

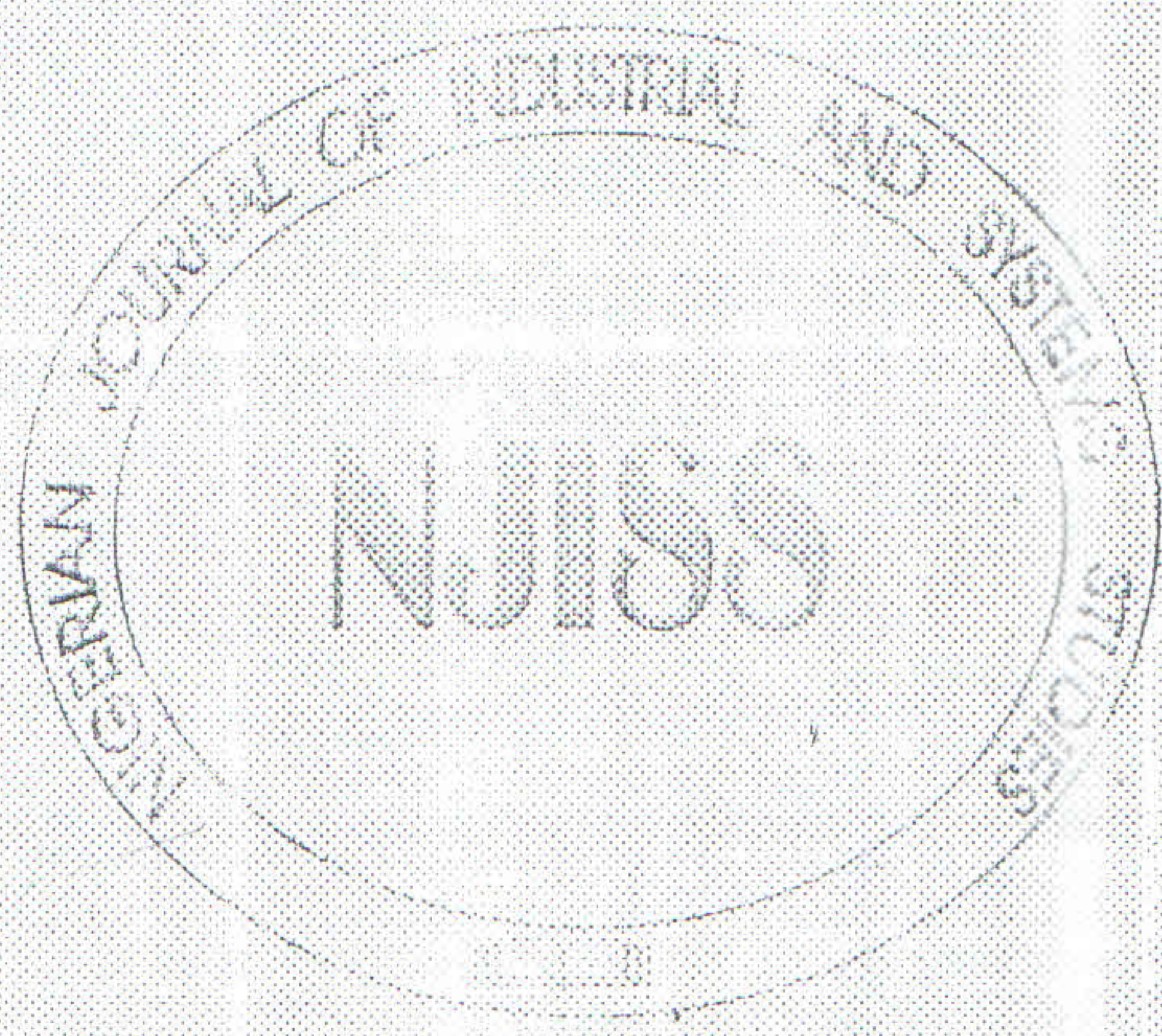
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# TECHNOLOGICAL AND ECONOMIC EVALUATION OF USING LOCAL BANANA FOR COMMERCIAL BISCUIT PRODUCTION

