International Journal of Phytocosmetics and Natural Ingredients 2017;4:6

doi 10.15171/ijpni.2017.06

Original Article

Characterization of Seed Oil From *Arachis hypogaea* Cultivated in Guatemala for Applications in Lip Gloss and Skin Cream

Mercy P. Cifuentes Rodas and Sully M. Cruz*

Laboratory of Natural Product Research, Department of Pharmacognosy and Phytochemistry, School of Pharmacy, University of San Carlos, Guatemala

Correspondence to
Sully M. Cruz
Email:
smargotcv@gmail.com

Received 28 Dec. 2016
Accepted 22 Apr. 2017
ePublished 24 July 2017

Abstract

Introduction: Peanut (*Arachis hypogaea* L.) is grown worldwide in the tropics and subtropical areas. This genus is endemic to South America, primarily as an oil seed crop. Peanut seeds make an important contribution to the diet in many countries, and its widespread acceptability is attributed to its economic value to the industry and nutritional benefits to consumers. Peanut oil is used in cooking and is also employed in the manufacture of margarines, cosmetics, pharmaceuticals and surfactants.

Methods: The oils and glycerides function in cosmetic formulations as skin-conditioning agents. The acid functions as a surfactant-cleansing agent, and the flour functions as an abrasive, bulking and/or viscosity-increasing agent. Chemical and microbiological characteristics of seed oil extracted by expression are evaluated for applications in lip gloss and skin cream. The physical and chemical properties of the oil and cosmetic products are evaluated, as well as color, acid, iodine and peroxide values (PVs), saponification index, melting, boiling and freezing points, rancidity value, pH, density, centrifugal and reversibility tests, homogeneity, and technical and economic feasibility for the development of products.

Results: The physical properties of the oil extracts showed the state to be fluid at room temperature (25-30°C) and the color to be pale-yellow or golden-yellow; in general, density was 0.911 ± 0.004 g/mL, refraction index 1.4696, boiling point >218°C, freezing point 7°C. Chemical properties of the oil extracts were: Acid value (AV) 0.71 ± 0.09%; PV (8.29 ± 0.51 meq O2/kg), saponification value (SV) (188.57 ± 1.39 mg KOH/g), and Iodine value (IV) of 88.11 ± 1.29 mg/100 were evaluated.

Conclusion: This oil offers the possibility of being considered at industrial level because the result of quality control for lip gloss and skin cream were satisfactory in compliance with the parameters evaluated. Compliance with the quality parameters indicates that the seed oil of *A. hypogaea* can be used as raw material in the formulation of cosmetics because the products evaluated were stable, and not expensive and easy to obtain. In cosmetics and personal care products, peanut-derived ingredients are used mainly in the formulation of moisturizers, skin care products, and skin cleansers.

Keywords: Cosmetics, Chemical and microbiological analysis, Stability, Peanut oil

Please cite this paper as: Cifuentes Rodas MP, Cruz SM. Characterization of seed oil from *Arachis hypogaea* cultivated in Guatemala for applications in lip gloss and skin cream. Int J Phytocos Nat Ingred. 2017;4:6. doi:10.15171/ijpni.2017.06.

Introduction

Peanuts (*Arachis hypogaea* L.) belong to the Fabaceae family.[1] The genus *Arachis*, native to South America with a probable center of origin in Brazil, is a main source of food including dietary fibers, proteins, micronutrients, monounsaturated fats, and polysaccharides. Peanuts have been consumed for their good nutritional value for a long time.[2]

The genus has 80 described species, grouped into Iodine value (IV) taxonomic sections. The section *Arachis* includes *A. hypogaea*, the most economically important species, considered the fourth oleaginous plant in the world. This species is cultivated in Asia, Africa, and America, mainly for high quality vegetal oil production as a feedstock and as natural or processed food for human consumption. Beyond its nutritional characteristics and commercial value, several studies have pointed to the biological properties of *A. hypogaea*.[3,4]

Peanuts contain several active components including flavonoids, phenolic acids, phytosterols, alkaloids, and stilbenes. Some therapeutic effects have been reported for peanut seed extracts, such as antioxidative, antibacterial,

antifungal, and anti-inflammatory activities.[5] Modern scientific research proves that many active components in peanuts can elicit several biological effects, including cardio-protective,[6] anti-inflammatory, anticancer and others. Djoko et al.[7] has found that peanut stilbenoids has the immunological activities. Among the bioactive components in peanut, polysaccharides are the important types.

