academicJournals

Vol. 9(3) pp. 142-154, March, 2015
DOI: 10.5897/AJFS2014.1135
Article Number: 66ADB0A50826
ISSN 1996-0794

http://www.academicjournals.org/AJFS

African Journal of Food Science

Full Length Research Paper

A survey on existing practices adopted in *Dambu* production and utilization in some northern states of Nigeria

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Received 13 January, 2014; Accepted 16 February, 2015

A survey was conducted in relation to the production process of *dambu*. *Dambu* is a staple food for the Fulanis and Hausas. A majority of the *dambu* dealers (42.7%) were less than 25 years old. A proportion of 78.7% of processors of *dambu* were females. The processors/consumers (37.4%) indicated that millet was the major raw material for *dambu* production. A significant difference (p = 0.01) existed among respondents on the variety of millet chosen for *dambu* production. The study reveals that 'gero' is the variety in common use. Spices are indispensable as an ingredient in *dambu* production with ginger being the single most important spice (p = 0.07). The traditional pounding method for processing millet into flour is still very much used. The processors (58.9%) and retailers (41.0%) generally agreed that the method of marketing *dambu* is by hawking in transparent low density polyethylene package. Sun drying as indicated by 35.3% of the respondents was the most common method of storing left-over *dambu*. Total percentage of 27.4, 39.2 and 33.4% were deduced for the poor, the middle and the rich class consumption of *dambu*, respectively. With increasing influence of advertising upon customers, small food processing enterprises making *dambu* will have to improve the packaging and preservation of their products as to survive the competition. The implications of these are highlighted and a possible solution of optimizing the *dambu* production process is recommended.

Key words: Ginger, cloves, *dambu*, millet, packaging, shelf-life.

INTRODUCTION

In tropical Africa, cereal grains are milled and used to produce different types of food which are known by various names in different parts of the African continent as thin porridge (ogi) (Apena et al., 2006), thick porridge

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fura (Jideani et al., 1995; Umoh, 2003; Filli et al., 2007), baked or fried fermented bread such as *mawè* (Hounhouigan et al., 1993), *masa* (Ayo et al., 2008), snacks (Vidyavati et al., 2004), alcoholic beverage (burukutu) (Igyor et al., 2006) and non-alcoholic beverages such as *kunun zaki* (Gaffa and Jideani, 2001; Ayo and Obeya, 2004; Gaffa et al., 2004). In West Africa, particularly in the Northern part of Nigeria, one of such cereal-based products is called *dambu* - a steamed non-fermented granulated dumpling generally made from pearl millet (Nkama et al., 1999; Agu et al., 2007, 2008). It is known as *dambu* among the Hausas while among the Fulanis, it is known as "nyamri" (Haruna, 2003). *Dambu* is similar to *fura* – a semi- solid dumpling cereal meal, but differs only in the production process (Jideani and Wedzicha, 1994).

Dambu is produced mainly from moistened pearl millet flour, blended with spices and steamed for 20 min. using two fold systems, which involves pouring the mixed flour with spices into a sieve and placed on an open pot that contains little water. Care is taken for the sieve not to touch the water. As the water in the pot boils, the steam cooks the *dambu* on the sieve. It has coarse particles resembling moistened couscous. It is sprinkled into fermented skimmed milk (*nono*), or fermented whole milk (*Kindirimo*) and sugar may be added to taste. It is a popular mid-day meal called "*dambu* da nono" in Nigeria (Nkama et al., 1999).

Dambu contains energy of 257 kcal, moisture of 37%, ash 1.1%, crude protein 10.7%, fat 3.4%, crude fibre 2.0%, and carbohydrate 45.9% per 100 g. It also contains essential and non- essential amino acids with major and minor mineral elements (Agu et al., 2007). *Dambu* has been produced with different grain types and pearl millet was rated high based on aroma, texture and overall acceptability (Agu et al., 2007) and based on this, using different pearl millet cultivars will be productive.

Dambu is produced at home both for family and commercial consumption. Most *dambu* producers use the traditional method involving wooden mortar to dehull or mill the grains. Pearl millet products like *fura* and *dambu* are sold from calabash containers to consumers without appropriate packaging (Jideani et al., 2001a; Agu et al., 2008). Good packaging not only serves as food container but protects and carries the necessary information about the food product. It is particularly important in countries with tropical and humid climates, where food deterioration is most rapid (UNIFEM, 1993). *Dambu* is hawked by the local producers. The processors and retailers of *dambu* are only concerned with having a calabash or enamel porcelain container for their food. The practice of opening and closing of the container during sales subjects the food to microbial contamination. *Dambu* has a limited shelf-life of one day at ambient temperature. Usually, a day after the production, *dambu* shows visible mould growth on the surface. The short shelf-life has always been a major deterrent to large scale production. Thus, improving the processing, packaging and storage life of *dambu* are of interest before food manufacturers can think of large scale production. This study was conducted to establish the materials and the ingredients as well as the production process for *dambu* from the processors and consumers. This will provide baseline information for food manufacturers and a basis for improving this process.

MATERIALS AND METHODS

Survey area

States in northern Nigeria chosen for the study included Bauchi, Plateau, Kaduna, Kano, Gombe, Jigawa, Borno, Adamawa and Katsina. These are the major *dambu* producing and consuming states in Nigeria (Jideani et al., 2001).

Methods

The study data was collected using a structured questionnaire. The questionnaires were designed and pretested before being distributed to the potential respondents. The questionnaires were divided into sections in order to collect information on:

1. Socio demographic particulars,
2. Raw materials for *Dambu* production,
3. Steps involved in primary processing,
4. Steps involved in secondary processing mode of display,
5. Equipment used and its cost details,
6. Cost of inputs, packaging, mode od display, shelf life storage methods product utilization,
7. By product utilization and,
8. Personnel needed

Data collection and analysis

The processors, retailers and consumers of *dambu* in Bauchi, Plateau, Kaduna, Kano, Gombe, Jigawa, Borno, Adamawa and Katsina states were distributed a total of 1000 questionnaires. The questionnaires were completed by the respondents in their homes, markets and offices. There was agreement on when the completed questionnaires could be picked up. Where the respondents could not speak English, interviews were conducted in the local language with the assistance of an interpreter. Questionnaires (827) representing 82.7% were retrieved. The remaining 17.3% were either reluctant to return their questionnaire or could not be located.

Data from the questionnaires were analyzed by tally and the number of the tallies for each question was entered into a MINITAB (version 11, 1996) and tabulated as percentages. The Kruskal-Wallis H test (a non-parametric one-way ANOVA) was used to compare the data.

