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Economic analysis of cassava crocket manufacturing process from raw cassava roots as an initiative for waste reduction

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Abstract
Cassava crocket is a convenient product which uses cassava root as main raw material. An economic analysis of anonymous cassava crocket processing plant was carried out to characterize inputs and outputs of the process and evaluate the profitability of production using Gross Margin and Profitability Ratio. Primary data obtained through interviewing production staff and Secondary data was used for the analysis and samples for analysis were collected using online multistage random sampling method over 60 working days. According to the results main wastes generated through the process were cassava peel, squeezed cassava liquid which were 21.5±1.3% and 20.8±1.7% of the raw cassava root weight respectively. According to the results of economic analysis the total raw material cost account for 41.3% of the total variable cost while the labour costs, transportation, rent and other costs accounted for 39.0%, 6.0%,12.5% and 1.2% respectively. From the total raw material cost the cost of Coconut oil made up the highest value which was 54% and cassava, scraped coconut, spices mix and salt made up 36%, 7%, 2% and 1% respectively. The cost and return analysis revealed the Gross margin of 360,740 LKR per year and benefit cost ratio of 1.76. This study reveals the production of cassava crocket in cottage level is profitable.

Keywords: cassava, cassava crocket, cassava waste, economic analysis, material analysis

Introduction
Cassava (*Manihot esculenta*) is a perennial vegetatively propagated shrub commonly cultivated within the low land tropics [1]. Cassava (*Manihot esculenta* Crantz) is the fourth most important food calorie crop in the tropics [2], and has been growing in importance both for food security (especially in Africa) and for multiple commercial and industrial uses (mainly in Latin America and Asia) [3].
According to the National Statistics in the Department of Census and Statistics [4], Sri Lanka The estimated annual production of cassava in year 2014 is 302,767 Metric tons. Sri Lanka has a surplus production of cassava and it is an unexploited tuber crop while having high demand in both local and export markets [5].
Developing of proper technologies is needed to increase the utilization of cassava as processed foods. That helps to increase the potential utilizations and minimize the postharvest losses of the crop. When cassava is sold at raw, the prospects for cassava as a source of income are limited. Diversification of cassava into value added products seems to be a way to increase the demand [5].
Cassava crocket is one of convenient processed product which uses cassava root as main raw material. Improving the productivity and profitability of cassava crocket process will increase the potential utilization of cassava as processed food and improve the market demand to minimize the postharvest loss of the crop.
Economic analyses are an essential tool not only to guide a rational selection of process type, but also a way to disclose the aspects of a given process that need further attention and optimisation [6]. The characteristics of today's competitive market and the need for higher efficiency and lower operational costs, are forcing companies to continuously search for ways to improve their operations [7].
This study is designed to carry out an economic analysis of a Cassava crocket processing plant to characterize inputs and outputs of the process and evaluate profitability of production using Gross Margin and Profitability Ratio.

Materials and Methods
The study involved the use of both primary and secondary data in obtaining information necessary for analysis. Primary data were obtained by interviewing the production staff of the processing plant, onsite observations and sampling. Secondary data relevant to this study were obtained from research reports, journals and textbooks. A multistage random sampling method was used when collecting samples from the process over 60 working days.

Process description
Undamaged fresh cassava roots were sorted and peeled and washed twice with well water. Then roots were grated manually with graters having 4mm diameter cutters. Grated cassava was squeezed to remove excess moisture. The solid residues were then mixed with scraped coconut, salt and spice mixture with 3:1: 0.02:0.01 ratios respectively. Then the mixture was sized in to 40g and shaped in to oval shapes. Then deep frying was done in hot coconut oil pan (170^{o}C for 10 minutes. The final product was then stored at room temperature without packaging and the shelf life of the product was only two (02) hours. The flowchart of cassava crocket manufacturing, inputs and outputs of each process step was shown in figure 1.

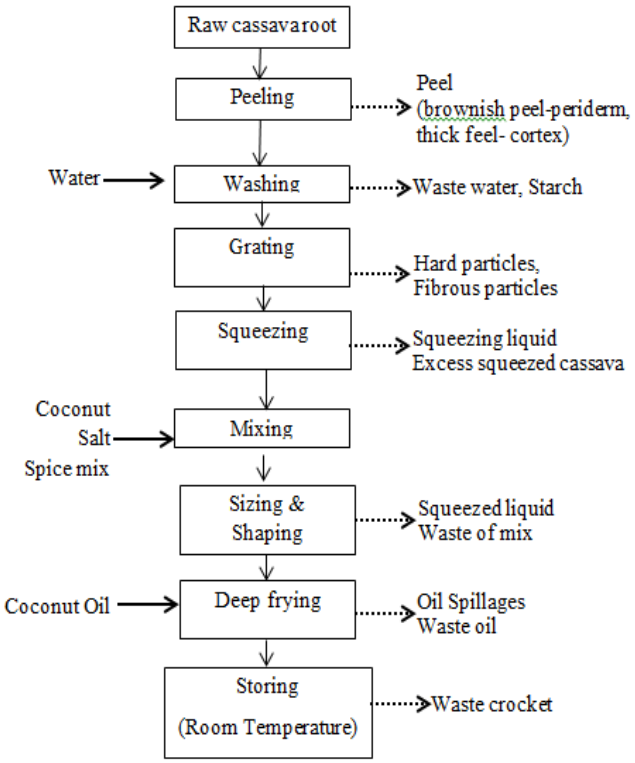

Fig 1: Production flow of cassava crocket

Material Analysis

Material Flow analysis (MFA) was carried out according to the method described in Brunner and Rechberger (2003) [8]. The principle of mass conservation supports establishment of materials balances. It serves as a means of control in cases where all flows are known (input = output ± storage). It can be used to determine one unknown flow per process [8].