Arachis hypogaea is one of the most cultivated oil seeds and a source of valuable edible oil, proteins and fiber. Peanuts contain 49% fat, 26% protein and 11% fiber.[8] Many lotions and creams contain peanut oil. Known as arachis oil, it can be found particularly in diaper rash creams and bath products. Some nipple creams may also contain peanut oil as a moisturizer. In manufacturing, peanut oil is used in skin and baby care products. Information on the concentration of peanut oil in various cosmetic product categories was not available. However, FDA data from 1984 indicated that peanut oil was used predominantly at a concentration of ≤25% (19 uses with one use at >50%).[9] Frequency and use of peanut oil and hydrogenated peanut oil in cosmetic formulations in the US market are described in CIR 2001.[10] No such data is available for the cosmetic products in the European Union.

Peanut oils are used mainly as cooking oils and for the production of soap, margarine, and cosmetics.[11] Peanut is an important source of edible oil for millions of people living in the tropics.[12] Vegetable oil has made an important contribution to diet in many countries, serving as a good source of protein, lipid and fatty acids for human nutrition, repair of worn out tissues, new cell formation as well as being a useful source of energy.[13-15] The oil extracted from peanuts has been used as a functional product since ancient times.

Peanut oil is traditionally used for cooking, massaging, and healing. Its chemical composition highlights the interest of many laboratories to use it in their best selling products. Recently, various studies were conducted, in vitro, animal models and human trials, suggesting that peanut oil could play a beneficial role in prevention of cardiovascular disease and its consumption could protect against atherosclerosis through a variety of biological mechanisms. It is because of its high content of specific antioxidants and mono- and poly-unsaturated fatty acids that peanut oil could be useful in preventing cardiovascular diseases and cancer. Its consumption could also increase antioxidant compounds in the serum of healthy individuals. Experimental studies have shown both anti-proliferative and pro-apoptotic effects of polyphenols and sterols extracted from peanut oil on prostate cancer cell lines and breast cancer cell lines. The utilization of peanut oil in diet will give best results in combating diseases like cancer, diabetes and cardiovascular diseases.[16]

Oil quality and its stability are therefore very important for the consumer and application industries.[17] This study investigated physical and chemical characteristics of seed oil extracted by cold press and evaluated its applications in lip gloss and skin cream to stimulate new studies about this genus.

Materials and Methods

Plant Material

The material was purchased from a local producer in Chiquimula, Guatemala, transported in polythene bags to the laboratory, and then dried in an oven at 60°C. The dried samples were then milled using a blender to produce a powder. It was stored in a plastic container in the desiccators prior to extraction and analysis.

Extraction and Analysis

The oil was obtained by cold expression from roasted seeds. The amount of oil extracted was determined using the equation:

Oil Content (%)=[weight of oil extracted /weight of seed] x 100

Physicochemical parameters (color, acid value [AV], peroxide value [PV], iodine value [IV], saponification value (SV), and melting, boiling and freezing points, rancidity value, pH, density, centrifugal and reversibility tests, homogeneity) were analyzed according to reported methods and all matched with reported values.[18,19]

These parameters were determined in triplicate samples and standard errors were calculated.

