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STUDIES ON THE POTENTIALS OF MANGO *(Magniferaindica)* SEED OIL AS RAW MATERIAL FOR THE PRODUCTION OF SOAP

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ABSTRACT

The seed oil of mango *(Magniferaindica)*was extracted by soxhlet extraction method using n-hexane as solvent and its chemical and physical properties were evaluated. The chemical parameters investigated include: saponification value (SV), iodine value (IV), peroxide value (PV) and Acid value (%AV). These were found to be85.3∓0.05mgKOH/g, 39.5∓0.10g I2/100gand 4.4mEq/kg and 2.4∓0.01mgKOH/g, respectively. The physical parameters evaluated include: percentage yield (10.21%), relative density (0.87), refractive index (1.4784) and moisture content (12.5%). Soap was then formulated using the oil and the properties of the product were evaluated. From the results, it was found that the products compared favorably to similar products sold in the market in terms of pH, colour, percentage alkali and solubility in water.

Keyword: Oil, Extraction, Chemical, Physical, Parameters, Evaluation

INTRODUCTION

The mango is a very common fruit usually found in southern Asia, especially in Eastern Indian, China, Burma, Andaman

Island and Central America (Palaniswamy*et al.,* 1974). Mangoes belong to the genus Mangifera consisting of numerous species of tropical fruits tress that are commonly known as Mangoes. Mangoes belong to the species *mangiferaindica* (Nzikou*et al.,* 2010). Mango trees (MangiferaIndica) reach 35-40m in height with a crown radius of 10m and 6-16cm broadly; when the leaves are young are orange-pink, rapidly changing to a dark glossy red then dark green when ripe depending on the cultivar. When ripe the unpeeled fruit gives a distinctive resinous sweet smell. In its centre is a single flat oblong seed that can be fibrous or hairy on the surface, depending on the cultivar (singh*et al.,* 2002).

Ripe mangoes are processed into frozen mango products, canned products dehydrated products and ready-to-serve beverages (Ramteks and Eipeson, 1997). After consumption or industrial processing of the fruits, considerable amounts of mango seeds are discarded as waste. Mango accounts for about 35%-55% of fruit (Bhalerau*et al.,*1989), depending on the variety, Actual figures on the quantity of mango waste generated commercially are not readily available. Therefore, the utilization of mango by-product especially mango seed may be an economical way of reducing the problem of waste disposal from mango production (Barreto*et al.,*2008).

Therefore, the utilization of mango by-product especially mango seed may be an economical way of reducing the problem of waste disposal from mango production (Barreto*et al.,*2008). Mango seed is a single flat oblong seed that can be fibrous or hairy on the surface, depending on the cultivar. Inside the seed coat 1-2mm thick is thin, lining covering a single embryo, 4-7cm long, 3-4cm wide and 1cm thick. Mango seed consist of

different varieties of mango ranges from 9% to 23% of fruit weight (Palansiwamy*et al.*, 1974) and the kernel content of the seed ranges from 45.7% to 72.8% (Hermavathy*et al.*, 1988). Mango kernel contains several oil, ash, crude fiber and carbohydrates. Variation in characteristics yield may be due to the difference in variety of plants, cultivation climate, ripening stage, the harvesting time of the seed kernels and the extraction method. Mango kernel contain almost 15wt% of oils (Nzikou*et. al.*, 2010)

Mango kernel oil has been used in cosmetics industry as ingredients in making, shampoos, and lotions because it is a good source of phenolic compounds (Soong and Barlow, 2004) including micro elements like copper and zinc (Schiber*et. al*, 2003). The main fatty acids found mango kernel oil are about 45% oleic acid and 38% steric acid, essential in human nutrition and helps reducing triglycerides, LDL-cholesterol, total cholesterol and glycemic index. Also, the increase in stability over oxidation of vegetable oil is attributed to oleic acid (Abdulkarim*et. al.*, 2007). Steric acid, a long C18 straight-chain saturated fatty acid, has been found to bond and plasticized composites (Netravali, 2003), human serum albumin (Bhattacharya *et. al.*, 2000) and helical sites in bio-molecules (Vila *et. al.*, 1998). Fatty acid is important as nutritional substances and metabolites in living organisms. Many kinds of fatty acids play an important role in the regulation of a variety of physiological and biological functions (Zhao *et. al.*, 2007). In addition, the extract of mango seed exhibited the highest degree of free-radical scavenging and tyrosinase-inhibition activities compared with methyl gallate and phenolic compounds from the mango seed kernel and

methyl gallate in emulsion affected the stability of the cosmetic emulsion systems (Akintayo*et al.,* 2002).

