value is however higher than 15.68 mgKOH/g,91.28mgKOH/g and 168 mgKOH/g reported for African star-apple, velvet tamarind and paprika seeds oil respectively[10]. The total acidity expressed as acid value

Full Paper

was 5.89 mgKOH/g oil. This value is higher than the reported values of 1.96 mgKOH/g oil of afzelia Africana seed oil 3.36 mgKOH/g oil African pear, 2.96 mgKOH/g oil paprika seed oil but lower than 35.46 mgKOH/g oil African star apple, 13.40 mgKOH/g oil horse eye bean and 14 mgKOH/g oil velvet tamarind[11]. The iodine value 127.75g/100g placed the oil as a stable, non- drying oil. As shown by the relative value less than 150g/100g. And this would suggest better oil stability and longer shelf life[12] which makes it useful industrial oil. The peroxide value is a chemical indicator of how much of the oil is in the early stage of oxidation and reflects the degree of oxidation[13]. The peroxide value 1.61meq/kg oil falls within the stipulated permitted maximum level of not more than 10 meq/kg oil e.g soybean, cotton seed and coconut oils[9] Figure 1 shows the proximate composition of *Helianthus annuus* seeds. The moisture content of 5.03%. This result compare so favourable with *cassia floribunda* 4.4% and *canavaliaensiformis*, 3.8 – 9.2%. The moisture content of *Helianthus annuus* seeds remains an asset in the storage and preservation of the nutrients. observed that higher moisture could lead to food spoilage through increased microbial action. The ash content of 4.02% (Figure 1) observed is within the 3.0 – 5.8% of the wild Jack bean And also compares well with melon seeds 4.3%[13] *Vignasublobata* 4.2%, *Vigna radiate* 4.4% and castor seeds 3.2%[3]. The value of ash content is indicative of the presence of nutritional important mineral elements in *Helianthus annuus*seeds. Crude lipid accounts for 19.80% of the whole seed flour. This value indicates the high oil content of *Helianthus annuus* seeds and it is comparable with other oil seeds such as cotton seeds and groundnut. The crude protein content of the seed flour is 28.25% (Figure 1). This value suggests that *Helianthus annuus* seeds can contribute to the daily protein need of 23.6 g for adults as recommended by the[14]. This result is comparable with selected legumes such as African locust bean 27.0%, wild jack bean 27.8-35.0%, velvet bean 31.4%. Genetic factors most likely explain these differences. However, environmental factors such as the place where the seeds grew, maturity of the seeds at time of harvest and fertilization conditions, might have played a role in the differences[15]. Noted that large genotypic variability for seed protein content is encouraging when looking for genetic improvement. The crude fibre content of the seed flour 3.50%. The fibre composition is determined because of the recent interest in the potential role of dietary fibre in human nutrition. Fibre helps to maintain the health of the gastrointestinal tract but in excess may bind trace element, leading to deficiencies of iron and zinc[16]. Carbohydrate, as nitrogen free extract (NFE) calculated by difference, accounted for 39.40% of the dehulled seed. The carbohydrate content suggests that the seeds could be good supplement to scarce grains as sources of energy and feed formulations. The nitrogen- free extract compares well with the range of 34.6-37.4% of different varieties of sesbaniaseeds[17].