The refractive indices of the oils were determined with Abbe refractometer[20] and the specific gravity measurement, both were carried out at room temperature using specific gravity bottle.[21,22]

Results and Discussion

The oil yield was 12.77 ± 0.78% (Table 1); other studies haves reported ranges of oil yield (18.6-20.8%) and in the varieties 19 wild *Arachis* species, the average oil content of was 56.69%. Wild *Arachis* germplasm has been shown to harbor high level resistance to foliar and viral diseases, which is not observed in the cultivated peanut.[23-25] The difference observed in the values may be due to the differences in the nutrient content of the soil and some other environmental factors. For example, temperature has been reported to have an influence on the level of oils and its composition. Other studies reported that pressing temperature, pressure, time and moisture content affected

Table 1. Oil Yield and Sensorial Analysis

Analysis	Result	Value Reference[15,64,65]
Oil yield	12.77 ± 0.78	43-45
Color	Pale-yellow or golden-yellow	Light yellow Pale-yellow
Odour	Agreeable	Distinctive nutty
State at room temperature (25-30°C)	Liquid and fluid	Liquid and fluid

the yield of vegetable oils.[26,27] Commercially, peanut oil is extracted by three different methods: oil extraction hydraulic pressing, expeller, and solvent extraction. When hydraulic pressing is used, it is followed by hot solvent extraction for nearly total recovery of the oil. Expeller extraction relies on friction and pressure within the expeller, which causes the meal to heat, thus facilitating the oil extraction process. This process removes approximately 50% of the peanut oil. The remaining oil is extracted using hexane, which is later removed through an evaporation-condensation system. The solvent extraction involves utilization of petroleum hydrocarbons or other solvents. Th s method gives higher efficacy with hexane, 95% ethanol, or absolute ethanol.[28]

The physical properties of the oil at room temperature (25-30°C) was recorded, state was fluid and its color was pale yellow or golden yellow in general, both for liquid and fluid. The color in peanut oil is primarily the result of presence of carotenoids.[29-31] Holley and Young[31] showed that the color reduction had a high correlation with maturity but noted that upon slow curing the pigmentation fades in all types of peanut. Emery et al[32] suggested using oil coloration as a maturity index and genetic marker of maturity inheritance. Physical properties results (Table 2) were similar to those reported by other studies on peanut oil. The oil described as a clear yellowish viscous liquid, with the specific gravity 0.91 g/mL at 25°C. The specific gravity obtained for other oil samples were less than 1.0 when measured at 30°C. The values of peanut oil compared well with reported values for cotton seed (0.9202), coconut oil and sunflower seed.[33]

Refractive index n20/D 1.470, is close to another reported (1.449) and showed that the oil contained some double bonds in its fatty acid composition; refractive index increases as the double bond increases.[34] The refractive indices of the oils were in close range with the values obtained for some conventional oils such as palm kernel oil (1.449-1.451) and soy bean oil (1.466-1.470).[35,36]

With respect to chemical properties of the peanut oil (Table 3), AV was 0.71; this result corresponds to low levels of free fatty acids present in the oil, which also suggested low levels of hydrolytic and lipolytic activities in the oils. Acid value represents free fatty acid content due to enzymatic activity and is usually indicative of spoilage. AV is used as an indicator for edibility of oil and suitability for use in the paint industry. The maximum

Table 2. Physical Properties Peanut Oil

Analysis	Result	Value Reference[15,64,65]
Specific gravity	0.911 ± 0.004 g/mL	0.888
Refraction index	1.4696	1.456-1465
Boiling point	>218°C	226.4
Freezing point	7°C	

P=0.0312

Table 3. Chemical Analysis of Peanut Oil

Analysis	Results	Value Reference[15,64,65]
Acid value (AV)	0.71 ± 0.09%	0.6-0.99
Peroxide value (PV)	8.29 ± 0.51 meq O^2/kg	11.01-11.2
Saponification value (SV)	188.57 ± 1.39 mg KOH/g	187-196
Iodine value (IV)	88.11 ± 1.29 mg/100	86-107
Rancidity value	No red coloration	
Cloud point was determined: after 5 h at 0°C	The oil presented clear solution no turbidity	0°C

acceptable level is 4 mg KOH/g oil,[37] for recommended international standards for edible Arachis oil below which the oil is acceptable for consumption. Since the AV of the almond is lower than the maximum permissible acid level of 4 mg KOH/g fat or oil required for edible virgin fats and oils, the almond nut oil is suitable for direct consumption. Therefore, the oil requires no refining processes to improve its quality for industrial purposes. In other studies, an AV of 5.99 mg KOH/g has been reported which is close to Soy bean at 4.279 mg KOH/g.[38]

Saponification is the process of breaking down a neutral fat into glycerol and fatty acids by alkali treatment. The saponification number is defined as the mg of KOH required to one gram of fat. High SV shows that more alkali would be required to effect neutralization of the available free fatty acid liberated by the oil.