RESULTS AND DISCUSSION

Demography of respondents

Demographic characteristics in relation to the status of

Table 1. Demographic Characteristics as related to the processor retailer/consumer status.

Question	Processor	Retailer	Processor/Retailer	Consumer	Processor/Consumer	Total	P-value
	n =216	n = 83	n = 211	n = 143	n = 174	n = 827	
Sex							
Male	46 (21.3)	22(26.5)	67 (31.8)	77 (53.8)	78 (44.8)	290 (35.1)	
Female	170 (78.7)	61 (73.5)	144 (68.2)	66 (46.2)	96 (55.2)	537 (64.9)	0.07
Age							
≤25	106 (49.1)	37 (44.6)	79 (37.0)	58 (40.6)	73 (41.9)	353 (42.7)	
26-35	70 (32.4)	27 (32.5)	43 (20.4)	49 (34.3)	40 (23.0)	229 (27.7)	
36-45	30 (13.9)	9 (10.8)	56 (26.5)	36 (25.2)	15 (8.6)	146 (17.7)	
>46	10 (4.6)	10 (12.0)	33 (15.6)	-	46 (26.4)	99 (12.0)	0.01
Education							
None	55 (25.5)	12 (14.5)	74 (35.1)	37 (25.9)	39 (22.4)	217 (26.2)	
Primary	59 (27.3)	28 (33.7)	64 (30.3)	26 (18.27)	34 (19.5)	211 (25.5)	
Sec/Tech/Com	36 (16.7)	7 (8.4)	40 (19.0)	33 (23.1)	12 (6.9)	128 (15.5)	
Vocational	42 (19.4)	20 (24.1)	28 (13.3)	21 (41.7)	44 (25.3)	155 (18.7)	
University/Poly	24 (11.1)	16 (19.3)	5 (2.4)	26 (18.2)	45 (25.9)	116 (14.0)	0.23
Ethnicity							
Kanuri	31 (14.4)	21 (25.3)	5 (2.4)	56 (39.2)	28 (16.1)	141 (17.0)	
Hausa	84 (38.9)	40 (48.2)	93 (44.1)	32 (22.4)	46 (26.4)	295 (35.7)	
Fulani	101 (46.8)	22 (26.5)	113 (53.6)	55 (38.5)	100 (57.5)	391 (47.3)	0.06

Figures in parentheses are percentages; Kruskal - Wallis one-way ANOVA test.

the respondents are presented in Table 1. A total of 827 respondents were used for the study. Processors /retailers were those who produced *dambu* and either hawked it or sold it on a wholesale basis. Retailers- those who do not process *dambu* but bought from processors to sell were also surveyed. Processors/consumers were those who produced *dambu* for consumption purposes. Consumers were those not involved in processing but purchased *dambu* for consumption (Jideani et al., 2001). The respondents were comparable in their demographic characteristics ($p < 0.05$) for any variable.

The respondents (35.1%) of those directly involved with processing and retailing of *dambu* did not have a formal education. This may contribute to improper hygienic practices during production and handling of *dambu* which could lead to product with potential health hazards to the consumers. A significantly ($p < 0.05$) greater proportion (53.6%) of the processor/retailers and consumers of *dambu* were Fulanis, followed by the Hausas (44.1%). *Dambu* is therefore a staple food for both Hausas and Fulanis. Majority of the *dambu* dealers were less than 25 years old. A proportion of 78.7% of processors of *dambu* were females. The processing and marketing of *dambu* is known to be a woman's trade.

The study reveals that no male considered himself to be a processor. Those men who know the processing method for *dambu* either watched their mothers make it when they are younger or watched their wives. It was however surprising to note that there were some men who were retailers (26.5%) and 44.5% were processors /consumers. More men (53.8%) consumed *dambu* compared to women (46.2%). This could be because men are usually the bread winners in Africa and in these cultures have the right to spend their money anyhow and whenever they want and for anything of their choice. The women who in this culture depend on what is made available to them by their husbands, are concerned primarily with the feeding of the family and therefore, would have limited money to purchase *dambu* for consumption except when the female has made it part of the family menu (Jideani et al., 2001).

Raw materials and ingredients for *dambu* production

The major raw materials and ingredients used for *dambu* production are shown in Table 2. The processors /consumers (37.4%) indicated that millet was the major raw material for *dambu* production. The processors /consumers (36.8%) indicated that there were three

Table 2. Major raw materials and ingredients used in *dambu* production.

Question		Status						P-value
		Processor	Retailer	Processor/ Retailer	Consumer	Processor/ Consumer	Total	
		n =216	n = 83	n =211	n =143	n = 174	n = 827	
(a)	**Major grain**							
	Millet	59 (27.3)	33 (39.8)	70 (33.2)	77 (53.8)	64 (36.8)	303 (36.6)	0.01
	Sorghum	72 (33.3)	21 (25.3)	64 (30.3)	45 (31.5)	39 (22.4)	241 (29.1)	
	Maize	48 (22.2)	25 (30.1)	59 (28.0)	15 (10.5)	65 (37.4)	212 (25.6)	
	“Acha”	37 (17.1)	4 (4.9)	18 (8.5)	6 (4.2)	6 (3.4)	71 (8.6)	
(b)	**How many varieties?**							
	1	48 (22.2)	49 (59.0)	32 (15.2)	71 (49.7)	29 (16.7)	229 (27.7)	0.48
	2	58 (26.9)	19 (22.9)	23 (10.9)	52 (36.4)	13 (7.5)	165 (19.9)	
	3	53 (24.5)	6 (7.2)	56 (26.5)	16 (11.2)	64 (36.8)	195 (23.6)	
	4	42 (19.4)	_	87 (41.2)	4 (2.8)	16 (9.2)	149 (18.0)	
	All	15 (6.9)	9 (10.8)	13 (6.2)	_	52 (29.9)	89 (10.8)	
(c)	**Variety commonly used**							
	“Gero”	89 (41.2)	21 (25.3)	66 (90.4)	53 (37.1)	54 (31.0)	283 (34.2)	0.01
	“Dauro”	58 (26.9)	15 (18.1)	73 (34.6)	32 (22.4)	45 (25.9)	223 (27.0)	
	“Maiwa”	17 (7.9)	29 (34.9)	49 (23.2)	21 (14.7)	19 (10.9)	135 (16.3)	
	Pearl Millet	50 (24.3)	18 (21.7)	23 (10.9)	13 (9.1)	38 (21.8)	142 (17.2)	
	No Response	2 (0.9)	_	-	24 (16.8)	18 (10.3)	44 (5.3)	
(d)	**Can a substitute be used?**							
	Yes	143 (66.0)	49 (59.0)	178 (84.4)	55 (38.5)	75 (43.1)	500 (60.5)	0.27
	No	73 (33.8)	34 (41.0)	33 (15.6)	88 (61.5)	99 (56.9)	327 (39.5)	
(e)	**If yes what is the substitute?**							
	Sorghum	63(44.1)	12(24.5)	66(37.1)	12(21.8)	34(45.3)	187 (37.4)	0.8
	“Acha”	-	-	26(14.6)	8(14.5)	29(38.7)	63 (12.6)	
	Millet	55(38.5)	20(40.8)	54(30.3)	14(25.5)	10(13.3)	153 (30.6)	
	Maize	25(17.5)	17(34.7)	32(17.9)	17(30.9)	-	91 (18.2)	
	No response	-	-	-	4(7.3)	2(2.7)	6 (1.2)	
	Total	143	49	178	55	75	500	
(f)	**Reason for Substitute.**							
	Unavailability of millet	173 (80.0)	34 (41.0)	99 (46.9)	51 (35.7)	120 (69.0)	477 (57.7)	0.04
	Choice	31 (14.4)	27 (32.5)	38 (18.0)	22 (15.4)	54 (31.0)	172 (20.8)	
	Economy	12(5.6)	22 (26.5)	74 (35.1)	70 (49.0)	_	178 (21.5)	
(g)	**Effect of substitute on quality**							
	Colour	59 (27.3)	17 (20.5)	32 (15.2)	46 (32.2)	32 (18.4)	186 (22.5)	0.17
	Texture	71 (32.9)	10 (12.0)	83 (39.3)	21 (14.7)	32 (18.4)	217 (26.2)	
	Taste	40 (18.5)	24 (28.9)	68 (32.2)	27 (18.9)	53 (30.5)	212 (25.6)	
	Colour, Taste, Texture	36 (16.7)	8 (9.6)	17 (8.1)	41 (28.7)	29 (16.7)	131 (15.8)	
	Texture, Texture	10 (4.6)	24 (28.9)	11 (5.2)	8 (5.6)	28 (16.1)	81 (9.8)	

