

Original Research Article

COMPARATIVE STUDY OF THE PHYSICO-CHEMICAL PROPERTIES OF OILS OF SHEANUT (*Vitellaria paradoxa*) AND COCOA (*Theobroma cacao*)

ABSTRACT

*This research work involves a study of the physico-chemical properties, fatty acid composition of oils of sheanut (*Vitellaria paradoxa*), cocoa (*Theobroma cacao*) and the effect of roasting on these properties.*

The physicochemical properties of the extracted oils were quite comparable, with roasting having little or no effect on them. The oils were found to be composed of both saturated and unsaturated fatty acids. The results revealed that sheanut will be a suitable substitute for cocoa in industrial application.

Keywords: *Cocoa, sheanut, cocoa nibs.*

INTRODUCTION

The tropical crops under study are cocoa (*Theobroma cacao*) and sheanut (*Butyrospermum parkii*). Cocoa belongs to the genus *Theobroma* in the family of *Sterculiaceae*, while sheanut belongs to the genus *Butyrospermum* in the family of *Sapotaceae* [1]. The tree crop, cocoa (*Theobroma cacao*) has played an important role in the economies of various regions of the world. Sheanut

tree is a medium-sized deciduous tree which occurs mostly in West Africa, Northern Uganda and Southern Sudan. The seed contains 45 – 60% of the oil called shea butter, which is solid at room temperature [2]. According to [2], shea nut butter is one of the Africa's most sustainable natural resources and the shea tree is an important source of income; it's the third largest cash crop in Burkina Faso and Ghana, where it's surpassed only

by cocoa and coffee. Shea butter has been used for centuries in Africa for its moisturizing and healing properties, where it has been used to protect and condition skin, which have been damaged by the sun and wind [3].

According to [4], the economic importance of the shea tree cannot be overemphasized, especially in the face of the unstable world market price for cocoa and the need to find suitable substitutes for cocoa in the beverage, confectionery and cocoa butter industries. In order to determine the suitability of sheanut as a substitute for cocoa and as a potential industrial raw material, there is need for comprehensive study of the sheanut oil.

Thus, this paper compares the physicochemical properties and fatty acid profiles of the oils extracted from the seeds of sheanut (*Butyrospermum parkii*) and cocoa (*Theobroma cacao*) and the effect of roasting on these properties.

MATERIALS AND METHODS

Sample collection and preparation

The samples used for this study were raw cocoa nibs, roasted cocoa nibs, raw shea nuts and roasted shea nuts. The dried cocoa beans were obtained from Idanre Town, in Idanre Local Government Area of Ondo State, while the dried shea nuts were obtained from Bida Town, in Bida Local Government Area of Niger State; both states are located in Nigeria. The samples collection and

analysis were carried out in 2010. The samples obtained were sun-dried, cleaned thoroughly to remove extraneous materials (stones, pebbles and twigs) and then separated into two portions. One portion was roasted in the oven at 120°C for 2 hours, while the other portion was used in its raw state. The raw and roasted cocoa beans were shelled to obtain the cocoa nibs. The different samples were pounded separately with a pestle in a clean wooden mortar and thereafter ground with a laboratory Waring blender to obtain suitable particle sizes for laboratory analysis. The ground samples were stored in an air-tight plastic container and kept in the refrigerator, prior to analysis.

Physico-chemical and fatty acid profile analysis of extracted oils

The extracted oils from the samples were analysed for smoke point, flash point, fire point, refractive index, saponification value, peroxide value, Iodine value, specific gravity, free fatty acid, and unsaponifiable matter using methods described by [5,6].

The fatty acid composition of the oils was obtained by gas chromatographic analysis of the methyl esters of the fatty acids according to [7] method.

RESULTS AND DISCUSSION

DISCUSSION

All the data obtained were subjected to one-way analysis of variance (ANOVA) using the Statistical Package for Social Scientists (SPSS) 15 and the means were separated using the New Duncan's Multiple Range Test.