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## ABSTRACT

Biscuit was produced using banana puree and powder obtained from three local cultivars namely Cavendish (CDH), Chinensis (CHS) and Senior (SER) bananas procured from the local market. Two separate formulations were used - Formulation A contained 37.50% Banana puree while Formulation B contained 30.75% Banana powder. Proximate analysis and sensory evaluation of biscuit samples were carried out. Also market, raw materials and equipment identification surveys were carried out. Economic feasibility of 250 T/annum production output was then evaluated. Sensory analysis indicated that biscuit samples produced from chinensis banana were most acceptable while samples from the three cultivars conform with SON (1992) quality requirement with similar proximate composition. Market survey showed that the demand - supply gap for biscuit was about 12,000 T/annum and raw material survey revealed that there is abundant and enough banana to sustain commercial production. Production equipment identification survey showed that the equipment could be sourced locally. Economic evaluation of 250 T/annum output of biscuit showed high profitability ratios, short pay back period and low break - even volume.

**Key words:** banana puree and powder, biscuit, economic evaluation

## INTRODUCTION

Banana (*Musa sapientum*) is one of the important fruits taken as food supplement by people to supply the body with part of the carbohydrate, protein, mineral and vitamin requirement. Ngeze (1994) analysed 100 grammes of green banana fruit to reveal nutrients shown in Table 1 below.

Table 1: Proximate Chemical Composition of Mature Green Banana Fruit

Nutrient	Parts per 100 gram me
Water	70
Total carbohydrates	21
Fat	21
Protein	1.3
Calcium	4.6 milligram me
Phosphorous	47.1 milligram me
Iron	0.4 milligram me
Ascorbic acid	14 milligram me
Caloric value	91 IU

Source: Ngeze (1994).

Brady and O'Connell (1976) reported an increase in the rate of protein synthesis during ripening of the banana fruit. Ketiku (1973) hydrolysed plantain pulp protein and identified 16 amino acids which were shown to increase during ripening. Again, Askar (1973) examined amino acid of banana pulp and found that they were similar to that of the plantain.

There is great potential in the utilization of banana as food and raw materials. Ripe banana fruits are sweet and are cherished by many people. (Ngeze 1994). Banana can also be processed into either puree or powder to fortify protein content in bakery products especially biscuit. Several attempts have been made by scientists to either reduce the quantity of wheat used in bakery products or to fortify the products with plant protein. Dendy et. al. (1970) and Olatunji and Akinrele (1978) worked extensively on the use of cassava starch, rice flour, yam flour, cocoyam flour, cassava flour and bread fruit flour as composite with wheat flour in bread production. Also, Tsen (1976) proved that protein-rich biscuit can be prepared from composite flour, such as wheat flour with soy, cottonseed, peanut or corn germ flours. Singh et. al. (1996) incorporated



shape of 2.5 cm radius. It was then docked with the tines of a fork. Baking was carried out in Bongard Deck Oven at 110°C for 20 minutes. The final products were then allowed to cool. Another set of biscuits were produced from Banana powder by the same method. The two sets of biscuits obtained from each cultivar were subjected to sensory analysis and proximate composition analysis using SON (1992) methods of analysis.

Table 2: Biscuit Recipe Using Banana Puree and Powder

INGREDIENT	PART PER 100	
	PUREE (A)	POWDER (B)
Banana Puree	37.50	-
Banana Powder	-	30.75
Wheat Flour	45.00	30.75
Sugar	7.50	15.00
Shortening	6.70	15.00
Milk	2.70	5.00
Salt	0.30	0.50
Leavening Agent	0.30	1.00
Water	-	2.00