Table 2. Contd.

(h)	**Effect of substitute on demand**							
	Increase	125 (57.9)	31 (37.3)	33 (15.6)	57 (39.9)	52 (29.9)	298 (36.0)	
	Decrease	65 (30.1)	29 (34.9)	74 (35.1)	52 (36.4)	65 (37.4)	285 (34.5)	0.85
	Remain the same	26 (12.0)	23 (27.7)	104 (49.3)	34 (23.8)	57 (32.8)	244 (29.5)	
(i)	**Cereal used in combination**							
	Yes	140 (64.8)	60 (72.3)	114 (54.0)	42 (29.4)	147 (84.5)	503 (60.8)	0.22
	No	76 (35.2)	23 (27.7)	97 (46.0)	101 (70.6)	27 (15.5)	324 (39.2)	
(j)	**Preferred combination**							
	Millet & Maize	81 (57.9)	15 (25.0)	22 (19.3)	33 (78.6)	66 (44.9)	217 (43.1)	
	Millet & Sorghum	46 (32.9)	22 (36.7)	75 (65.8)	9 (21.4)	81 (55.1)	233 (46.3)	0.08
	Maize & Acha	13 (9.3)	23 (38.3)	17 (14.9)	_	_	53 (10.5)	
	Total	140	60	114	42	147	503	
(k)	**Purpose of combination**							
	To increase test	69 (31.9)	15 (18.1)	17 (8.1)	23 (16.1)	35 (20.1)	159 (19.2)	
	To make product brighter	82 (38.0)	12 (14.5)	46 (21.8)	59 (41.2)	49 (28.2)	248 (30.0)	0.66
	Absence of required grain	13(6.0)	34(41.0)	84 (40.0)	34 (23.8)	62 (35.6)	227 (33.5)	
	No response	52(24.1)	22(26.5)	64 (30.3)	27 (18.9)	28 (16.1)	193 (23.3)	
(l)	**Effect of combination on quality**							
	Colour	52 (24.1)	18 (21.7)	52 (24.6)	21 (14.7)	38 (21.8)	181 (21.9)	
	Texture	45 (20.8)	23 (27.7)	40 (19.0)	33 (23.1)	39 (22.4)	180 (21.8)	0.81
	Taste	69 (31.9)	36 (43.4)	27 (12.8)	27 (18.9)	42 (24.1)	201 (24.3)	
	Others	50 (23.2)	6 (7.2)	92 (43.6)	62 (43.4)	55 (31.6)	265 (32.0)	
(m)	**Effect of combination on demand**							
	Increase	68 (31.5)	34 (41.0)	48 (22.7)	53 (37.1)	21 (12.1)	224 (27.1)	
	Decrease	108 (50.0)	28 (33.7)	96 (45.5)	39 (27.3)	100 (57.5)	371 (44.9)	0.18
	Remain the same	40 (18.5)	21 (25.3)	67 (31.8)	51 (35.7)	53 (30.5)	232 (28.0)	
(n)	**Other ingredients used**							
	Potatoes	21 (9.7)	19 (22.9)	28 (13.3)	18 (12.6)	92 (52.8)	178 (21.5)	
	Ginger	63 (29.2)	18 (21.7)	66 (31.3)	24 (16.8)	20 (11.5)	191 (23.1)	0.71
	Pepper	25 (11.6)	24 (28.9)	54 (25.6)	47 (32.9)	33 (18.9)	183 (22.1)	
	Cloves	107 (49.5)	22 (26.5)	63 (29.9)	54 (37.8)	29 (16.7)	275 (33.2)	
(o)	**Proportion added**							
	Cloves/ginger/pepper							
	1:01:01	73 (33.8)	80 (96.4)	192 (91.0)	74 (51.7)	82 (47.1)	501 (60.6)	
	2:01:02	45 (20.8)	3 (3.6)	7 (3.3)	18 (12.6)	43 (24.7)	116 (14.0)	0.002
	4:01:01	93 (43.1)	-	12 (5.7)	51 (35.7)	49 (28.2)	205 (24.8)	
	No response	5 (2.3)	-	-		-	5 (0.6)	
(p)	**Commonest spice used**							
	Ginger	46 (21.3)	57 (68.6)	53 (25.1)	43 (30.1)	84 (48.3)	283 (34.2)	

Table 2. Contd.