Figure 1 summarizes the physicochemical properties of the extracted oils of the samples. Natural fats and oils are identified by their physical and chemical properties. The smoke point of the samples was between 140-170°C. The smoke point is the temperature at which a fat or oil gives off a thin bluish smoke or flame [8].

The flash points of the samples were between 220-290°C. The flash point is the lowest temperature at which an applied ignition source will cause the vapors of a sample to ignite. Therefore, it is a measure of the tendency of a sample to form a flammable mixture with air [9].

The fire points for the samples were between 250-310°C. The fire point is the temperature at which oil gives off sufficient vapour which when ignited continues to burn for at least 5 seconds [10]. Thus, fire point of oil or fat is the temperature at which the substance will sustain continued combustion [8]. Smoke, flash and fire points are particularly useful in connection with fats or oils used for any kind of frying [8]. A knowledge of flash and fire points of oils is helpful in providing safeguards against fire hazards during their storage, transportation,

handling and use [10]. It was observed that roasting has no definite effect on these parameters.

The specific gravity of the cocoa butter and shea butter ranged between 0.913 and 0.919. This indicates that the oils are less dense than water. According to [5, 11], the specific gravity of cocoa butter must be less than 1.0.

The refractive index which is a useful property in the preliminary examination of oils and fats purity ranges from 1.453 to 1.488 at 25°C for the extracted oils. Refractive index is the precise method related to the average chain length and degree of unsaturation of the fatty acid in the oil or fat being examined. According to [12], edible oils have refractive index of about 1.4; this confirms that the extracted oils are edible and pure.

The percentage free fatty acids for the analysed oils ranged from 0.30 to 0.40%. Free fatty acid (FFA) is used as a general indication of the condition and edibility of oils and fats.

The Standard Organization of Nigeria (SON) specified that the percentage FFA for cocoa butter should not be more than 1.75% [11]. The results obtained for these samples shows that they are edible and that they may be stored for long period with minimum spoilage through oxidative rancidity.

The saponification value which is the amount of alkali required to neutralize the fatty acids resulting from the complete hydrolysis of 1g

of the oil or fat ranged between 176.35 and 192.31 mg/g. These values agree with 188 - 196 mg/g specified for cocoa butter by Pearson (1976). The saponification value (S.V) is inversely proportional to the mean of the molecular weights of the oil. Thus, the higher the S.V, the lower the molecular weight of the oil. The high S.V recorded for the oils indicates that they are of lower molecular weight and this makes them suitable for soap making [13].

The unsaponifiable matter for the cocoa butter and shea butter ranges from 1.18 to 1.23%. Most oils and fats of normal purity contain less than 2% of unsaponifiable matter. These values show that the extracted oils are pure [5].

Peroxide value is a measure of the peroxides contained in an oil or fat. The concentration of peroxides in an oil or fat gives an indication of the extent of spoilage. The peroxide values of the fats range from 0.36 to 0.44 meq/kg. The maximum peroxide value specified for cocoa butter by Standard Organization of Nigeria is 2.0 meq/kg [11]. The low peroxide values for these extracted oils indicate that they are edible and are less liable to oxidative rancidity at room temperature [14]. The peroxides values of the shea butter compare well with that of the cocoa butter, with roasting causing a slight reduction in the peroxides value of the roasted samples.

The iodine value which is a measure of the degree of unsaturation in oils or fats ranges from

35.20 to 40.40 for the samples. These values agree well with the iodine value of 33 to 42 specified for cocoa butter by Standard Organization of Nigeria [11] and are in agreement with earlier research work done on cocoa butter by [15]. Roasting decreased the iodine value of all the samples.

These values show that the extracted oils contain mainly saturated fatty acids and that the less unsaturated oils with low iodine values are solid at room temperature [5].