Assumptions- The cassava crocket processing plant utilizes 1440kg of raw cassava root per annum and has the production capacity of 34320 cassava crockets per annum.

The inputs involve cassava roots, scraped coconut, salt, spice mixture, coconut oil, water and energy.

Economic analysis

According to the Industrial commission of India cottage industry definition is industries carried on in the home of workers, where the scale of operation is small, and there is but little organization. As cassava crocket processing plant is operated at cottage level with negligible fixed costs the economic analysis method used in Odoemenem and Otanwa, (2011) [9] was used to estimate the Gross Margin. The difference between revenue (returns) and Total Variable Cost (TVC) makes up the Gross Margin (GM).

$$GM = GI - TVC$$
$$GI = TVP = TPP.Py$$
$$GM = TPP.Py - TVC$$

Where,

Py is the price of a unit product
TVC is the total variable cost
TVP is the total value of production
TPP is the total physical product
GI is Gross income

The profitability ratio used is Benefit-Cost Ratio (BCR). The Benefit-Cost Ratio is the ratio between Gross Income (Total revenue) and Total Variable Cost.

$$BCR = GI/TVC$$

Economic analysis was based on following assumptions. (1) Operation hours for cassava crocket plant were assumed 8h/day. (2) The source of Water for manufacturing was well water and no cost involve for water other than electricity cost. (3) No direct or indirect marketing cost was involved.

Results and Discussion

Material flow analysis of cassava crocket production

At raw material receiving only sorted roots with no physical damages were bought thus had not caused any waste at the raw material receiving process. According to the results of material flow analysis the amount of wastes generated at peeling process was 21.5±1.3%. The hand peeling can constitute 20 to 35% of the total weight of tuber [10]. The further analysis of peel wastes revealed that from the peel waste 3.6±0.5% of total cassava root is the brownish peel which is the periderm and 17.7±1.0% of the total cassava root is thick peel which is the cortex.

The output of washing was the washed and peeled root showed a significant increase in its weight, which was 2.5±0.8% from the initial weight of the peeled root after the washing process. The amount of waste water generated annually was 2480L which also contain starch leached out from the tubers.

The results of the material flow analysis showed that 5.0±1.0% and 20.8±1.7% from the raw cassava weight was wasted as fibrous hard materials while grating and squeezed liquid while squeezing. The inputs of mixing process were scraped coconut, spices mixture, salt and squeezed cassava and no significant waste was observed at mixing. The sizing process results the shaped cassava crocket as main output and 0.5±0.1% and 0.03±0.015% from the raw weight was wasted as the squeezed liquid and cassava crocket mixture.

The results of material flow analysis revealed that 45.1±5.0%, 10.0±2.5%, 8±3% of the total coconut oil was waste as discoloured liquid fried oil, spillages and evaporation while frying. About 35±7% of the total coconut oil was wasted while frying as absorbing to the fried cassava crocket which even cause for poor quality and reduced shelf life in the final product. The waste occurred at the storage was the returned poor quality cassava crockets due to moisture absorption and it accounts 5±1% from the final cassava crocket production.

Economic analysis of cassava crocket production

This is done to determine the cost and returns to cassava crocket manufacturers for effective comparative analysis of the costs and returns in cassava crocket production in the selected cassava crocket processing plant. The economic analysis was based on statistics obtained on annual production.

Costs that were considered here include cost incurred from variable inputs like raw material cost, labour, transportation, rent and other costs. Note that there were no cost involved for water as the source was pumped well water from a well available in the manufacturing premises. The cost for pumping water was also inclusive with the electricity cost which included as other costs for the analysis.

Figure 2 illustrates that the total raw material cost accounted for about 41.3% from the total variable cost, while analysis of other costs revealed that the percentages share of labour costs, transportation, rent and other costs were 39.0%, 6.0%,12.5% and

1.2% respectively. Other costs included the fuel cost which is the LP gas for cooker used to heat oil in the frying process and electricity cost which included pumping water and general purposes. The production process was manual and thus electricity cost was low.

