Yield and Chemical composition of Leaf protein concentrates and bagasse obtained from Cassava (Manihot esculenta Crantz.) using two extraction methods

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Abstract

This study was carried out to determine the yield, physical properties and chemical composition of leaf protein concentrates and bagasse obtained from Cassava (*Manihot esculenta Crantz*.) leaves using two extraction methods. The extraction was done using heat coagulation and alum precipitation methods, after which the leaf protein concentrates and bagasse obtained were analysed for some chemical composition. The yield of Leaf Protein Concentrate (LPC) obtained from alum precipitation method (6.36%) was higher than LPC obtained from heat coagulation method (4.46%) and this difference was statistically significant and hence, it can be said that alum precipitation method is more efficient. From the chemical analysis, the DM for heat coagulation method (93.60%), alum precipitation method (85.70%) and the bagasse (95.00%) were not significantly different. Crude protein (CP) (39.44%) and ether extract (EE) (17.38%) of the LPC from alum precipitation was better ($P<0.05$) than CP (33.45%) and EE (10.06%) of the LPC obtained using heat coagulation method while the CP and EE of bagasse was 3.92% and 4.10%. The Ash (3.36%) and CF (34.02%) of bagasse was substantial and the Ash (5.51%) of LPC obtained from alum precipitation method and Ash (3.73%) of LPC from heat coagulation method were not different while CF from heat coagulation method (1.76%) and alum precipitation method (1.43%) were not significantly different. The nitrogen-free extract (NFE) of bagasse (51.70%) and of LPC from heat coagulation extraction method (49.73%) were significantly higher ($P<0.05$) than that of LPC obtained from alum precipitation (37.48%). The results from the two extraction methods showed that the yield of CLPC was quite comparable and these may serve as an alternative for the more expensive protein feedstuffs like soybean meal, groundnut cake and other protein feedstuffs in feed formulation considering the high protein content, although CLPC from heat coagulation would be preferred because of its higher CP and could be used as feed for ruminants and also ensiled and used for dry season feeding when feed is scarce.

Keywords: Yield; Chemical composition; Cassava; Leaf protein concentrate; Bagasse

Description of Problem

Protein synthesis is one of the chief activities of the green part of the plant. Some forage crops produce leaf protein in large quantities of up to 5 tons per hectare – three to four times that of grain crops (1). Protein and calorie malnutrition is widely spread in the developing countries. Moreover, importing high-grade animal products put a strain on these country economic (2). Local production is plagued by high cost of production this is because, protein component such as soybean meal, fish meal and groundnut cake are all conventional sources contributing to the increasing cost of livestock production and products (2). Leaf protein is a good source of amino acids, with methionine being a limiting factor, it can also be rich in polyphenols. It has high fibre content and other anti-nutritional factors such as phylate, cyanide and tannins. Cassava (*Manihot esculenta Crantz.*) yield up to 4.60 tonnes dry matter per hectare, and may be produced as a by-product at root harvest (3). The leaf contains an average of 21% crude protein but values ranging from 16.7% to 39.9%. Bagasse, also called megass, is a vegetable fibre mainly composed of cellulose, which has a relatively high modulus. However, there is dearth of information on the effect of method of extraction on the yield and composition of the leaf protein. Therefore, this study was designed to determine the yield and proximate composition of leaf protein concentrates and bagasse obtained from

Cassava leaf (*Manihot esculenta*) extracted using alum precipitation and heat coagulation methods.

Materials and Methods

Harvest and processing of Cassava Leaf

Fresh cassava leaves were harvested early in the day before sunset and were taken immediately to the laboratory for processing as illustrated by (4) and modified by (5). Harvested cassava leaves were weighed, rinsed with clean water free from foreign substances that may have an influence on the accuracy of the result and ground. The slurry was put on a sieve cloth and pressed thoroughly to separate the juice from the fibrous chaff (Bagasse).

Production of Cassava Leaf Protein Concentrate (CLPC) using Heat Coagulation Method

The cassava leaf juice was poured in a clean pot and placed on a stove to heat. The juice was heated, causing the protein to curdle and separate from the liquid whey. After cooling, the curd is filtered out using Whatman filter paper, sun-dried, weighed, and the yield of LPC was recorded.

Production of Cassava Leaf Protein Concentrate (CLPC) using Alum Precipitation Method

After extracting the juice, 1g of crushed alum was added to every 50ml of juice to coagulate the proteins, forming a curd of Leaf Protein Concentrate (LPC). This curd was then separated from the liquid using Whatman filter paper. The sample of LPC taken was sun-dried, weighed, and the yield was recorded.

Data Analysis

The LPC derived from both extraction and resulting bagasse was analyzed for proximate composition, and some mineral content of the LPC were also analyzed using the GENSTAT 12th edition for Windows package at a 5% significance level ($p < 0.05$).

Results and Discussion

The yields from two methods were 4.46% and 6.36% for heat coagulation and alum precipitation methods, respectively. Every 100kg dry matter of Cassava leaf produced an average of 4.46kg and 6.36kg of Cassava leaf protein concentrate for heat coagulation and alum precipitation methods, respectively. The DM and ash contents of the LPC from heat coagulation (93.60% and 3.73%) and alum precipitation (85.70% and 5.51%) were statistically the same ($P>0.05$). The DM (95.00%) was significantly ($P<0.05$) higher than the Ash (3.36%) content of bagasse.

