Chemical Analysis of Sheabutter Produced From A Locally Fabricated Extruder

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Abstract

As elemental content of sheabutter play a vital role in various physiological and metabolical activities in h human body, efforts have been made to analyze the semisolid product from the design and fabrication of sheabutter extraction machine for small scale industry. The result was compared with the composition of extract from other techniques. The result shows increasing recoveries of most of the elements on progressing to design machine and soxhlet apparatus from traditional procedure. The chemical analysis results showed the amounts of lead, mercury, manganese, iron, copper, calcium, iodine, magnesium and phosphorous present in the sheabutter. The amounts of 22.8µg/l sheabutter from modern machine are higher than the from the traditional extracting method. Possible reasons and implication of the findings are discussed.

Keywords: *Sheabutter, Extraction machines, Elemental content, Semi-solid product.*

Introduction

The sheanut grows on semi-wild medium size three in the savannah zone where rainfall is not excessive. The tree begins to bear fruits at 12,– 15 years and reaches full bearing capacity at 20 – 25 years (Koku, i989). The fruit produces nut which tastes like pea. It is "egg-shaped" (Oval), with stony hard nut containing considerable quantities of oil (Shukla and Pandey (1982). The sheanuts are collected and stored or extraction. The outer coats for the nuts are removed by hammer or otherwise and the seed met is roasted.

Both industrial and domestic application of oils/fats have necessitated lipid research and the search for the best method of extraction. The design and construction of the sheabutter extractor was made with the view to improve the nutrients in sheabutter in terms of yield and quality of the oil extracted. The construction was made within the available local raw materials (see figure 1) and the main components of the design had been analysed. According to Inegbenebir and Abdulkareem (1993) the main component of the design were:

i. The power screw which serve the dual purpose of a conveyor and squeezer or plasticizer. It is a left hand square thread with single start thread and has a lead equal to the pitch.

ii. Housing I a thin seamless walled cylinder. The ratio of the wall thickness (t_w) to the cylinder diameter (d_w) is the design criterion.

iii. Adjuster, which is made of many intermittently, parts for example, washer, spring, fastners and others. The adjuster moves to regulate the pressure in the housing.

iv. Cone-regulates the pressure within the housing by means of other adjuster accessories.

After carefully working out the components for the extractor, cold rolled mild steel was selected for the components. The conditions of selecting such steel were based on its high yield and tensile strength.. Also its machinability, easy formability, surface-scale free and weldability. Bohkari and Ahmed (1990) proposed a level of is 20 off-pressure (pf) for ground oil extractor. This value is taken as the working pressure for the sheabutter extractor since the sheanut is coarse in texture when compared with groundnut. He sheabutter extraction machine will be used to extract oils from sheanuts.

According to Shukla and Pandy (1982) and Bokhari and Ahmed (1990), the sheanut contains 50-555 o sheabutter. In order to improve on the percentage of sheabutter from sheanut, Inegbenebor and Abdukareeem (1993), designed and constructed sheabutter extraction machine in Fig.1. The designed machine was based on the principle of the traditional method (Figure 2) of processing sheanut into butter. The traditional procedure of extraction of sheabutter re inefficient since only 25-27% of oil is extracted from the nut as reported by Koku (1989).

Since the design and construction of the sheabutter extractor was made with the view to improve the nutrients in sheabutter, it is therefore necessary to compare the chemical analysis of the product of this machine, with the products from other extractors such as soxhlet, and the traditional methods.

The aim is to know the elemental contents of the extracts from the designed machine and laboratory extract compare these with the traditional product. This will give idea of the level of the elemental compositions in the nutrient value of the human being consumption of the extract of the traditional procedure.

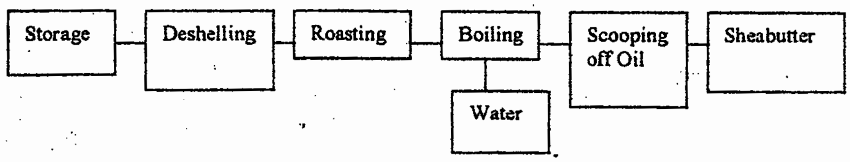

Fig.2: Traditional procedure for the production of sheabutter

Materials and Methods

The dried sheanut (20g) were ground to a fine powder and extracted with water in the chemical laboratory with soxhlet apparatus. The resulting brownish aqueous extracts were concentrated to about $500cm^3$, and centrifuged to remove the fine precipitate, which had been formed. The supernatant was shaken with ether ($5x250cm^3$). The ether fractions were bulked, dried over Na_2SO_4 evaporated to dryness. The yield of (A) is 6.23g. twenty grams (20g) of semisolid product from the designed machine (B, Table 1) was dried in the oven at 750^0C for 24hours. The dried semisolid was ground into fine powder. The yield from he designed machine was 11.58g.

The (20g) of semisolid (resin) from the traditional method (c) was obtained as described by Inegbenebor and Abdulkareem (1993). The roasted met was pounded to fine paste in a wooden mortar. Large quantity of water is added to he oaste and is subjected to heating. The floating oil is collected and is further subjected to heating for pure butter. By this procedure, the percentage of the sheabutter obtained is not much. The yield was however 11.45g.

Residues from the extraction methods A, B and C were analysed for their elemental contents. Approximately 1.0g of each of the powdered sheabutter was digested by dissolving in formaldehyde and concentrated H_2SO_4 mixture (1:1, v/v) $50cm^3$. this mixture was heated with further addition of a mixture of HNO3, HCl and HClO4 in a $500cm^3$, flask. The heating continued for about 2 hours.