The SV obtained was 188.57 mg KOH/g. Previous studies have reported a SV of 193.20 mg KOH/g in agreement with Pearson's,[38] 187-196 mg KOH/g. This property makes it useful in soap making.

Kyari[39] reported that SV for palm oil was 200 (mg KOH/g sample), for groundnut was 193 (mg KOH/g sample) and for coconut oil was 257 (mg KOH/g sample). SVs were reported to be inversely related to the average molecular weight of the fatty acids in the oil fractions.[40] High SVs of fats and oils are due to the predominantly high proportion of shorter carbon chain lengths of the fatty acids.[39]

Saponification value is used in checking adulteration. The high SVs recorded for the seed oil suggests a low level of impurities.[37,41] The PV was 8.29 mEq O2/Kg. The PV reported in other studies was 11.50 meq/kg which was not far from cotton seed oil at 2.5 meq/kg.[42] Low values indicates that the oil can resist lipolytic hydrolysis and oxidative deterioration.

An IV of 88.11 mg/100 was obtained. The IV is a measure of oil chemical stability, with oils having higher (Iv) being more unsaturated and chemically less stable. IVs reported from Florida peanut genotypes ranged (73.87-107.64) from levels comparable to olive oil (78-86) to those similar to corn (103-130) and cottonseed (103-115) oil. The high IV denotes a high degree of unsaturation of the oil caused by the extent of oxidation.[43] Low IV in the

nut demonstrates suitability for cooking while the PVs are indicators of the ability to resist lipolytic and oxidative deterioration when stored.[44]

The values obtained here suggested that the oil is highly unsaturated and may be susceptible to rancidity. Also higher IVs indicate that the oils could be used in the manufacture of cosmetics, oil paints and varnish, as well as for nutritional purposes. The observed IVs were higher than typical IVs obtained for coconut (25-40), palm (37-54), olive (75-95) and peanut oils (85-100). However, it falls within the range of typical IVs for corn (115-130) and fish oils (120-180) rich in omega-3-fatty acids.[45] According to Demian,[46] AVs are used to measure the extent to which glyceride in the oil has been decomposed by lipase and other actions such as light and heat. The determination is often used as a general indication of the condition and edibility of oil.

Denniston et al,[47] reported that high SV indicated the presence of a greater number of ester bonds in molecules were intact. The SV was lower compared to other oils, which indicates that the weight of fatty acid was larger in triglycerides.

Similarly, the PV of local and refined oils was less than the standard PV (10 mEq/kg) for vegetable oil deterioration. Fresh oils have a value less than 10 mEq/kg and values between 20 and 40 mEq/kg results in rancid taste.[48]

The results of the present analytical study show that oil could be useful as edible oils and for industrial applications. These results are similar with those described by Dzondo-Gadet et al.[49]

Table 4 shows the formulation of cosmetics products and Table 5 the quality control of products developed. Lipids may be used in a topical preparation of interest. As is known in the literature, oils may be derived from animals, plants, petroleum, etc. Those derived from animals, plant seeds and nuts are similar to fats and consequently, can contain one or a significant number of polar acids and/or ester groups. Alternatively, oils derived from petroleum are usually aliphatic or aromatic hydrocarbons that are essentially free of polar substitution and therefore may be preferred for certain applications.[50]

Other oil-based products that can be used include hydrocarbons or mineral fats obtained by the distillation of petroleum (petroleum jelly); vegetable oils and liquid triglycerides; animal fats or solid natural triglycerides; and waxes or solid ethers of fatty acids and organic alcohols. Lanolin or wool fats that are obtained from sheep wool and made up of fatty acids and cholesterol esters; and cetyl and stearyl alcohols, which are solid alcohols obtained by hydrogenation of their respective acids are also useable.