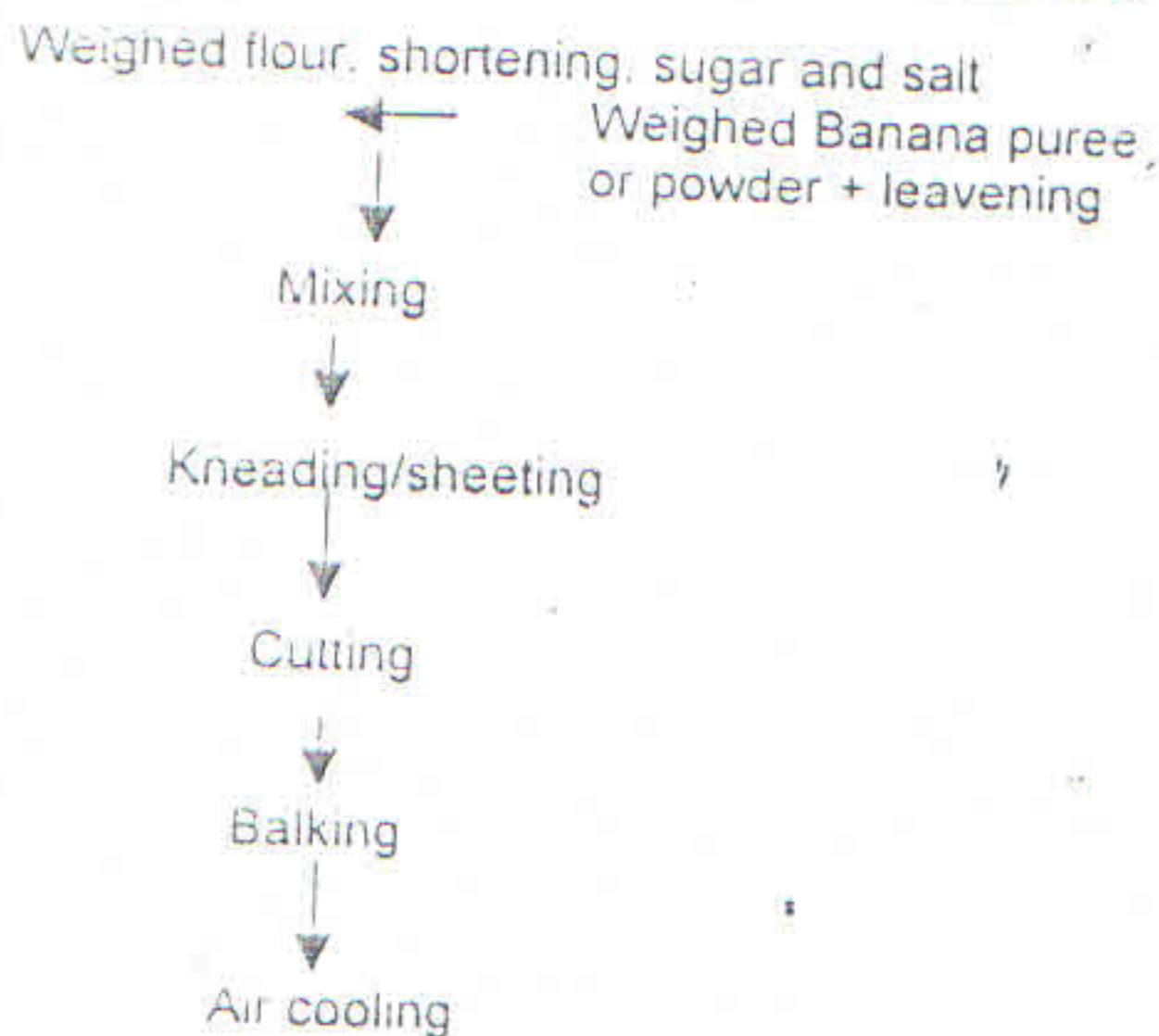


Fig. 2: Operational Flow Chart for Banana Biscuit Production

## MARKET SURVEY

Market survey was carried out to determine rate of consumption of biscuit. The existing major biscuit producers were identified through industrial directory and contacted. Demand questionnaires were personally administered to some distributors within Lagos. Open market survey was carried out in both rural and urban settlement of Lagos and environ. Information on importation of biscuit to the country was obtained from FOS (1998) publications.

## RAW MATERIALS SURVEY

Banana is one of the major raw materials on which raw material survey was carried out. Some states Ministry of Agriculture in the Western zone were contacted personally, and by post to ascertain their annual level of banana production. FOS publications were proved useful to supply the estimated annual production of banana. For other raw materials – Flour, sugar, milk, salt, leavening agent and margarine – major distributors and suppliers were visited in Lagos and Ibadan.