	Cloves	78 (36.1)	8 (9.6)	44 (20.9)	63 (44.1)	63 (36.2)	256 (31.0)	
	Pepper	84 (38.9)	13 (15.7)	62 (29.4)	26 (18.2)	21 (12.1)	206 (24.9)	0.07
	Ginger/Pepper	8 (3.7)	5 (6.02)	52 (24.6)	11 (7.7)	6 (3.4)	82 (9.9)	
(q)	**Is it added for any purpose?**							
	Yes	99 (45.8)	35 (42.2)	82 (38.9)	94 (65.7)	92 (52.9)	402 (48.6)	0.68
	No	117 (54.2)	48 (57.8)	129 (90.2)	49 (34.3)	82 (47.1)	425 (51.4)	

Figures in parentheses are percentages; Kruskal - Wallis one-way ANOVA test.

varieties of millet, while (7.5%) indicated only two varieties. The number of varieties of millet varies from one state to another. For instance, in Bauchi State, there are three varieties of pearl millet in the market. These are 'gero', 'dauro', or 'maiwa' and 'gayamba'. In the other states, 'gero' and 'dauro' are very common. A significant difference ($p = 0.01$) existed among respondents on the choice of variety of pearl millet for *dambu* production. Majority of the respondents indicated that 'gero' is the variety in common use.

Although millet is the major cereal for *dambu* production, some other substitute grain can also be used alone or in combination with millet (Table 2). The choice of a substitute grain was not significant ($p = 0.27$). Among other substitute grain, sorghum was a significant grain of choice. The present study results are in agreement with results of Agu et al. (2007, 2008) which stated that different cereal grains could be used for *dambu* production. The significant reason ($p = 0.04$) given for the choice of a substitute grain was unavailability of millet. Other reasons included (i) the processors choice (ii) not sufficient money to purchase millet.

Other ingredients added to cereal flour for *dambu* production were sweet potatoes, as sweeteners; ginger, pepper and cloves as flavouring, potatoes were added as a sweetener. There was no significant difference ($p = 0.71$) in the choice of these ingredients. The quantity of these spices added was generally small. However, some of the respondents who estimated the ratio of the mixture gave 1:1:1, 2:1:1 and 4:1:1 for cloves, ginger and pepper respectively. There was a significant ($p = 0.05$) difference in the proportion of these spices. According to Agu et al. (2007, 2008) spices like ginger, cloves and pepper are used for *dambu* production in various proportions.

Most of the respondent indicated that the spices were added mainly for flavour purposes and other reasons given where for its medicinal and sedative properties. According to Zaika (1988) and Norman (1990), spices are one of the various strongly flavoured or aromatic substance of vegetable origin obtained from tropical plants commonly used as condiments and possess significant antimicrobial activity. These spices include cloves, ginger, pepper and nutmeg (Norman, 1990). The levels of the spices added in *dambu* are obviously not sufficient to produce a preservative effect. However, the properties of these spices if used in an overall approach (Giese, 1994), could be effective in extending the shelf-life of *dambu*.

The production process for making *Dambu*

The production process for making *dambu* can be divided into primary and secondary processing (Figure 1). Primary processing are those to which the cereal grain is subjected but the product is still not directly consumable (Table 3). The objective is to perform a clean separation of the pericarp (bran) from the rest of the grain. In spite of the increasing number of dehulling machines, the producers of *dambu* prefer the traditional hand pounding of dehulling the grain and producing the flour. The respondents (25.8%) believed that decorticating (dehulling) of the grain was achieved by pounding the moistened grain with the butt end of a heavy wooden pole (pestle) in a mortar to knock off the outer seed coat. The beaten mixture was washed to separate the bran. The respondents (40.6%) indicated that the step of pounding was very important and needed improvement. The respondents (24.9%) suggested the use of a dehuller as alternative to local but wooden mortar and pestle approved by 45.1% of the respondents.

The endosperm obtained was allowed to drain in a sieve for 15 - 20 min, spread under the sun for 2 h as to further reduce the moisture content to 10 – 15% before grinding to flour by second pounding. Some of the respondents (51.4%) own grinding machines (metal but foreign) while 48.6% own metal but local. The respondents (processors) charge between 20 - 50 naira for grinding. The processors (55.1%) pay around N50 for grinding. The grinding of the flour was coarse then sieved using 600 µm.

Secondary processing are those processes to which the end product of primary processing (flour) undergoes to obtain *dambu* and it is shown in Table 3. This involved processes such as mixing, steaming, cooling and packaging. After mixing flour with the spices, it then poured into a sieve and placed on an open pot that contained little water. Care should be taken that the sieve

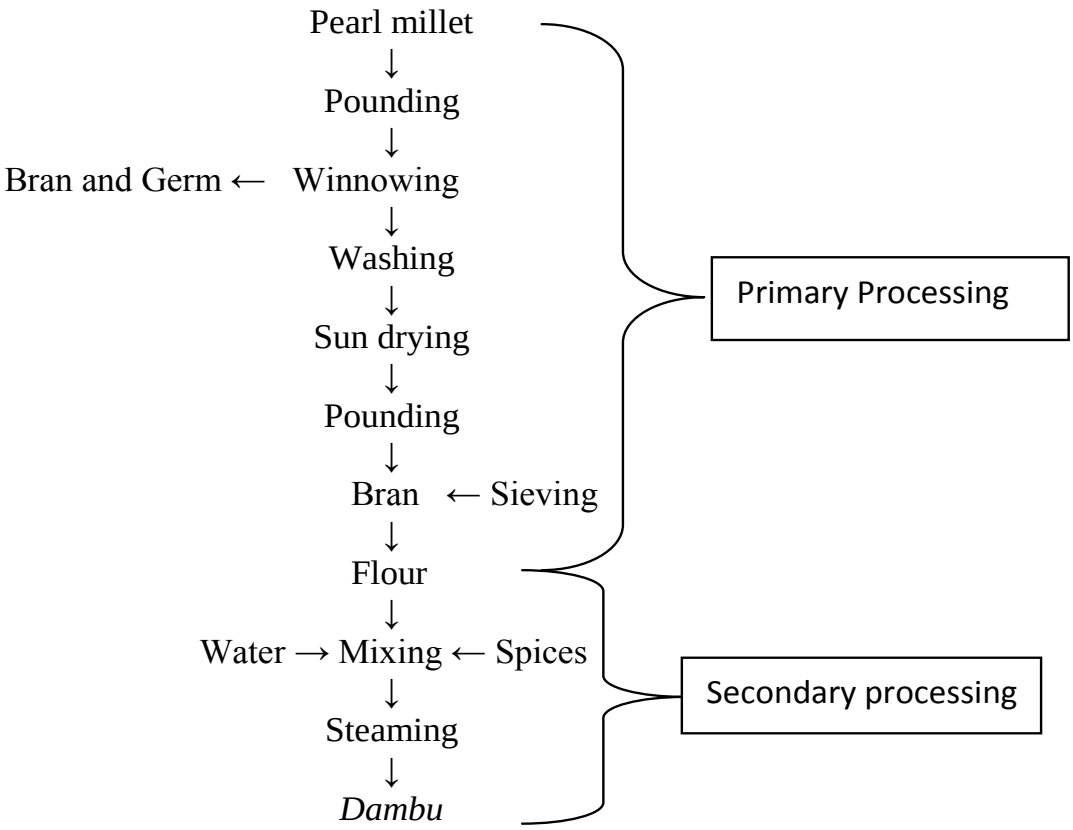

Figure 1. The Traditional Production of *dambu.*

does not touch the water. As the water in the pot boiled, the steam cooked the *dambu* on the sieve. The pot was covered and allowed to steam until the aroma was perceived. The respondents (28.3%) indicated that they mix between 30 – 60 S, while 32.6% indicated they steam between 20 – 45 min. The *dambu* after steaming was cooled between 1-5 min as indicated by 35.8% of the respondents.