The term oil is used in generic sense to describe all substances that are greasy or oily fluids at room temperature. They are non-volatile and are insoluble in water but are soluble in organic solvents. Oils from seeds or kernels or nuts along with proteins and carbohydrates, constitute the majority of foodstuffs. They are also found in wide industrial applications, like formulation of soap, toiletries, paints, varnishes, bio-diesels and lubricant (manji*et al,* 2013)

Soap is a surfactant used in conjunction with water for washing and cleaning. It usually comes in solid moulded form, termed bars due to its historic and most typical shape. The use of thick liquid soap has also become widespread, especially from dispensers in public washrooms. When applied to a soiled surface, soapy water effectively holds particles in suspension so the whole of it can be rinsed off with clean water. Many soaps are mixtures of sodium (soda-solid soap) or potassium (potash-liquid soap) salts of fatty acids which can be derived from oils or fats by reacting them with an alkali (such as sodium or potassium hydroxides) at 80 - 100°C in a process known as saponification. The fats are hydrolyzed by the base, yielding glycerol and crude soap (manji*et al*, 2013).

Soap when used with water, decreases surface tension loosening unwanted particles, emulsify grease and absorb dirt and grime into foam. Its use has increased over the years until its manufacture has become an industry essential to the comfort and health of civilized societies. It is consumed in large quantities on daily basis for laundry, hair dressing,

personal and hygiene, in homes and commercial cleansing operations. Textile mills also consume considerable quantity of soap in boiling cotton, scouring wool and silk agitation to remove impurities prior to finished operation and to assist the level of application of softening agents used to improve fabric feed. Thus, because of increased demand for cleansing agents, there is need to evaluate and develop raw materials that have good properties for making varieties of such agents. The present work is therefore aimed at investigating the physical and chemical properties of mango seed oil as raw material in the production of soap.

MATERIALS AND METHODS

A. Sample Collection and preparation

Julie Mango seeds were collected from Adamu Aliero farm at Aliero Local government Area of Kebbi State. The kernel was first removed from the shell using a sharp metal object (machete), washed, sun dried for one week (seven days). The kernel was then grinded in an iron pestle and mortar to reduce the particle size to a maximum diameter of 500mm as measured by sieve. The crushed sample was seal in a plastic container and stored until required for further analysis.

B. Oil Extraction.

The oil was extracted using Soxhlet apparatus, 100g of mango kernel flour were placed in cellulose paper cane and placed in a Soxhlet apparatus and extracted using hexane (b.p 40-60^{o}C in a five in one Soxhlet extractor for five (5) hours as reported by Pena *et. al.,* (1992). The oil recovered by evaporating the solvent using rotary evaporator model N-1 (Eyela and TokoyoRikakikal Co. Ltd. Japan) and residue solvent was removed by drying in an oven at 60^{o}C.

C. Physical parameters;

Percentage oil yield

The percentage yield calculated using the relation

$$\% \text{ oil yield} = \frac{\text{Weight of the oil}}{\text{weight of the sample}} \text{X } 100.$$

Refractive index (R.I)

The refractive index of oil is a function of molecular structure and impurity. RI provides a quick and easy method to identify oil and determine its purity (Bailey, 1951; Apple White and Bailey, 1985). Abbey refractometer was used and the refractive index determined as explained by Rossel (1971).

Moisture content (M.C.)

The moisture content of oil is expressed as the percentage weight loss when the oil is dried to a constant weight at 110°C. A dry crucible was weighed and the dried oil (5 g) was poured into it. The crucible and content were dried in an oven at 110°C and cooled indesiccators and weighed. This process was repeated until constant weight was attained. And result calculated using the relation

$$\% \text{ Moisture content} = \frac{\text{W1} - \text{W2}}{\text{W1} - \text{W0}} \text{X } 100$$

Where, W_0 = weight of crucible, W_1 = weight of crucible + oil, W_2 = weight of crucible + moisture.