## RESULTS AND DISCUSSION

### Biscuit Prepared

Tables 3 and 4 show the results of the banana biscuit proximate composition and sensory evaluation respectively.

The proximate composition shown in Table 3 represent mean values of two determinations. The Moisture content, which is 5.80, is the same for three cultivars. The ash content is 1.92 for cavendish cultivar while chinensis and senior cultivars have the same values of 1.90. The Acidity of extracted fat is 0.69 for chinensis cultivar, 0.71 for cavendish cultivar and 0.74 for senior cultivar. The three cultivars have same value of acid insoluble as, the value of which is 0.02. Chinensis cultivar has the highest value of protein content, which is 6.85. The protein contents of cavendish and senior cultivars are 6.70 and 6.75 respectively. There is no presence of hydrocyanic acid, yeast and mould in any of the biscuit samples.

Table 4 shows the sensory evaluation results for the banana biscuit samples and the control as biscuit sample obtained from the open market. The colour of all the banana biscuit samples are acceptable although Chinensis cultivar gave biscuit of most acceptable colour. Biscuit samples obtained from Senior and Cavendish are very crispy while those of Chinensis are less crispy. All the biscuit samples from the three cultivars have characteristic banana fruit flavour.

## EQUIPMENT IDENTIFICATION SURVEY

Production equipment for small scale level was identified through equipment identification survey carried out in Lagos. Raw material Research and Development Council (RMRDC 1997) publication on Nigerian equipment fabricators was useful in supplying names and addresses of local fabricators. Five local equipment manufacturers who claimed competency and capability in biscuit equipment were visited and interviewed.



defatted soy flour up to 20% level in the formulation of biscuit without affecting the overall quality. Again, Mc Walters (1980) confirmed the possibility of replacing costly milk proteins with proteins from cowpea and field pea flours in baking biscuit. Though, Ogazi (1996) reported that Leclerc and Wessling in 1918 and Pupaigue and Richard in 1965 used banana flour as composite with wheat flour to produce bread and biscuit respectively, there is no report of extensive work on this. As, he also noted, literature is limited on the use of banana flour in composite flour for the bakery products when compared with the extensive literature on the use of other starch staples and grains in composite flour. He, therefore, carried out an in-depth research work on utilization of plantain flour and produced acceptable biscuit with 100% plantain flour with other baking ingredients but he did not evaluate the production process economically.

This study reports production of banana biscuits using banana puree/powder with other baking ingredients. It also evaluates the production process economically in order to report the market potentials, raw materials availability, industrial equipment and financial indices and profitability ratios of commercial production of banana biscuits which are not adequately reported in literature.

## MATERIALS AND METHODS

The raw material used for Banana Puree and Powder production are green matured banana fruits. These were obtained from open market in Lagos and kept in jute bag with perforations of not more than 0.18mm aperture for six days to allow for artificial ripening. Hand sugar refractometer was used to monitor the sugar level of the banana until it ripened to 18-22% brix of sugar. All purpose wheat flour, sugar, shortening/margarine, milk, salt and leavening agent were also obtained from the local market in Lagos.

## METHOD

### Banana Puree and Powder Preparation

Ripened banana fruits were sorted to remove unsound fruits fingers, weighed and washed before being peeled. The peeled banana fruits were immersed in 1% solution of sodium metabisulphite for 10 minutes, sliced, mashed into very smooth slurry and screened to remove seed. The slurry was subjected to pasteurisation at 94°C for 5 minutes, cooled to 30°C and 2.2g of citric acid/kg of puree was added as antimicrobial preservative. Puree yield is average of 65% based on raw banana fruit.

Further processes to produce powder were carried out by drying a portion of the puree in laboratory tray dryer and the dried cake was milled into powdery form of 675 micron particle size by hammer mill. The average yield of banana powder is 17.5% based on raw banana fruit.