The traditional pounding is a tedious task, which limits the use of the cereal. Enough pearl millet for a family meal (about 2.5 kg) takes two women about 1.5 h; converting the product into flour with a mortar and pestle requires an additional 2 h; sometimes more (NRC, 1996). Secondly, the moistening of the grain to facilitate removal of the bran and pounding into flour can result in slightly fermented flour leading to a modified flavour (Perten, 1983). Many of the respondents indicated that mechanical process needs to be improved in such a way to produce flour similar to that produced by the traditional method. The major criticism of the mechanical process is that dry grain must always be used, producing flour that is too dry and when used to produce *dambu,* does not result in the same taste as the traditionally processed flour (Jideani et al., 2001).

However, the production process for *dambu* can be optimized. Such optimization if achieved, would reduce the drudgery of women in *dambu* eating areas, improve health and family welfare and convert millet into a much more convenient grain and lead to food manufacturers getting involved in production of *dambu*. Moreover, with improvement in living standards in Nigeria and Africa at large, there has been an increasing demand for better quality food. Quality requirement for traditional *dambu* should consequently change. At present, the burden of the toil in millet processing is causing a silent rebellion against millet (Jideani et al., 2001) and the resulting *dambu*.

Packaging and distribution of *Dambu*

Packaging and distribution of *dambu* is shown in Table 4. The processors (58.9%) and retailers (41.0%) generally agreed that the method of marketing *dambu* is by hawking in a plastic (transparent low density polyethylene bag) while the processors (8.8%) and retailers (4.8%) indicated the use of calabash during hawking. At the vending point (market garage/park) the *dambu* are wrapped

Table 3. Primary and secondary processing of *dambu*.

Question		Status						
		Processor	Retailer	Processor/Retailer	Consumer	Processor/ Consumer	Total	P-value
		n = 216	n = 83	n = 211	n = 143	n = 174	n = 827	
(a)i	**Steps you follow in dehulling**							
	Winnowing, conditioning, pounding	64 (29.6)	0	91 (43.1)	16 (11.2)	42 (24.1)	213 (25.8)	
	Conditioning, pounding, drying	32 (14.8)	4 (4.8)	76 (36.0)	33 (23.2)	66 (37.9)	211 (25.5)	
	washing, winnowing, drying	88 (4.1)	56 (67.5)	28 (13.3)	15 (10.5)	19 (10.9)	206 (24.9)	
	No Response	32 (14.8)	23 (27.7)	16 (7.6)	79 (55.2)	47 (27.0)	197 (23.8)	1
(ii)	**Which step do you think improvement is Necessary?**							
	Winnowing	18 (8.3)	6 (7.2)	35 (16.6)	17 (11.9)	63 (36.2)	139 (16.8)	
	Pounding	83 (38.4)	59 (71.1)	76 (36.0)	44 (30.8)	74 (42.5)	336 (40.6)	
	Conditioning	32 (14.8)	_ (0)	25 (11.8)	36 (25.2)	_ (0)	93 (11.2)	
	Drying	8 (3.7)	_ (0)	19 (9.0)	21 (14.7)	28 (16.1)	76 (9.2)	
	No response	75 (34.1)	18 (21.7)	56 (26.5)	25 (17.5)	9 (5.2)	183 (22.1)	0
(b)i	**Steps in grinding to achieve desired quality**							
	Pounding & Sieving	93 (43.1)	45 (54.2)	65 (30.8)	43 (30.1)	69 (39.7)	315 (38.1)	
	Dehulling & Drying	78 (36.1)	8 (9.6)	31 (14.7)	72 (50.3)	28 (16.1)	217 (26.2)	
	Conditioning	42 (19.4)	30 (36.1)	87 (41.2)	13 (9.1)	47 (27.0)	219 (26.5)	
	Washing	3 (1.4)	_	28 (13.3)	15 (10.5)	30 (17.2)	76 (9.2)	0.04
(ii)	**Steps in which improvement is necessary to make grinding profitable**							
	Pounding & Sieving	36 (16.7)	43 (51.8)	65 (30.8)	88 (61.5)	83 (47.7)	315 (38.1)	
	Dehulling	79 (36.6)	32 (38.6)	83 (39.3)	35 (24.5)	46 (26.4)	275 (33.2)	
	Conditioning	56 (25.9)	8 (9.6)	33 (15.6)	16 (11.1)	27 (15.5)	140 (16.9)	
	Washing	45 (20.8)	_ (0)	30 (14.2)	4 (2.8)	18 (10.3)	97 (11.7)	0.01
(c)	**Steps in preparation of *dambu* with duration**							
i.	**Mixing**							
	30 - 60 S	53 (24.5)	15 (18.1)	72 (34.1)	31 (21.7)	63 (36.2)	234 (28.3)	
	1- 5 min	31 (14.4)	31 (37.3)	15 (7.1)	58 (40.6)	32 (18.4)	167 (20.2)	
	6 - 10 min	12 (5.6)	9 (10.8)	48 (22.7)	16 (11.2)	45 (25.9)	130 (15.7)	
	11 - 15 min	82 (38.0)	18 (21.7)	31 (14.7)	25 (17.5)	18 (10.3)	174 (21.0)	
	16 - 20 min	38 (17.6)	10 (12.0)	45 (21.3)	13 (9.1)	16 (9.2	122 (14.7)	0.22
ii.	**Steaming**							
	20 - 45 min	78 (36.1)	33 (39.8)	61 (28.9)	54 (37.7)	44 (25.3)	270 (32.6)	
	45 - 50 min	65 (30.1)	28 (33.7)	39 (.18.5)	68 (47.6)	33 (19.0)	233 (28.2)	
	50 - 60 min	59 (27.3)	12 (14.5)	83 (39.3)	13 (9.1)	15 (8.6)	182 (22.0)	
	1 - 12 h	14 (6.5)	10 (12.0)	28 (13.3)	8 (5.6)	82 (47.1)	142 (17.2)	0.44
iii.	**Cooling**							
	1 – 5 min	89 (41.2)	16 (19.3)	78 (37.0)	65 (45.4)	48 (27.6)	296 (35.8)	
	6 – 10 min	45 (20.8)	43 (51.8)	94 (44.5)	32 (22.4)	19 (10.9)	233 (28.2)	
	11 - 15 min	62 (28.7)	13 (15.7)	12 (5.7)	14 (9.8)	35 (20.1)	136 (16.4)	
	16 – 20 min	20 (9.25)	11 (13.3)	27 (12.8)	32 (22.4)	72 (41.4)	162 (19.6)	0.23
iv.	**Packaging**							
	10 – 20 min	4 1(19.0)	13 (15.7)	54 (25.6)	32 (22.4)	18 (10.3)	158 (19.1)	
	20 – 30 min	34 (15.7)	33 (39.8)	72 (34.1)	48 (33.6)	34 (19.5)	221 (26.7)	
	30 – 40 min	82 (38.0)	16 (19.3)	38 (18.0)	19 (13.3)	56 (32.2)	211 (25.5)	
	40 – 50 min	59 (27.3)	21 (25.3)	47 (22.3)	44 (30.8)	66 (37.9)	237 (28.6)	0.64