Relative Density

Relative density describes the density of oil in relation to equal water at a particular temperature. A measuring cylinder used was cleaned thoroughly with sodium hydroxide after which it was rinsed with distilled water to remove impurities. It was later dried with ethylated spirit and weighed as W_1. 10cm^3 of water was poured into a measuring and weighed as

W_2. The same procedure was repeated for oil and the weight was recorded as W_3. The relative density was determined by the use of equation

$$\text{Relative Density} = \frac{M}{V}$$

Where; M= mass of the oil gram, V = volume

D. Chemical parameters

The analysis of chemical properties (Saponification value, Acid value, Iodine value, peroxide value, Free fatty acid and Ash content) were carried out using the methods described by Association of Official Analytical Chemist (2007). All determination was done in triplicates.

Saponification value

Saponification can be described as the alkali hydrolysis of fatty acids ester (triglycerides) by the use of potassium hydroxide to yield glycerol and sodium or potassium of fatty acids.

The saponification value is therefore described as the main molecular weight of the fatty acid present in fat. It measures the amount of alkali required.25cm^3 of ethanolic potassium hydroxide solution was measured into a bottom flask and 2g of the oil sample was dissolved in it. A reflux condenser was attached to the flask and it was heated in a water bath for 1 hour with agitation at intervals, 7cm^3 phenolphthalein solution (1%) was added and was titrated against 0.5M HCl solution to a point where the pink color vanished. A blank titration was done as well. The saponification value was calculated by using equation 2.9, (Saniet *al.*, 20014).

$$\text{Saponification value} = \frac{(B - S)X\ M\ X\ 56.1}{W}$$

S = sample titre value, B = Blank titre value, M = Molarity of HCl, W = weight of oil sample, 56.1 = Molecular weight of KOH.

Acid value;

Is the measure of free fatty acids present in the fat which result from the hydrolysis of triglycerides with base or alkali or water producing free fatty acids and glycerol respectively deterioration of fats containing items is a function of free fatty acid presented, hence its determination

The 5% ethanol was boiled on water bath to expel the dissolved gasses. The solution was then neutralized by adding a few drops of 1% phenolphthalein indicator and 0.1M KOH solution until pale pink color was obtained. 2.0g of the oil sample was weighed in a conical flask and 25cm^3 of hot alcohol was added. The mixture was boiled and allowed to cool. The solution was titrated with 0.1M KOH until the pink color is restored. (Frank *et al.,*1986). Equation 2.7 is used to calculate the acid value

$$\text{Acid Value} = \frac{\text{M X V X 56.1}}{\text{W}}$$

Where;

M = Molarity of KOH, V = Volume of KOH, 56.1 = constant, W = weight of sample

Iodine Value;

Iodine value measures the proportion of unsaturated fatty acid that reacts with hydrogen. It also measures the amount of halogens (iodine) that can be absorbed by the unsaturated fatty acids. It is known that the higher iodine value is expressed as the number of milligram of halogen absorbed

per gram of fat and oil.1.0gram of oil sample was weighed in a conical flask, 5cm^3 hydrochloric acids was added and the mixture was stirred until the oil sample is mixed homogeneously. 25cm^3 of iodine solution was added and the mixture was stirred for 5 minutes after which it was titrated with 0.1M $Na_2S_2O_3$ solution until a pale straw color was obtained. At this point, 1cm^3 of starch indicator was added to give blue-black color. The titration continued until a colorless end point was observed. The same procedure was carried out using all reagents except the oil black titration. The procedure was repeated twice for the oil to obtain the average title value. (Frank *et al.*, 1986). The formula below was used to calculate the iodine value

$$\text{Iodine Value} = \frac{(\text{B} - \text{S})\text{X M } 12.69}{\text{W}}$$

Where;
B= Volume of $Na_2S_2O_3$ for blank titration, S = Volume of $Na_2S_2O_3$ for sample titration, M = molarity of standard sodium thiosulphate, 12.69 = weight of iodine, W = weight of oil sample.

Peroxide value;
Peroxide value can be described as a measure of oxidative characteristics of fat and oil which in turns give rise to a phenomenon called rancidity. Its value is used as an indication for oxidation as that when oxidation takes place, double bond of unsaturated fatty acids breaks to form peroxides (NLR *et al.*, 1992).