Amphiphilic compounds such as soaps or salts of fatty acids, that may be acidic or basic depending on whether its lipophilic group is anionic or cationic, sulfated alcohols which are semisynthetic substances and synthetic surface active agents are known in the art and can be used in the topical preparation of interest. Glycerin is obtained from fats and, due to its hydrophobicity, has the property of extracting water from the surface of the mucosa or denuded skin.[51,52]

Arachis oil is used in some brands of vitamins, ear drops, and creams for diaper rash and eye pencils. Also they are often used in intramuscular injections, peanut oil is an emollient plant oil best known for its skin-softening and antioxidant properties. In fact, it is considered a moisturizing agent for dry and/or mature skin types. When applied topically, peanut oil for skin benefits as anti-inflammatory and analgesic properties help calm skin especially when skin is experiencing discomfort, tightness, or itchiness in extremely drying conditions. Peanut oil can help relieve minor irritations while reducing redness. Antioxidant powers found in its vitamin E content, an antiaging free radical. As a rich emollient, peanut oil is able to help condition and moisturize for skin that looks and feels softer and smoother.[53,54]

Cosmetic products play a paramount role from the consumer's perspective. This includes color, odor and texture of the product. The natural lip balm can be made using naturally occurring base, oils, extract, color and flavoring agents which can be evaluated for their resistance to temperature variations, pleasant flavor, and smoothness during application, adherence and easy intentional

Table 4. Formulation of Cosmetic products

Skin Cream Formulation(%)	Ingredient (%)
Water (80.0)	Propylparaben (0.2)
Citric acid (0.1)	Isopropyl myristate (1.4)
Methyl paraben (0.2)	Liquid petrolatum (6)
Stearic acid (4.0)	Triethanolamine (1.6)
Cetyl alcohol (2.0)	Peanut oil (3)
Glyceryl monostearate (1.0)	BHT (0.5)
Essence (2 drops)	
Lip Gloss Formulation(%)	
Ozokerite wax (6)	Peanut oil (10)
Castor oil (15)	BHT (2)
Liquid petrolatum (12)	Essence (2 drops)
Solid petroleum (55)	Coloring (2 drops)

Table 5. Quality control cosmetic products

Lip Gloss Analysis	Result
Consistency	Semisolid
Runoff test	> 40 °C
Skin cream analysis	
Color	White
Texture	Creamy
pH	6.99±0.005
Density	2.15±0.08
Homogeneity	Homogeneous layer
Centrifuge test	Without phase separation
Reversibility test	Without changes color, smell and consistency

removal, etc. To formulate lip balms, it is necessary to balance the concentration of the main ingredients including butters, oils, waxes and other excipients.[55]

Fatty acids can be saturated or unsaturated, thereby determining the stability and property of the oil. Oils with a high degree of saturated fatty acids (lauric, myristic, palmitic and stearic acids) include coconut, cottonseed, and palm oils.

Oils with a high degree of unsaturated fatty acids (oleic, arachidonic, and linoleic acid) are canola, olive, corn, almond, safflower, castor and avocado oils. Saturated oils are more stable and do not become rancid as quickly as unsaturated oils. However, unsaturated oils are smoother, more precious, less greasy, and better absorbed by the skin. Natural butters like shea, avocado or cocoa butters are not true butters but natural fats. In general, natural butters are excellent emollients and thickeners and depending on the type may have various additional properties (e.g. antioxidant and soothing properties in shea and avocado butter due to phenolic compounds). The oil mixture is required to blend properly with the waxes to provide a suitable film on the applied lip skin. An ideal mixture is one which enables the product to spread easily and produces a thin film with good covering power.[56,57]