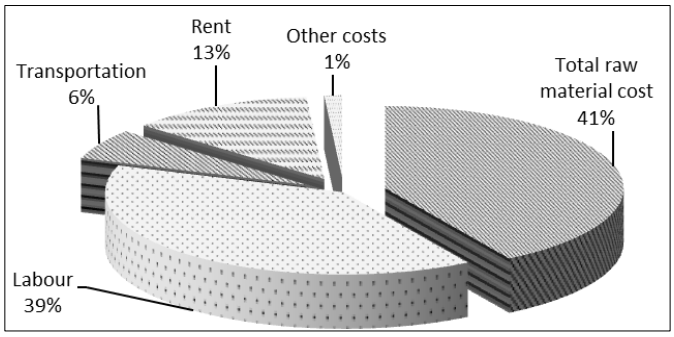

Fig 2: Total variable costs of cassava crocket production

As shown in Figure 3 and Table 1, more than three quarter of total raw material cost was made up of cost of coconut oil, and cost of raw cassava. From the cost for main raw material which is for cassava was 18% lower than the cost of coconut oil which was 54% of the Total raw material cost.

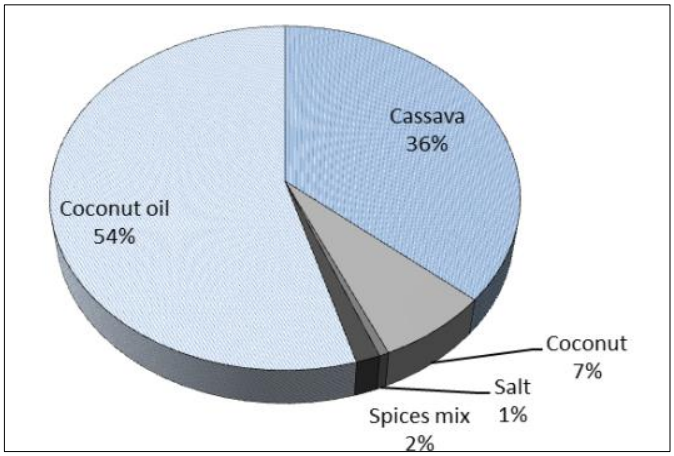

Fig 3: Total raw material cost of cassava crocket production

The result of Gross margin analysis was presented in Table 1. The costs and returns analysis showed the gross margin of 360,740 LKR per year. That shows a monthly income of 30061 LKR. The benefit cost ratio showed a figure of 1.76. The analysis revealed the production of cassava crocket in cottage level yields profit to manufacturers.

Table 1: Gross Margin Analysis of Cassava Crocket Production

(A) Variable cost/Inputs	**Amount (LKR)**	**%**
Raw material cost		
Cassava	72000	15.0
Coconut	14100	2.9
Salt	1200	0.2
Spices mix	3000	0.6
Coconut oil	108000	22.5
Total raw material cost	198300	41.3
Labour	187200	39.0
Transportation	28800	6.0
Rent	60000	12.5
Other costs (fuel, Electricity)	5760	1.2
Total other costs	281760	58.7
Total Variable cost(TVC)	480060	100.0
(B) Revenue		
Cassava crocket	840800	100.0
Total Revenue(TR)	840800	100.0
Gross Margin=TR-TVC=	360740	
Benefit cost ratio= TR/TVC=	1.75	

Conclusion

This case study revealed that there was a considerable amount of waste occurred in the production of cassava crocket from raw cassava roots and the production of cassava crocket in cottage level is a profitable process which can empower the economy of women.

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References

1. Jekayinfa SO, Olajide JO. Analysis of energy usage in the production of three selected cassava-based foods in Nigeria. Journal of Food Engineering. 2007; 82:217-226.
2. Somendrika MAD, Wickramasinghe I, Wansapala MAJ, Peiris S. Material flow analysis of Cassava crocket manufacturing process from raw cassava (Mannihotesculenta) roots. International Journal of Innovative Research in Technology. 2016; 2:32-35.
3. Somendrika MAD, Wickramasinghe I, Wansapala MAJ, Peiris S. Quantification of the Material Flow of Raw Cassava

Tubers Processing for Export Market. European Journal of Academic Essays. 2016; 3:105-108.
4. National Accounts of Sri Lanka 2014, Department of Census and Statistics August 2015.
5. Wijesinghe WAJP, Sarananda KH. Utilization of Cassava Through Freezing. Journal of Food and Agriculture. 2008; pp.17-29.
6. Leda R Castilho, Carla MS Polato, Edmond A Baruque, Geraldo L Sant'Anna Jr, Denise MG Freire. Economic analysis of lipase production by Penicillium restrictum in solid-state and submerged fermentations. Biochemical Engineering Journal. 2000; 4:239-247.
7. Nunes B Bennett. Green operations initiatives in the automotive industry: An environmental reports analysis and benchmarking study. Benchmarking: An International Journal. 2010; 17(3):396-420.
8. Practical Handbook of Material Flow Analysis, Brunner P.H and Rechberger H, CRC Press, 2003; pp.1-44.
9. Odoemenem IU, Otanwa LB. Economic Analysis of Cassava Production in Benue State, Nigeria. Current Research Journal of Social Sciences. 2011; 3(5):406-411.
10. Ubalua AO. Cassava wastes: treatment options and value addition alternatives. African Journal of Biotechnology. 2007; 6(18):2065-2073.