Exactly 1.0g of potassium iodide (KI) and 20cm^3 of solvent mixture (glacial acetic acid: chloroform 2:1 v/v) was added to 1.0g of oil sample and the mixture was boiled for one minute. The hot solution was poured into a flask containing 20cm^3 of

5% potassium iodide solution. Few drops of starch solution were added to the mixture and letter titrated with 0.025M $Na_2S_2O_3$ (sodium thiosulphate) solution until there is sudden disappearance of the blue color which signifies the end product. The peroxide value was obtained by the use of the equation below

$$\text{Peroxide Value} = \frac{(\text{S} - \text{B})\ \text{X}\ \text{M}\ \text{X}\ 12.69}{\text{W}}$$

Where; S = vol. of $Na_2S_2O_3$ used for titration, B = vol. of $Na_2S_2O_3$ used for titration with blank, M = Molarity of Sodium thiosulphate, 12.6 = Molarity of iodine, w = weight of oil sample.

E. Soap production

20% of Sodium hydroxide was dissolved in 100 mL of distilled water and 10 mL of the oil was added into the mixture. The mixture was boiled for 50 minutes under controlled heating using heating mantle; high enough to maintain a constant boiling mixture, saturated solution of sodium chloride were then added. The mixture stirred constantly until it becomes pasty. Saponification was completed within 30-40 minutes. The soap was allowed to hardened by air drying for 24hours and was tested forFoam and cleaning, (Warra, 2012).

Foam ability Tests

About 2.0g each of soap (shavings) was added to a 500cm3 measuring cylinder containing 100cm3 of distilled water as reported [Warra, *et al* 2011] for synthetic detergent. The mixture was shaken vigorously so as to generate foams. After shaking for about 2 minutes, the cylinder was allowed to stand for about 10 minutes. The height of the foam in the solution was measured and recorded. The result compare to the produce from seed fat and oil.

pH Determination:

The pH was determined using a pH meter (827 pH lab Model). 10g of the soap shavings was weighed and dissolved in distilled water in a 100cm3 volumetric flask. This was made up to prepare 10% soap solution in line with literature report in Warra, *et al* [2011].The electrode of the pH meter was inserted into the solution. The pH reading was recorded. The steps were repeated using soaps produced from each fat or oil.

RESULT

Table 2; Physical property of mango seed oil

Oil yield (%)	Moisture content(%)	relative density	refractive index
10.21	12.5	0.87	1.48

Table 1; Chemical property of mango seed oil

Sapon. Value (mgKOH/g)	Iodine value ($gI_2/100g$).	Acid value (mgKOH/kg)	Peroxide value (mgEq/kg)
85.3∓0.05	39.5∓0.10	2.4∓0.01	4.4∓0.50

The values are mean of triplicates determinations.

Table3;Physical and chemical characteristics of the mango seed oil soap

pH	Foam Height(cm)	Colour
9.0	1.8	milky

The values are mean of triplicates determinations.

Table 4; pH of various soap samples

Soap sample	pH value
Neem seed oil soap	9.90
Cotton oil soap	9.38
Castor oil based soap	9.70
Egusi seed oil soap	9.88
Mango seed oil soap	**9.00**

The values are mean of triplicates determinations.

Table 5; foam height of various soap sample

Soap samples	Foam height (cm)
Castor oil based soap	1.6
Cotton oil soap	4.5
Egusi seed oil soap	4.8
Neem seed oil soap	2.0
Mango seed oil soap	**1.8**

The values are mean of triplicates determinations.

DISCUCCION

Tables 1 - 5 present the chemical and physical properties of the crude oil and the formulated soap and similar soap products sold in the market. The results of the chemical properties of mango seed oil are shown in (**Table 1**), Saponification value which indicates the molecular weight of triglycerides in the oil and also indicate the quantity of fatty acid present in the oil is 85.3mgKOH/g. This value is lower than178.01±1.25 mgKOH/g in Egusi and 106.30±2.37 mgKOH/g of sweat orange as reported by Abdulhamid *et al*(2014), and higher than 24.13±3.93 mgKOH/g in Papaw (Abdulhamid *et al*,

2014). The values for *Mangiferaindica*ishigh enough to be utilized for soap production.

Iodine value is a measure of the degree of unsaturated fatty acid. Iodine value determine the degree of unsaturation and hence tendency of oil to absorb oxygen. The higher the iodine value, the higher the degree of unsaturation and the higher the degree of adulteration of the oil (Satyanarayana and Chakrapani, 2011). The iodine value which is useful in predicting the drying property of oils was found to be 37.5 and happens to be slightly less than the 39.5 reported by Nzikou*et al.,* 2010. Thus, the value obtained confirms that the seeds produce drying oils (Adelaja, 2006).