This was evaporated to $5cm^3$, together with the residue was taken up in $10cm^3$ of 2 M, HNO_3 and $30cm^3$ distilled water into $100cm^3$, volumetric flask. The volume was made up to mark with distilled water. Blank smples and standard solutions for the various elements were similarly prepared. All samples were stored in plastic containers in a refrigerator maintained at 4°C) prior to analysis.

Flame emission spectrometer (FES) Gallen Kamp (FEA 330) was used to determine the Na, K and Ca, in the samples. Phosphorous was determined gravimetrically as detailed in Vogel (1978). The other elements were determined by atomic absorption spectrophotometry (AAS) with 9 unicarm. Airaropane and air/acetylene (ethyne) flames were respectively used in the FES and AAS procedures. Standard calibration quantitative method was used in both procedures. In this technique, plot of emission (FES) and absorbance (AAS) readings were prepared for the known standard concentrations. The test elements were drawn from these concentrations of the relevant elements in the pulverized sheabutter. Samples ere obtained using their measured emission and absorbance values as the case may be.

Results and Discussion

The results of the elemental determination of sheabutter extracts are given in tables 1 and 2. it appears that the amounts of Pb, Mg and Cd 16.50, 0.18 and 0.23µg/l respectively in the sheabutter extracted from traditional procures differ significantly from hoe of soxhlet apparatus (20.88, 0.37. 0.45µg/l) on the basis of smple etraction procedures.

Table 1: Average contents of sheabutter in Extractions from three different methods

Extraction Method	Elemental Content (µg l)							
	Pb	Hg	Mn	Fe	Cu	Ca	Mg	P
A	20.88	0.07	0.51	19.72	0.18	23.42	[illegible]	0.97
B	21.91	0.05	0.58	22.80	0.16	22.68	[illegible]	0.87
C	16.50	0.03	0.41	16.16	0.10	[illegible]	[illegible]	0.65

Table 2: Average contents of sheabutter in Extractions from three different methods

Extraction Method	Elemental Content (µg/l)							
	Ag	Cd	Co	Cr	Na	K	Ni	Zn
A	0.31	0.45	0.39	0.08	0.68	0.21	[illegible]	0.23
B	0.35	0.45	0.41	0.08	0.70	0.19	[illegible]	0.25
C	0.29	0.23	0.34	0.05	0.55	0.20	[illegible]	0.19

A = Soxhlet Extraction
B = Design Machine
C = Traditional Procedure

The Hg, Mn, Fe, Ca, P, Ag, Cr, Na, Ni and Zn levels show similar difference between the results obtained from samples tht were extracted from the designed machine and those obtained from samples were extrated from soxhlet apparatus and the traditional procedures. In all cases, the Pb, Mn, Fe, Ag, Co, Na and Zn levels obtained from samples extracted from design machines are higher than the corresponding values obtained from samples ...ted from the other methods. The difficulty of ...mations of soluble residues from the traditional method of extraction may be responsible for the difference in the result.

The result in table show increasing recoveries of most of the elements on progressing of design machine and soxhlet apparatus from traditional procedure. Inspections of the tables shows that the losses of the elements more than 15% in extraction methods A and C alone. Bernas (1973:1976) has reported on the use of high pressure decomposition vessels for the preparation of inorganic and organic materials prior to element analysis by AAS. The designed and fabricated machine (Inegbenebor and Abdulkareem, 1993) and soxhlet apparatus provide this high-pressure-decomposition demand of sheanut extraction.

Majority of the in-field installations operating today including soxhlet apparatus are powered from a constant current source. The designed extractor machine used in this work is portable and is manually operated, and can be used where electricity may not be available. Also the method of preparation of the extracts from traditional procedure is probably responsible for the lower, elemental compositions.

Conclusion

Extraction with the designed machine with the use of high-pressure-decomposition vessels manually operated is more efficient for this purpose of extraction. Consequently extraction with the designed machine and laboratory machine (soxhlet) enables, the extraction of higher levels of the element of the sheabutter than the traditional procedure. This is due to high-pressure-decomposition system, which is incorporated into the design of these machines.

A knowledge of the elemental composition of the sheabutter is necessary for the industrial and domestic applications of the sheabutter. The work has been able to show the level of elemental compositions in the extract of sheabutter using modern machines and the traditional way of extraction. The traditional procedure should be improved in order to recover higher elemental compositions.

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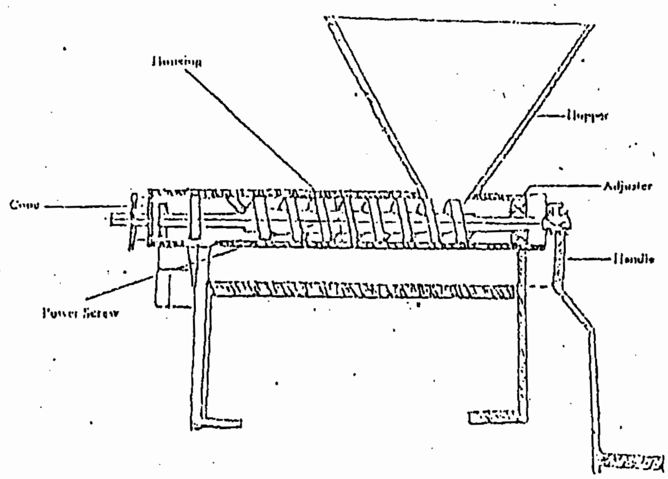

FIG. 1. THE EXTRACTOR ASSEMBLY (AFTER INEGBENEBOR AND ABDULKAREEM, 1993)