Figure 2 shows the percentage composition of methyl esters of the fatty acids present in the extracted fats. Fatty acids are aliphatic monocarboxylic acids, derived from, or contained in esterified form in an animal or vegetable fat, oil or wax. Natural fatty acids commonly have a chain of 4 to 28 carbons (usually un-branched and even numbered), which may be saturated or unsaturated. Fatty acids are produced by the hydrolysis of the ester linkages in fat or biological oil (both of which are triglycerides), with the removal of glycerol [16].

The results showed that all the oils composed of both saturated and unsaturated fatty acids. The quantified saturated fatty acids were palmitic, stearic, arachidic, Behenic and lignoceric acids, while the quantified unsaturated fatty acids were palmitoleic, oleic and linoleic acids. The percentage palmitic acid composition of the samples ranges between 3.79 and 17.59%. It was observed that the palmitic acid contents of the

sheanut samples were lower than that of the cocoa samples, with roasting having an increasing effect on the palmitic acid content. These values were lower than 24% palmitic acid content reported for cocoa butter by [1].

The percentage stearic acid contents of the samples ranges from 38.61 to 49.35% with roasting having an increasing effect on it. These values were higher than the 34% stearic acid reported for cocoa butter by [1].

Other saturated fatty acids quantified in all the samples were arachidic, behenic and lignoceric acids, but at trace levels.

The percentage oleic acid composition of the samples ranges from 30.80 to 49.9% respectively, with roasting having a reducing effect on it. The oleic acid content of the examined cocoa fat was found to be lower than 38% oleic acid reported for cocoa butter by [1].

The sheanut samples contained higher percentage of linoleic acid, 5.67-6.43% when compared with cocoa samples of 0.01%. Linoleic acid is one of the essential fatty acids required by the human body for various physiological functions [17]. This property makes sheanut fat better for human consumption than cocoa fat.

In the body, essential fatty acids are primarily used to produce hormone-like substances that perform a wide range of functions, including blood pressure, blood clotting, blood lipid levels, the immune response, and the

inflammation response to injury infection. Fatty acids play an important role in the life and death of cardiac cells because they are essential fuel for mechanical and electrical activities of the heart [18, 19].

CONCLUSION

This research work compared the physicochemical properties and fatty acid composition of the oils of cocoa and sheanut, and most importantly the effect of roasting at improving or enhancing these properties. The physicochemical properties and fatty acid composition of the shea oil also compare favourably well with that of cocoa oil.

The results also revealed that roasting significantly increased the physicochemical properties and fatty acids contents of the extracted fats of the seeds with few exceptions.

The fatty acids analysis revealed that the samples composed majorly of saturated fatty acids; this confirmed their existence as solids at room temperature. Shea fat was found to contain a higher percentage of linoleic acid (an essential fatty acid) than cocoa fat, while the effect of roasting on the fatty acid composition followed the same trend in all the samples.

It can be conveniently concluded that sheanut and its products will be a suitable substitutes for cocoa and its products in the beverage, confectionery,

chocolate and other industries where cocoa is being widely used. As a result, sheanut can serve the same household and industrial purposes as cocoa. This research was conducted for one year only, and further research is needed to see the effects of environments in each year on these Physicochemical composition components.