The acid value is a good nutritional index because it tells us the degree of acidity of an oil or fat. Oils with low acid value are better in making soap. The higher the acid value the higher the level of fatty acid which translate into decrease oil quality (Atinafu and Bedemo, 2011). From the result obtained the value 4.8mg KOH/g of the oil of mango seed is higher than the acceptable acid values of cooking oil (0.00-3.00mgKOH/g) as reported by Oderinde*et al*,. (2009). Thus this oil has a higher tendency of becoming rancid (Tamzid*et al.,* 2009) and unsafe for human consumption (Satyanarayana and Chakrapani, 2011). High acid value in oil showed that the oil may not be suitable for use in cooking (edibility), but however, be useful for production of paints, liquid soap and shampoos (Akintayo, 1997; Aremu*et al.,* 2006). The peroxide value is also very low4.4∓0.50 mgEq/kg, indicating that the oil would be stable (to a large extent), to oxidative degradation. Rancidity begins to be noticeable when the peroxide value reaches 20 - 40 mgEq/kg (Charles and Guy, 1991).

The physical properties of the mango seed oil are shown in (**Table 2**). The oil yield was found to be 10.21% compare to what is reported in wara (2012), indicating that the oil content is law, a factor that is unfavorable for industrial application of the oil. The moisture content and relative density of the oil are very low, therefore its stability is guaranteed. The oil has light yellow colour. The foam height of the soap formulated was 1.80 cm lower than that of Neem seed oil soap (2.00cm) and thatof Egusi oil soap (4.8cm) and higher than that of castor oil soap(1.6cm), the soap was milky incolour and slightly soluble in distilled water.The pH of the soap and shampoo are 8.92 and 9.0 respectively, these have fallen within tolerable pH range (6.5 - 9.4) (Poucher, 1984)

CONCLUTION

From the results obtained after the analysis of the oil it can be concluded that the selected oil is utilizable for soap making thought the oil yield is law, therefore different solvent and method is recommended to increase the oil yield. The properties exhibited by the soap solution indicated its suitability for commercial production. Also Toxicity and Pharmacological study of the oil should be carried out to explore its potential medicinal properties.

REFERENCES

Abdulkarim, S.M., Long, K., Muhammad, S.K.S. and Ghazali, H.M. 2007. Frying quality and stability of high-oleic *Moringaoleifera* seed oil in comparison with other vegetable oils. Food Chemistry 105: 1382-1389.

Abdulhamid Abubakar, Sani Ibrahim, Fakai I. Musa (2014) Physicochemical Analysis of Soxhlet Extracted Oils from Selected Northern Nigerian Seeds. International

Journal of Biological, Bimolecular, Agricultural, Food and Biotechnological Engineering Vol:8, No:11, 2014

Adebisi, G.A.(2009). The Physico-chemical properties of seed oil of shea nut (*Vitellariaparadoxa*), Wild Custard Apple (*Annonasenegalensis*) and Cam wood(*Baphianitida*). *Nig. J. of Sci. and Tech. Research (NISJOSTER*), 3(2):6-10

Adelaja, J.O. (2006), Evaluation of mineral constituents and Physico-chemical properties of some oil seed. M.Sc. Industrial Chemistry, University of Ibadan, Ibadan.

Akintayo, O., Adebayo, E.A. and Arogundade, L.A.(2002). Chemical composition, physical and functional properties of Akee(*B. Sapid*) pulp and seed flours. *Food Chemistry* 77:333-336.

Akpan U.G, Jimoh A, Muhammed (2006). Extraction, Characterization and Modification of Castor Seed Oil Leonardo Journal of Sciences. Issue 8;43-52.

Amadi B. A. Nwachukwu M.J and Agomuo F.N. (2007). Extraction and Characterization of Vegetable Oil from Avocado Pear(Perseaamericana). *International Journal of Tropical Agriculture and Food Systems*, 1(4):352-354.

AOAC 1990.Association of Official Analytical Chemists, Official methods of Analysis, 15th edition, Washington D.C. USA.