Arachis hypogaea is not only known as a good source of oil and protein, but it also possesses great diversity of bioactive components, which have potential therapeutic and other biological functions.[53] Several studies in different varieties of peanuts were detected fatty acid: palmitic (16:0), stearic (18:0), oleic (18:1), linoleic (18:2), arachidic (20:0), eicosenoic (gadoleic) (20:1), behenic (22:0), and lignoceric (24:0) acids, however, no significant differences could be found among varieties.[58]

Peanuts present great diversity of secondary metabolites, and many of them are responsible for plant defense against herbivores or pathogenic microorganisms and for response to damage in any plant tissue, as well as protection against ultraviolet radiation. Water-soluble fractions from peanut skins present the ability to inhibit hyaluronidase activity because of the presence of tannin and proanthocyanidins.[54]

Peanut oil is used in cosmetics as a skin-conditioning occlusive agent.[50] As of January 1998, peanut oil was reported to be used in 22 cosmetic formulations.[10] Data from 1984 indicated that peanut oil was used predominantly at concentrations <25% (19 uses), with 1 use at >50%.[9]

The CIR Expert Panel was satisfied that the results of toxicity, mutagenicity, carcinogenicity, reproductive/developmental, and sensitization studies cited in this report supported the safety of Peanut (*A. hypogaea*) oil, hydrogenated peanut oil, peanut acid, and peanut glycerides in cosmetic formulations.[9,59]

The Panel acknowledged the irritation observed in animal studies that used technical grade peanut oil but relied on clinical studies in which subjects had no irritation. Further, these four ingredients are oils or oil-based and therefore escape the 2 major concerns associated with peanuts, the peanut protein responsible for allergic reactions and aflatoxins. The protein and aflatoxins do not partition into the oil. The Panel cautioned manufacturers to make certain that these ingredients are free from aflatoxins and protein. Based on the available data, the CIR Expert Panel concludes that peanut (*A. hypogaea*) oil, hydrogenated peanut oil, peanut acid, and peanut Glycerides are safe for use in cosmetic formulations. The available data are insufficient to support the safety of Peanut (*A. hypogaea*) flour for use in cosmetic products.[10,58]

Edible peanut oil is described by a US manufacturer as comprised of 100% fat with no detectable protein, carbohydrate, water, ash, and only trace amounts of minerals. The fatty acid composition of cosmetic grade Peanut Oil is specified as 57% oleic and 26% linoleic (both unsaturated acids), 8% palmitic (saturated), and smaller amounts of the saturated stearic, arachidic, behenic, and lignoceric acids.[57,60]

Peanut oil can also be used for aromatherapy. It is used as a massage oil to energize the body and help to alleviate achy joints and muscles and to get rid of acne. Peanut oil works for both normal and dry skin, helps protect skin from blackheads and is used to treat dandruff. This edible oil also helps reduce protein loss, thickens hair, adds moisture to split ends, and regenerates damaged hair; it is also used to moisturize the lips.[61]

It is clear or sometimes pale yellow and has a very oily base and nutty scent. It is an ideal choice for massage. It contains essential oils such as alpha linoleic acid (ALA), LA, OA, minerals, proteins, and vitamins. It may be used as a base without dilution and suits all types of skin. It is effective against arthritis.[62-67]

Peanut oil is utilized as a skin softener, emulsifier and emollient. It can also be used as a substitute for more expensive oils such as almond and olive in cosmetic creams. It has a higher vitamin A, E, and nicotinic acid content than other nut oils.[63] Traditionally, the oil is used in sunscreen preparations and after-sun oils. It is substantive and protective to the harshest of external conditions.[64,66]

Conclusion

The current work provides new reference data for the potential uses of peanut oil in cosmetic industries. Based on the physicochemical properties of the oil examined in this work we believed that it should be profitable to tap oil seeds to supplement the ever-increasing demands and use the abundant availability of the oil seeds to expand the economic horizon in others markets. Peanut oil is traditionally used for cooking, massaging, and healing. Its chemical composition highlights the interest of many laboratories to use it in their bestselling products.

Competing Interests

None.

Acknowledgements

The authors wish to thank Alejandra Morales, Nereida Marroquín and Carlos Palencia for their participation and support.

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