Banana fruit Preparation (Artificial ripening, sorting, weighing and washing)

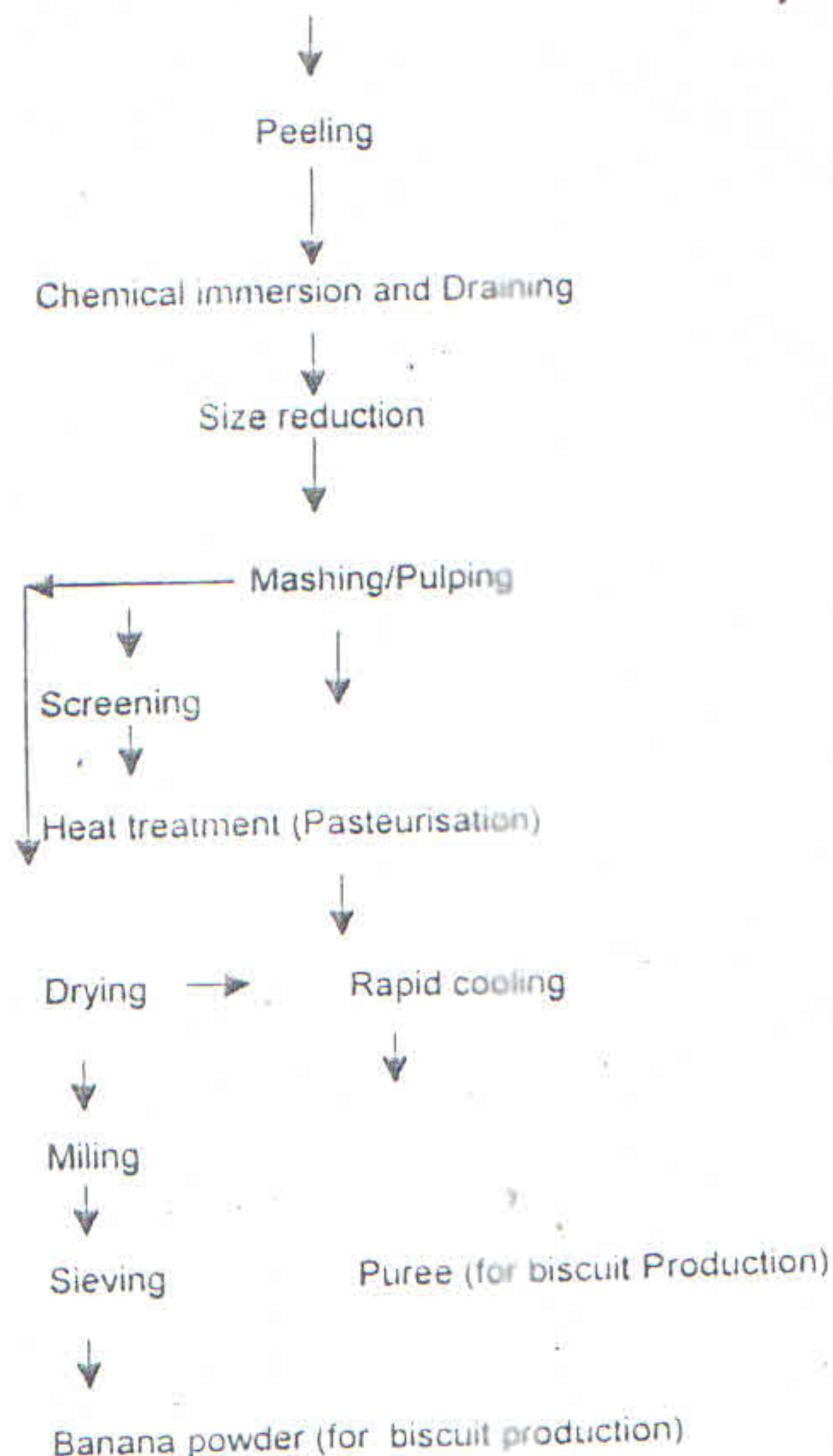


Fig. 1: Operational Flow Chart for Banana Puree and Powder Production

### Biscuit Preparation

The required quantities of the raw materials (Table 2) were measured and mixed together with the exception of the leavening agent. The leavening agent was mixed with the required quantity of banana puree. The two were then mixed together thoroughly using dough mixer to have consistent dough. The dough was rolled out into sheet of 0.4cm thickness and cut into round



Table 3: Proximate Composition of Banana Biscuit Samples.