Figures in parentheses are percentages Kruskal - Wallis one way ANOVA test.

Table 4. Mode of marketing and storage stability of *dambu*.

Question		Status						
		Processor	Retailer	Processor/ Retailer	Consumer	Processor/ Consumer	Total	P-value
		n =216	n = 83	n =211	n =143	n = 174	n = 827	
(a)	**What packaging material is used for the product?**							
	Low density polyethylene	112 (51.9)	58 (69.9)	121 (57.3)	31 (21.7)	73 (42.0)	395 (47.8)	
	Paper	64 (29.6)	21 (25.3)	72 (34.1)	53 (37.1)	62 (35.6)	272 (32.9)	
	None	21 (9.7)	-	-	15 (10.5)	25 (14.4)	61 (7.4)	
	Calabash	19 (8.8)	4 (4.8)	18 (8.5)	44 (30.8)	14 (8.1)	99 (12.0)	0.01
(b)	**How do you market your product?**							
	Hawking	127 (58.8)	34 (41.0)	84 (39.8)	71 (49.7)	85 (48.9)	401 (48.5)	
	Whole sale	38 (17.6)	24 (28.9)	79 (37.4)	53 (37.1)	63 (36.2)	257 (31.1)	
	Consumption	46 (21.3)	25 (30.1)	48 (22.8)	19 (13.3)	26 (14.9)	164 (19.8)	
	No response	5 (31.3)	-	-	-		5 (0.6)	0
(c)	**Where do you sell your product?**							
	Market	102 (47.2)	136 (43.4)	116 (55.0)	44 (30.8)	93 (53.5)	391 (47.3)	
	Home	68 (31.5)	32 (38.6)	17 (8.1)	39 (27.3)	28 (16.1)	184 (22.2)	
	Garage/park	46 (21.3)	15 (18.1)	78 (36.8)	60 (42.0)	53 (30.5)	252 (30.5)	0.09
(d)	**How long it takes to sell the product?**							
	1 – 5 h	72 (33.3)	45 (54.2)	93 (44.1)	33 (23.1)	56 (32.2)	299 (36.1)	
	5 – 25 h	38 (17.6)	6 (8.4)	54 (25.6)	25 (17.5)	82 (47.1)	230 (27.8)	
	1 – 2 days	49 (22.7)	7 (8.4)	-	46 (32.2)	23 (13.2)	125 (15.1)	
	1 – 2 weeks	53 (24.5)	-	63 (29.9)	27 (18.9)	9 (5.2)	152 (18.4)	
	No response	4 (1.9)	-	1 (0.5)	12 (8.4)	4 (2.3)	21 (2.5)	0.01
(e)	**How is left over *dambu* preserved?**							
	Refrigeration	42 (19.4)	72 (86.8)	55 (26.1)	32 (22.4)	49 (28.2)	250 (30.2)	
	Sun-drying	97 (44.9)	5 (6.0)	82 (38.9)	45 (31.5)	63 (32.2)	292 (35.3)	
	Room Temperature	63 (29.2)	-	74 (35.1)	66 (46.2)	20 (11.5)	223 (27.0)	
	Others	-	-	-	-	42 (24.1)	42 (5.1)	
	No response	14 (6.5)	6 (7.2)	-	-	-	20 (2.4)	0
(f)	**How long can *dambu* be stored?**							
i.	**Refrigeration**							
	1 – 2 days	17 (16.2)	6 (35.3)	19 (23.2)	29 (40.0)	52 (57.4)	123 (34.4)	
	3 – 4 days	35 (33.3)	-	32 (39.0)	18 (28.6)	18 (19.8)	103 (28.8)	
	5 – 7 days	53 (50.5)	11 (64.7)	31 (37.8)	16 (25.4)	21 (23.7)	132 (36.9)	0.84
(ii)	**Sun-drying**							
	12 h	33 (45.2)	16 (36.4)	13 (24.5)	12 (31.6)	19 (17.0)	93 (35.8)	
	1 day	19 (26.0)	4 (9.1)	31 (58.5)	18 (47.4)	21 (39.6)	93 (35.8)	
	2 days and above	21 (28.8)	24 (54.6)	9 (17.0)	8 (21.1)	13 (24.5)	75 (28.8)	0.75
(iii.)	**Room Temperature**							
	1 day	15 (39.5)	3 (13.6)	34 (44.7)	16 (38.1)	12 (40.0)	80 (38.5)	
	2 days	18 (47.4)	19 (86.4)	17 (22.4)	5 (11.9)	3 (10.0)	62 (29.8)	

Figures in parentheses are percentages,Kruskal - Wallis one-way ANOVA test.

dambu migrating to towns and continents some distance from where *dambu* is made, a wider range of *dambu* packaging is required. Such packaging must be able to withstand transportation hazards, provide longer shelf-life and communicate necessary information about the product.

It takes about 1 - 5 h for 54.2% of the retailers to sell *dambu* worth N200.00. Some of the retailers (8.43%) would sell the same amount of *dambu* for 1 - 2 days. The rate of sale of *dambu* actually varies with the weather; peak of demand for *dambu* is usually the hot season (March to June) when the temperature range is 24.7 - 42.0°C.