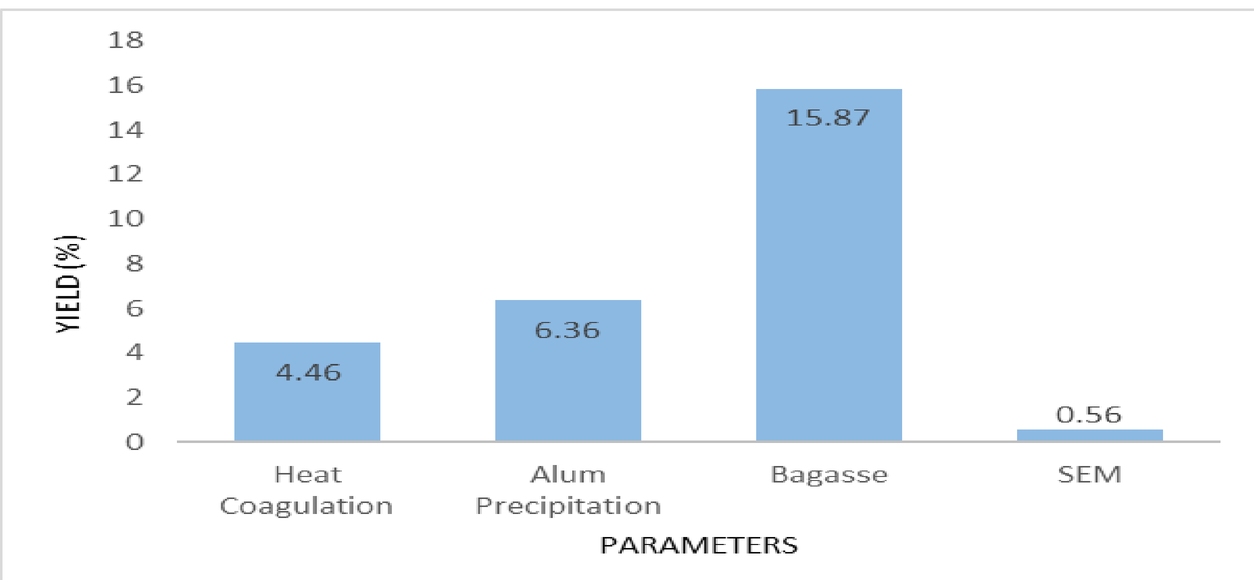

Figure 1: Percentage Yield of CLPC and Bagasse Extracted Using Heat Coagulation and Alum Precipitation

Table 1: Proximate Composition of CLPC and Bagasse Extracted Using Heat Coagulation and Alum Precipitation

Parameters	Heat Coagulation	Alum Precipitation	Bagasse	SEM
DM (%)	95.60	85.70	95.00	4.34
CP (%)	33.45^{b}	39.44^{c}	3.92^{a}	0.51
ASH (%)	3.73^{a}	5.51^{b}	3.36^{a}	0.78
EE (%)	10.06^{b}	17.38^{c}	54.10^{a}	0.5
CF (%)	1.76^{a}	1.43^{a}	34.02^{b}	0.26
NFE (%)	49.73^{b}	37.48^{a}	51.70^{b}	1.10

Mean with the same alphabet on the row are not significantly (p>0.05) different, SEM = Standard Error Mean, DM = Dry Matter, CP = Crude Protein, CF = Crude Fibre, EE = Ether Extract, NFE = Nitrogen Free Extract, CLPC = Cassava Leaf Protein Concentrate.

The CP (39.44%) and EE (17.38%) contents of LPC obtained from alum precipitation method was significantly higher (p<0.05) than the CP (33.45%) and EE (10.06%) contents of LPC obtained from heat coagulation method. The CP content of bagasse (3.92%) was lower (P<0.05) than the values in both alum precipitated and heat coagulated LPC. The CF content of bagasse (34.02%) was statistically higher (P < 0.05) than that of both alum precipitated (1.43%) and heat coagulated (1.76%) LPC. The NFE content of heat coagulated LPC (49.73%) was significantly higher (p<0.05) than that of alum precipitated LPC (37.48%), while the NFE of bagasse was 51.70%.

Percentage yield of cassava LPC (4.46%) using heat coagulation method was significantly lower (p<0.05) than 5% yield obtained from avocado LPC and significantly higher than 2.213% *Raphanus sativus* LPC reported by (2) and (6) respectively using the same method. Percentage yield of Cassava LPC (6.36%) using alum precipitation method was significantly higher (p<0.05) than 3.95% obtained from avocado LPC as reported by (7) using same method. Hence, this could serve as an important source of protein supplementation that is needed in livestock feeding. The percentage yield of bagasse (15.87%) obtained in the present extraction was lower than the 23.62% recorded in bagasse yield obtained from pawpaw leaf processing, as shown by (8).

Conclusion and Application

The results from the two extraction methods showed that the yield of CLPC was quite comparable and these may serve as an alternative for the more expensive protein feedstuffs like soybean meal, groundnut cake and other protein feedstuffs in feed formulation considering the high protein content, although CLPC from heat coagulation would be preferred because of its higher CP and could be used as feed for ruminants and also ensiled and used for dry season feeding when feed is scarce.

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