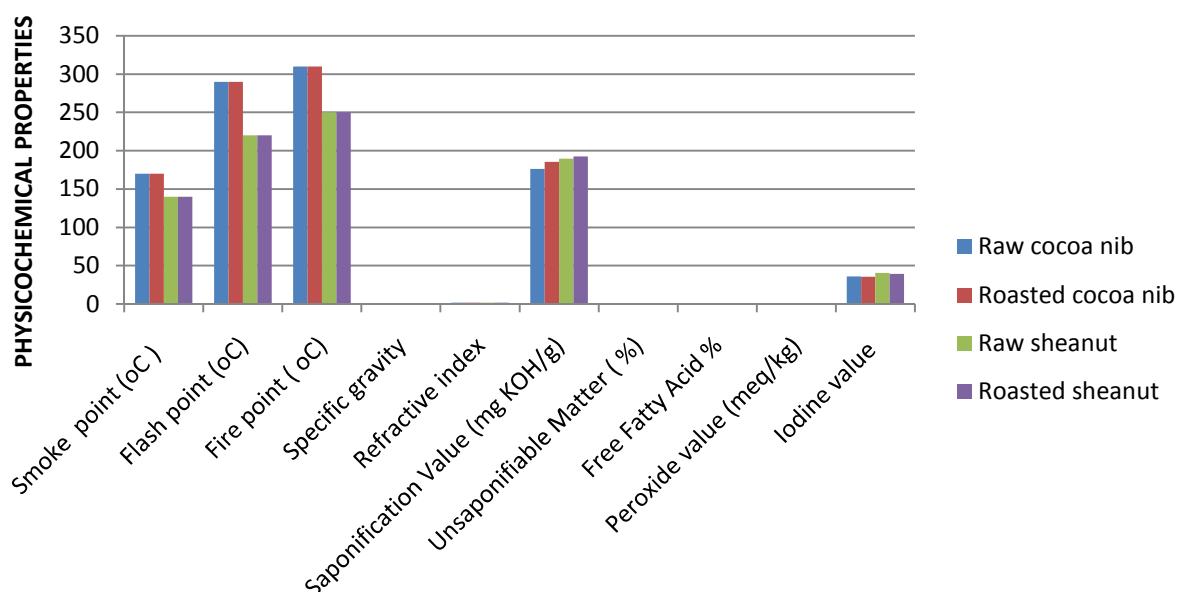


Figure 1: The Physicochemical Properties of Extracted Oil

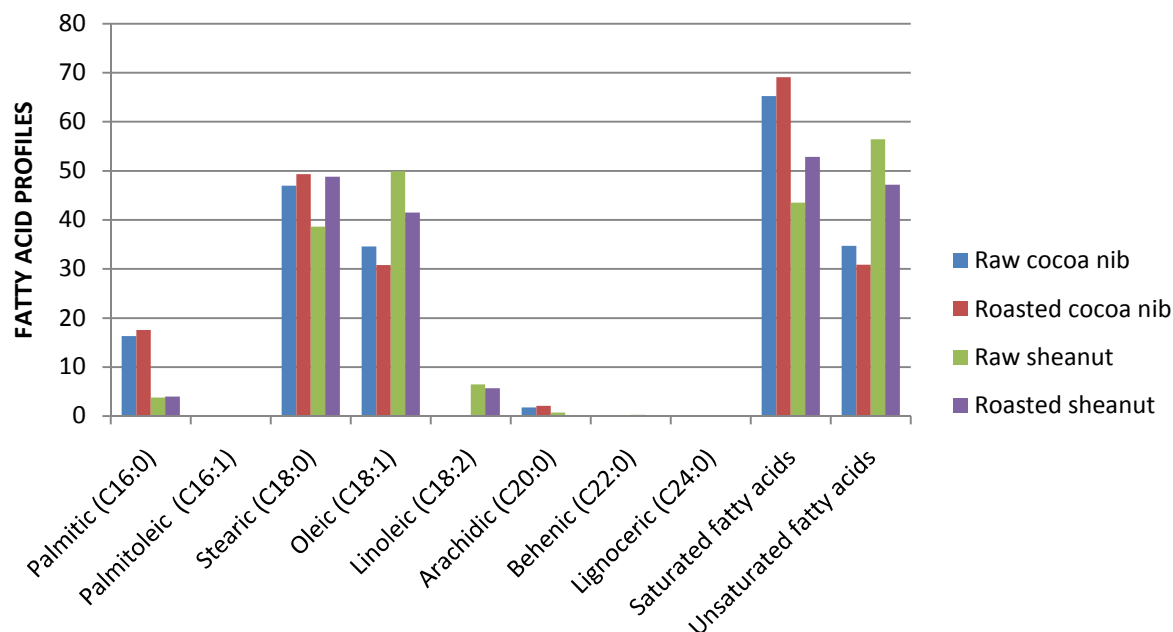


Figure 2: The Fatty Acid Profiles of Extracted Oils

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