RESULTS



Full Paper

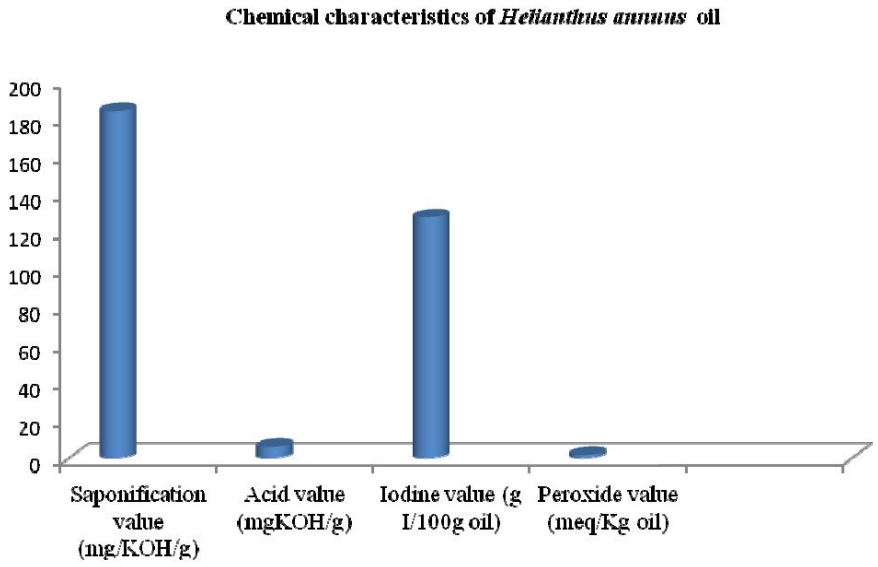


Figure 1

CONCLUSION

The parameters assayed are the proximate composition of the seed flour and the chemical characteristics of the oil. Result from the study revealed that the seeds of *Helianthus annuus* are rich in crude protein (28.25%), carbohydrate (39.40%), crude lipid (19.80%) crude fibre (3.50%) ash content (4.02%) and moisture content (5.03%). The value of the crude lipid is high; therefore the seeds should be given attention as a potential oil seed. The carbohydrate content suggests that the seeds could be good supplement to scarce grains as sources of energy and feed formulations. The crude fibre content provides a good indication of nutritive value of the food material. The ash content shows that the seed flour contains a good amount of minerals. The chemical characteristics show that the saponification value (184.12 mgKOH/g oil), acid value (5.89 mgKOH/g oil), iodine value (127.75 Ig / 100g oil), peroxide value (1.61 meq/Kg oil) are comparable with other reported values of oils from plant seeds. Thus, from these findings *Helianthusannuus*seeds can be adopted as a supplement in both human and animal diets.

RECOMMENDATION

A further study on location effects among this plant grown in different states of the country is recommended with the view of looking for genetic improvement.

REFERENCES

[1] F.D.Snell, L.S.Ettre; Encyclopedia of industrial chemical analysis interscience publishers New York, 259-264 **(1971)**.

[2] O.D.Ekpa, U.J.Ekpe; The effect of coconut oil concentration and air exposure to the total acidity of palm oil, Global Journal of Pure and Applied Sciences, **2,** 51-58 **(1995)**.

[3] E.N.Onyeike, G.N.Acheru; Chemical composition of selected nigerian oil seeds and physiochemical properties of the oil extracts, Food Chemistry, **7**, 431-437 **(2002)**.

[4] Y.Pomeranz, C.E.Meloan; Food analysis: Theory and practice, The avi publisher company inc, Westport Connecticut, USA, 578-591 **(1971)**.

[5] R.R.Allen; Determination of unsaturation, Journal of American Oil Chemists Society, **32**, 671-674 **(1955)**.

[6] Y.Pomeranz, J.A.Shellenberger; The significance of fatty acids in cereal, American Miller Processor, **6**, 9-11 **(1966)**.

[7] R.A.Dutcher, C.O.Jensen, P.M.Althouse; Introduction of agricultural biochemistry, John Wiley and Sons Inc, New York, 269-282 **(1951)**.

[8] Codex alimentarius commission, Recommended internal standards of edible fats and oils, 11 FAO/ WHO: Rome, **(1982)**.

[9] V.I.E.Ajiwe, C.A.Okeke, U.Agbo, G.A.Ogunleye, S.C.Ekwuzor; Extraction, Characterization and industrial uses of velvet-tamarind and nickernut seeds oils, Bioresource Technology, **57**, 121-125 **(1996)**.

[10] M.U.Akpuaka, E.Nwankwor; Extraction, Analysis and Utilization of Drying Oil from Tatracarpidiumconophorum, Bioresource Technology, **73**, 195-196 **(2000)**.

[11] O.M.Meestri, D.O.Labuckas, A.L.Lamarque, J.A.Zygadlo, N.R.Grosso; Proximate composition and seed lipid components of sorghum cultivars from argentina, Journal of Science Food Chemistry, **70**, 334-336 **(1996)**.

[12] N.Siriwardhana, K.E.Lee, S.H.Kim, J.H.Ha, J.T.Park, Y.J.Jeon; Lipid peroxidation inhibitory effect of (hizikiafusiformis), Methanolic extract on fish oil and linoleic acid, Journal of Food Science and Technology, **2**, 67-72 **(2004)**.

[13] B.O.Omavufbe, O.S.Falade, B.A.Osuntogun, S.R.A.Adewusi; Chemical and biochemical changes in africa locust bean(parkiabiglibosa) and melon (citrullusvilgaris) seeds during fermentation to condiments, **(2004)**.

[14] National research council; Recommended daily dietary allowance, Nutritional Review, **12**, 373-375 **(1974)**.

[15] A.Idouraine, E.A.Kohhepp, C.W.Weber; Nutrient constituent from eight lines of naked seed squash (cucurbitapepal), Journal of Agricultural Food Chemistry, **44**, 721-724 **(1996)**.

[16] P.Shiddhuraju, K.Vijayakrimari, K.Janardhanan; Chemical composition and nutritional evaluation of an underexploited legume (acacia nilotica), Food Chemistry, **53**, 385-391 **(1996)**.

[17] M.A.Hossain, A.Becker; Nutritive value and antinutritional factors in different varieties of sesbania seeds and their morphological fractions, Food Chemistry, **73**, 421-431 **(2001)**.