Parameter	Banana Biscuit			SON (1992) Specification
	CHS	CDH	SER	
Moisture (% W/W)	5.80	5.80	5.80	6.00**
Ash (% W/W)	1.90	1.92	1.90	2.00**
Acidity of Extracted fat [as oleic acid] (% W/W)	0.69	0.71	0.74	1.00**
Acid insoluble ash (% W/W)	0.02	0.02	0.02	0.05**
Protein % (N X 5.7)	6.85	6.70	6.75	5.00*
Hydrocyanic acid (HCN) (Dry wt. mg/kg)	Nil	Nil	Nil	0.03**
Yeast and Mould	Nil	Nil	Nil	Nil

Values represent mean of 2 determinations; \*minimum level, \*\*maximum level

Table 4: Result of Sensory Evaluation

Sensory Parameter	Mean of score of biscuit samples						
	Sample A			Sample B			Control
	CDH	CHS	SER	CDH	CHS	SFR	CO
Colour	4.50 <sup>a</sup>	5.13 <sup>a</sup>	5.25 <sup>a</sup>	4.48 <sup>a</sup>	5.10 <sup>a</sup>	5.25 <sup>a</sup>	4.38 <sup>a</sup>
Texture/Crispiness	6.11 <sup>a</sup>	4.44 <sup>a</sup>	6.56 <sup>a</sup>	6.10 <sup>a</sup>	4.54 <sup>a</sup>	6.60 <sup>a</sup>	3.22 <sup>b</sup>
Flavour	5.67 <sup>a</sup>	4.78 <sup>a</sup>	6.11 <sup>a</sup>	5.64 <sup>a</sup>	4.80 <sup>a</sup>	6.10 <sup>a</sup>	2.78 <sup>b</sup>
After taste	5.56 <sup>a</sup>	5.88 <sup>a</sup>	5.89 <sup>a</sup>	5.51 <sup>a</sup>	5.76 <sup>a</sup>	5.79 <sup>a</sup>	2.50 <sup>b</sup>

a or b implies that means with the same superscript letters along the same row are not significantly different ( $P \leq 0.05$ ). CDH - Cavendish cultivar, CHS - Chinensis cultivar, SER - Senior cultivar

while the control lacked the flavour, therefore, rated as being significantly different ( $P \leq 0.05$ ). Also, all the banana biscuit samples were adjudged to have quite desirable after taste. This result shows that banana powder/puree is good for biscuit making with biscuit samples from Chinensis most acceptable

#### Availability of Raw Materials

Raw materials survey carried out on availability of banana showed that there is abundant banana in Nigeria. Banana is widely grown in the southern part of Nigeria where condition is favourable for large acreage cultivation. In 1992 and 1993, the output of banana produced in Nigeria are 1.013 and 1.057 million metric tonnes respectively (FOS, 1998). Recent FOS publications were not available for use as at the time of this study. Among the states Ministry of Agriculture contacted, only Ekiti State could supply the recent banana output in the State. The figures were put at 0.720 and 0.850 million metric tonnes for 1998 and 1999 respectively (MAE, 2000). Though there was no documented price of banana in the

publications available during the survey period, the survey was able to obtain N7 500/ton as average price of banana from farmers and farmer representatives at State and Local Government levels. Survey of other raw materials - wheat flour, shortening, sugar, milk, salt, baking powder and chemical preservatives required for small scale production of banana biscuit was carried out in Lagos and Oyo States. The result showed that they are readily available in the major markets, distribution stores and local vendor shops. The quantity of raw materials required for 250 T/annum of banana biscuit is shown in Table 5

Table 5: Annual Raw Materials Requirement For 250 T/Annum of Banana Biscuit.