Aremu M.O., Olonisakin A., Bako D. A. and Madu P. C.(2006). Compositional studies and physico-chemical characteristics of cashew nut (Anarcadiumocidentale) flour. *Pakistan Journal of Nutrition* 5(4):328-333.

Atinafu D.G, Bedemo B. (2011) Estimation of Total Free Fatty Acid and Cholesterol Content in Some Commercial Edible Oils. Ethiopia Bahir, Journal of Cereals and Oil Seeds 2(6);71-76.

Barreto JC, Trevisan MT, Hull WE (2008). Characterization and quantitation of Polyphenolic compounds in bark, kernel, leaves, and peel of mango (*Mangiferaindica L.*).*J. Agric. Food Chem.* 56(14):5599-5610.

Bailey AE (1951). Industrial Oil and Fats Products, Science Publishers incorporated, pp. 220-235.

Bhattacharya, A.A., Grune, T. and Curry, S. 2000. Crystallographic analysis reveals common modes of binding of medium and long-chain fatty acids to human serum albumin. Journal of Molecular Biology 303: 721–732.

Hassan L.G., Sani N.A., Dangoggo S.M. and Ladan M.J., 2008; Nutritional value of bottle gourd(*Lagenariasiceraria)* seeds; *Global Journal of Pure and Applied Sciences.*Vol.14, No 3: 301-306.

Manji A. J. Sarah E. E. and Modibbo U. U. (2013)Studies on the potentials of *Balanitesaegyptiaca*seed oil as raw material for the production of liquid cleansing agents

Nzikou, J.M., Kimbonguila, A., Matos, L., Loumouamou, B., Pambou-Tobi, N. P.G., Ndangui, C.B., Abena, A.A., Silou, TH., Scher, J. and Desobry, S. 2010. extraction and characteristics of seed kernel oil from mango (*Mangiferaindica*). Research Journal of Environmental and Earth Sciences 2(1): 31-35.

Oderinde R.A and Ajayi.I.A.(1998).Metal and oil characteristics of Terminaliacatappa. *Riv.Ital.Sostanze Grasse.* 75:361-362.

Palaniswamy, K.P., Muthukrishna, C.R. and Shanmugavelu, K.G. 1974. Physicochemical characteristics of some varieties of mango. Indian Food Packer 28(5): 12-18.

Poucher, WA (1984).Modern Perfumes, Cosmetics and Soap.Revised by GM, Howard. Chapman and Hall Ltd. 3:218-280.

Rossel JB (1971). Vegetable Oils and Fats. Blackie and Sons Ltd., Glasgow. pp. 263 270.

Sani I, Owoade C, Abdulhamid A, Isah M.F, Bello F.(2004) Evaluation of Physiochemical Properties, Phytochemical and Minerals Composition of Coconuferal(Coconut) Kernel Oil Internal Journal of Advanced Research in Chemical Science. 1(8)22-30.

Satyranayana.U .and Chakrapani.U (2011). Biochemistry (3rd Edition) Books and Allied (p) ltd. India pp28-35.

Schiber, A., Berardini, N. and Carle, R. 2003. Identification of flavonol and xanthol glycosides from mango peels by HPLC. Journal of Agricultural and Food Chemistry 51: 5006-5011.

Singh R.P, Jagdish .S, (1996) Environmentally Sound Technologies For Women in Agriculture vol 11 pp213.

Singh SK, Sharma HC, Singh SP.In vitro polyembryony in monoembryonic mango cultivars (*Mangiferaindica L.)*. In:

Kapoor AC, editor. Sustainability of Hill Agriculture: Emerging Trends and Possible Solutions; 2002. p. 295–9.

Soong, Y.Y. and Barlow, P.J. 2006.Quantification of gallic acid and ellagic acid from longan (*Dimocarpuslongan*Lour.) seed and mango (*Mangiferaindica*L.) kernel and their effects on antioxidant activity. Food Chemistry 97(3): 524-530.

Vila, J.A., Ripoll, D.R., Villegas, M.E., Vorobjev, Y.N. and Schrage, H.A. 1998. Role of hydrophobicity and solvent-mediated charge–charge interactions in stabilizing -helices. Biophysical Journal 75: 2637-2646.

Zhao, X., Wang, H., You, J. and Suo, Y. 2007. Determination of free fatty acids in bryophyte plants and soil by HPLC with fluorescence detection and identification by online MS. Chromatography 66: 197-206.

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