Storage stability of *dambu*

Left over *dambu* can either be preserved by refrigeration, sun drying or at room temperature (Table 4). Sun drying as indicated by 35.3% of the respondents was the most common method of storing left over *dambu*. Choice of sun drying is not surprising since a majority of the processors/retailers do not have access to refrigerators. Storage of *dambu* under the sun was achieved by leaving the *dambu* in a desired container uncovered under the sun. Storage of *dambu* uncovered exposes the product to insects, flies and dust. The presence of dirt and dust on any food will increase the rate of spoilage because they carry microorganisms (UNIFEM, 1993). The habit of consuming the *dambu* without reheating can constitute a health hazard. The shelf-life of *dambu* stored under this condition was indicated by 35.6% of the respondents as 12 h, 35.6% of the respondents as 1 day (24 h) and 2 days and above by 28.7% of the respondents. It is known that shelf-life increases with decease in temperatures.

Storage at room temperature was achieved by leaving the *dambu* in a desired container (plate or calabash) uncovered. Storage of *dambu* without coverage predisposes the product to insect, flies and dust which will increase the rate of spoilage. This constitutes a health hazard. The variation in shelf-life depends on the ambient temperature. The best way to preserve *dambu* according to 36.9% of the respondents is by sun-drying. The respondents (33.5%) indicated it is by storing at room temperature and 28.8% at refrigeration temperature. Unfortunately, not many processors and consumers of *dambu* have access to refrigerators.

The two major signs of spoilage are off-odour and mould as indicated by 32.6 and 31.6% of the respondents respectively. Many of the respondents (32.9%) indicated that *dambu* stored under the sun was not safe for consumption after 1 day while majority indicated that it was after 4 - 7 days. Some of the respondents still believed that it can be consumed after this day.

***Dambu* Utilization Pattern**

The common liquid in which the *dambu* are crumbled are 'nono' (fermented skim milk) and 'Kindrimo' (fermented whole milk) as indicated by 35.7 and 37.7% of the respondents respectively. Water and milk seem to be the alternative media for eating *dambu* (Tables 5 and 6). *Dambu* can be eaten alone as indicated by 57.9% of the respondents' that is, in the absence of 'nono', 'kindrimo', water or milk. *Dambu* can be eaten as a main meal when accompanied with 'nono' or 'kindrimo'. Total percentage of 27.4, 39.2 and 33.4% was deduced for the poor, the middle and the rich class consumption of *dambu*, respectively. Majority of the respondents indicated that in a paper, low density polyethylene bag or mashed into fermented skim or whole milk for immediate consumption. *Dambu* is distributed with minimum packaging (Jideani et al., 2001). Processors and retailers of *dambu* are primarily concerned with reducing wastage and having a container for their food. Their choice of suitable packaging is to provide protection during a short shelf life and for local distribution. With population growth and consumers of infants at the age of 0 - 3 years consume *dambu*. The poor consumed less *dambu* as compared to other classes. A possible reason may be that they lack the money to meet up with the increasing cost of *dambu* and the corresponding 'nono' or 'kindrimo'. The respondents (55.5%) indicated that 30 - 60% of each class consumed *dambu*. The middle class ate more of *dambu* than all the classes. The rich does not eat as much as expected since money was not their problem. The problem of the rich and elites (particularly non - Fulani or Hausa) seemed to be the unsatisfactory method with which *dambu* was handled. The study reveals that there is a market potential for *dambu* if the processing method, packaging and storage are improved.

Economics of *dambu* processing

The economics of *dambu* processing is shown in Table 6. The cost of equipment for *dambu* production may be regarded as capital expenditure in the business of *dambu* production. Total cost was less than ₦2,000 depending on the size of the equipment purchased. Moreover, the equipment are not used for *dambu* production only. They find use in other household chores. This made them quite profitable to the processor.

The price of the grain varied, being low during the harvesting period. The cost of fuel (firewood), which was most common in use ranged from ₦35 - ₦40. The cost of outsourcing dehulling and grinding was about N10. Processing of 2.5 kg of millet grain will produce *dambu* worth ₦400 - ₦600 with by-product (bran) either sold for feedstuff or fed to animals as well as the water obtained from washing. *Dambu* production therefore was quite economical. Apart from the profit obtained from the marketing of the product, the by-products are of economic importance.

Labour cost in *dambu* production was fairly cheap. Majority employs assistants during *dambu* production.