Item	Quantity/Annum (Tonnes)
Banana	246.25
Wheat Flour	170.50
Shortening	25.00
Sugar	27.70
Milk	9.90
Salt	1.20
Baking Powder	1.20
Chemical	3.20



## Market Survey

Market survey carried out indicated that bakery products especially biscuit are widely consumed in rural as well as urban areas in Nigeria by people of all age groups. Modern life and economic situation have forcefully increased the working hours of women folks, therefore, they have little or no time to prepare family menu. The result of this is an increase in the rate of consumption of processed foods. The most popular among the processed foods is biscuit which comes in large number of varieties with low cost and longer shelf-life. The survey indicated that there are biscuits of different shape, size, composition, flavour, cost and packaging in the market. About 15 companies were identified as major manufacturers of different brands of biscuit with production volume total up to 60,000 tonnes of biscuit per annum. National demand for biscuits was estimated based on many factors. These are biscuit importation data, local production volume, consumption pattern, open market survey, buyers intention survey, analysis of producers, distributors and retailers past sales records and consideration of Nigerian market vis-à-vis the population. Application of statistical technique to raw demand and supply data collected and consideration of aforementioned factors showed that the demand supply gap for biscuit is 12,000 T/annum.

## Equipment Identification

Equipment identification survey carried out showed that major production equipment for 250 tonnes/annum production output could be fabricated locally. The survey indicated that other equipment that cannot be fabricated locally are available in the country. They could be sourced from major processing and laboratory equipment importers/suppliers. Table 6 shows the list of machinery and equipment required.

## Economic Evaluation

The economic evaluation was carried out in line with the national definition of Small and Medium enterprises by National Council on Industry (NCI). NCI in 1996 (CBN, 1997) defined small scale Enterprises as those with total cost, including working capital but excluding cost of land, above ₦1.0 million but not exceeding ₦40.0 million with a labour size of between 11 and 35 workers. Based on the above definition, the total investment cost is ₦6.5 million while a labour size of 25 workers was considered. The cost of banana used was ₦10,000 per tonne.

Table 6: List of Major Machinery and Equipment Required for 250 Tonnes/Annum Banana Biscuit Production

Item	Source
Baking oven	Local
Dough Mixer	Local
Dough Roller	Local
Pasteurizer	Local
Biscuit cutter	Local
Colloid Mill	Local
Wrapping Machine	Imported*
Deep Freezer	Local
Refractometer	Imported*
Weighing scale	Imported*
Quality Control Equipment	Imported*
Cabinet dryer	Local
Hammer mill	Local
Washing vat, storage accessories, knives, scoops wooden pallets and burner	Local

\* Could be sourced within the country.

The profitability analyses of 250 T/Annum Banana biscuit production output were based on the production programme assumed below:-

Production Volume/Day - 1 Tonne  
 Production Day/Annum - 250 Tonnes  
 Production Volume/ Annum(Full capacity)  
 - 250 Tonnes  
 First Year Production volume (75% Capacity)  
 - 175 Tonnes  
 Second and Third Year Production volume  
 (80% capacity) - 200 Tonnes  
 Fourth and Fifth Year Production Volume  
 (90% capacity - 225 Tonnes

The profitability ratios are summarised below:-

Rate of Return on Investment (ROI): 45%  
 Rate of Return on Equity (ROE): 110%  
 Internal Rate of Return (IRR) >50%  
 Pay Back Period: < 2 years  
 Break Even Point: 40% of full capacity production

## CONCLUSION

Industrial utilization of banana fruit in Nigeria is overdue. Most of the annually produced banana get wasted due to lack of the knowledge of economic potential of the fruit. Using banana to produce biscuit will reduce the wastage drastically. It will also encourage cultivation of banana by farmers. The use of banana as raw material for biscuit production is economical as the cost of



wheat flour required for production replaced by banana puree/ powder is about thrice the cost of banana used.

## RECOMMENDATION

Biscuit is one of the food products, as such, its production must be standardised. It is recommended that standard quality control equipment for testing both raw materials and finished products be put in place. Material of construction of machinery and equipment should be food grade stainless steel. Production personnel should pass through rigorous medical examination before being employed. It is important to register all food products with regulatory agencies especially NAFDAC and comply with all the registration requirements.

It is also recommended that detailed feasibility study on the project be carried out to support investment decision, the report could be prepared by FIRO. FIRO also offers technical assistance service which include machinery and equipment sourcing, installation and commissioning and personnel training on the installed equipment.

## ACKNOWLEDGEMENT

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