Table 5. *Dambu* Product Utilization

Question		Status						
		Processor	Retailer	Processor/ Retailer	Consumer	Processor/Consumer	Total	P-value
		n = 216	n = 83	n = 211	n = 143	n = 174	n = 827	
(a)	**What is *dambu* eaten with?**							
	Soup	-	-	-	14 (9.79)	-	14 (1.7)	
	Water	-	-	-	4 (2.30)	-	4 (0.5)	
	"Madara"	86 (39.81)	16 (19.28)	6 (28.4)	35 (24.48)	59 (33.91)	202 (24.4)	
	"Nono"	73 (33.80)	45 (54.22)	77 (37.40)	17 (11.89)	81 (46.55)	295 (35.7)	
	"Kindirimo"	57 (26.39)	22 (26.51)	126(59.72)	73 (51.05)	34 (19.54)	312 (37.7)	0
(b)	**Can *dambu* be eaten alone?**							
	Yes	139 (64.35)	41 (49.40)	156(73.93)	90 (62.94)	53 (30.4)	479 (57.9)	
	No	77 (35.65)	42 (58.60)	55 (20.67)	53 (37.06)	121 (69.64)	348 (42.1)	0.36
(c)	**Is *dambu* eaten as a meal?**							
	Yes	138 (63.8)	31 (37.35)	95 (45.04)	41 (28.67)	80 (45.98)	385 (46.5)	
	No	78 (36.1)	52 (62.65)	116(54.98)	102 (71.33)	94 (54.04)	442 (53.4)	0.62
(d)	**If no, is it a snack?**							
	Yes	54 (69.23)	16 (30.77)	93 (80.17)	25 (24.51)	84 (84.3)	272 (61.5)	
	No	24 (30.77)	36 (69.23)	23 (19.83)	77 (75.49)	10 (10.63)	170 (38.5)	
	Total	78	52	116	102	94	442	0.3
(e)	**What classes of people eat *dambu*?**							
	Poor	74 (32.8)	19 (22.89)	44 (20.85)	32 (22.38)	61 (35.06)	227 (27.4)	
	Middle class	72 (33.53)	48 (57.83)	93 (44.08)	63 (44.06)	48 (27.59)	324 (39.2)	
	Rich	73 (33.80)	16 (19.28)	74 (35.07	48 (33.57)	65 (37.36)	276 (33.4)	
(f)	**Can you estimate the % of each?**							
	30 - 60%	118 (54.63)	60 (72.29)	163(77.15)	38 (26.57)	80 (45.98)	459 (55.5)	
	60 - 90%	68 (31.48)	15 (18.07)	42 (19.91)	71 (99.65)	66 (37.93)	262 (31.7)	
	90 - 100%	28 (12.96)	8 (9.69)	6 (2.81)	34 (15.87)	28 (16.99)	104 (12.6)	
	No response	2 (0.93)	_	_	_	_	2 (0.2)	
(g)	**Do infants eat *dambu*?**							
	Yes	115 (53.24)	45 (54.22)	142 (67.3)	78 (54.55)	92 (52.87)	472 (57.1)	
	No	101 (49.76)	38 (45.78)	69 (32.7)	65 (95.45)	82 (47.13)	355 (42.9)	0.26
(h)	**If yes at what age is *dambu* introduced?**							
	0 - 3 months	46 (40)	21 (46.67)	83 (58.45)	18 (23.08)	76 (82.61)	244 (51.7)	
	4 - 6 months	61 (53.04)	13 (28.89)	39 (27.46)	44 (56.04)	12 (13.04)	169 (35.8))	
	9 months - above	8 (6.96)	11 (24.44)	20 (14.08)	16 (20.51)	4 (4.35)	59 (12.5)	
	Total	115	45	142	78	92	472	
(i)	**If no what is the reason?**							
	Not ideal for them	34 (33.7)	7 (18.4)	23 (33.3)	9 (13.8)	3 (3.7)	76 (21.4)	
	Infant system cannot digest it	29 (28.7)	18 (47.7)	32 (36.4)	21 (32.3)	32 (39)	132 (37.2)	
	Constipation	23 (22.8)	13 (34.2)	14 (20.3)	35 (53.8)	47(57.3)	132 (37.2)	
	No response	15 (14.9)	_	_	_	_	15 (4.2)	
	Total	101	38	69	65	82	355	0.01
(j)	**Does *dambu* have any special attribute?**							
	Yes	120 (55.6)	53 (63.9)	93 (44.1)	71 (49.7)	89 (51.1)	426 (51.5)	
	No response	96 (32.4)	30 (36)	118 (55.9)	72 (50.3)	85 (51.1)	401 (48.5)	0.79

Figures in parentheses are percentages Kruskal - Wallis one-way ANOVA test.

Table 6. Economics of *dambu* processing.

Question		Status						
		Processor	Retailer	Processor/ Retailer	Consumer	Processor/Consumer	Total	P-value
		n = 216		n = 211	n = 143	n = 174	n = 827	
(a)	**If yes describe the attribute**							
	Medicinal	85 (70.8)	44 (83)	69 (74.2)	19 (26.8)	71 (79.8)	288 (67.6)	
	sedative	35 (29.2)	9 (16.9)	24 (25.8)	52 (73)	18 (20)	138 (32.4)	
	Total	120	53	93	71	89	426	0.06
(b)	**What kind of by-product is derived?**							
	Bran	103 (47.7)	48 (57.8)	145 (68.7)	61(42.7)	122 (70.0)	479 (57.9)	
	Chaf	113 (52.3)	35 (42.2)	66 (31.3)	82 (57.3)	52 (29.9)	348 (42.1)	0.28
(c)	**How is by product used?**							
	Animal feed	160 (74.1)	55 (66.3)	133 (63)	69 (48)	38 (21.8)	455 (55.0)	
	Fire wood	56 (25.9)	28 (33.7)	78 (36.9)	74 (51.7)	136 (78)	372 (45.0)	0.59
(d)	**Any monetary value to a produce**							
	Yes	81 (37.5)	14 (16.9)	182 (86.3)	5 (3.5)	89 (51.1)	371 (44.9)	
	No	135 (62.5)	69 (83)	29 (13.7)	138 (96.5)	85 (48.9)	456 (55.1)	0.67
(e)	**If yes indicate the value**							
	Per Mudu 2 - 5	32 (39.5)	12 (85.7)	93 (51.1)	5 (100)	68 (76.4)	210 (56.6)	
	Per bag 50 kg	45 (55.6)	2 (14.3)	82 (45.1)	-	21 (23.6)	150 (40.4)	
	No response	4 (4.9)	-	7 (3.8)	-	-	11 (3.0)	
	Total	81	14	182	5	89	371	0.61
(f)	**Is anyone assisting you in processing?**							
	Yes	146 (676)	72 (86.7)	182 (86.3)	78 (54.5)	96 (55.2)	574 (69.4)	
	No	70 (32.4)	11 (13.3)	29 (12.7)	65 (45.5)	78 (44.8)	253 (30.6)	0.03
(g)	**If yes, describe**							
	Relative	40 (27.4)	38 (52.8)	84 (46.2)	63 (80.8)	43 (44.8)	268 (46.7)	
	Employees	21 (14.4)	3 (4.2)	14 (7.7)	1 (1.3)	21(21.9)	60 (10.5)	
	Children	63 (43.2)	31 (43.1)	84 (46.2)	14 (17.9)	32(33.3)	224 (39.0)	
	Other	22 (15.1)	-	-	-	-	22 (3.8)	
	Total	146	72	182	78	96	574	0
(h)	**Which of these in Q. (f) do you pay?**							
	Relative	20 (16.5)	14 (42.4)	43 (58.9)	21(77.8)	12 (25)	110 (36.4)	
	Employees	21 (17.4)	12 (39.4)	14 (19.2)	1 (3.7)	21 (43.8)	60 (19.9)	
	Children	51 (12.4)	16 (48.5)	16 (21.9)	5 (18.5)	15 (31.3)	67 (22.2)	
	No response	65 (53.7)	-	-	-	-	65 (21.5)	
	Total	121	33	73	27	48	302	0.8

Figures in parentheses are percentages Kruskal - Wallis one-way ANOVA test.

Out of this number, majority employs their relatives' and friends. The cost of employing these workers is usually minimal.

When *dambu* quality is improved, consumers can have confidence in the products and the producers can obtain better prices. Moreover, with the increasing influence of

advertising upon customers, small food processing enterprises like *dambu* will have to improve the packaging and preservation of their products if they are to survive against competition (Jideani et al., 2001).

Conflict of interests

The authors did not declare any conflict of interest.

ACKNOWLEDGEMENTS

The authors are grateful to Miss Victoria Nnaji, Mr. Daniel Yakubu, Aliyu Ibrahim and Abdulraheem Saratu and others for helping in the distribution of the questionnaires and interviewing the respondents.

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