FACTORS INFLUENCING CASSAVA - PULP FERMENTATION PERIOD FOR GARI PROCESSING AMONG CASSAVA PROCESSORS IN SOUTHEASTERN NIGERIA.

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ABSTRACT
*This paper examined factors influencing cassava pulp fermentation period for gari processing among cassava processors in South-eastern Nigeria. Five out of nine states that constitute South-east Agro-ecological zone of Nigeria were purposively sampled on the basis of being notable for cassava production. From each sampled state and by simple random sampling technique, 64 cassava processors were selected evenly from across the agricultural zones of the state. This summed up to a sample size of 320 respondents from the entire study area. Using structured interview schedule, data on age of farmers, educational status, years of gari processing experience, marital status, membership of cooperative societies, etc were collected from the respondents. Data collected were analyzed with descriptive statistics and Probit model analysis. Result of probit model analysis at 5% significance level shows an R^2 value 0.4728 indicating that 47.28% of factors affecting cassava-pulp fermentation practices in the study area were accounted for by the variables considered in this study. Marital status (2.236**) and respondents' cultural influences (1.960**) were positively related to long period fermentation of cassava-pulp among the respondents. On the contrary, socio-economic statuses (-2.466**) of the respondents were negatively related to long period fermentation of cassava-pulp among the respondents. It is therefore, recommended that awareness campaign should be mounted to sensitize cassava processors to the health risks associated with short period of fermentation of cassava-pulp during gari processing. Similarly, extension agents should use occasion of personal visits to farmers to educate them on the importance of adequate fermentation of cassava pulp during gari processing. Cultural groups and activities should be explored by extension agents and nutritionists in disseminating information on need for longer period of fermentation of cassava pulp during gari processing.*

KEY WORDS: **Cassava-pulp, Fermentation, Gari Processing, Cyanide, Toxic**

INTRODUCTION

The negative effects of high levels of cyanide in cassava products on health of consumers have been on the increase especially with growing dependence of many Nigerian households on cassava for sustenance. Cassava roots contain cynogenic glucosides, linamarin and lotaustralin which, on hydrolyses, yield hydrogen cyanide (HCN) which is toxic to man and animals. Achinewhu and Owuamanam (2001) reported that some disease conditions such as endemic goitre, tropical diabetes and cretinism have been linked to consumption of cassava diets with high HCN. As a result, high level of HCN in cassava limits the use of cassava and its products for food and feed, more so as fresh cassava roots cannot be stored beyond 3 - 4 days after harvest. Therefore, cassava must be processed into various forms in order to increase shelf life of the products, reduce its cyanide content and post harvest losses of fresh tubers as well as provide raw materials for small-scale cassava based rural enterprises. 'Gari' is one of the local important primary products of cassava in Nigeria. It is the grated, fermented and fried cassava mash in its final form (Ekwe, 2004). In Nigeria, cassava is processed into such major staples like gari, flour and paste (fufu). But among the three, gari is the most popular and indispensable in Nigerian households for a variety of reasons. It is convenient, ready to eat, storable and easily processed to conform to the organoleptic preferences of the consumers (Sani *et al* 1994). The importance of gari in the diet of Nigerian households is long established. Sani *et al* (1995) indicated that approximately 28, 41 and 31% of a

Nigeria community consumed gari once twice and thrice daily respectively. A good evidence of the importance of gari in Nigeria's food system was given by a newsletter report of what happened in Akwa Ibom State when the cassava crop failed in 1993 due to certain leaf disease. The price of gari responsively increased threefold and famine threatened numerous households in the State. The crisis so affected the State's population that gari had to be brought in from neighbouring states by the State government in order to keep the market price down and arrest the famine (Anonymous, 1993).

Traditionally, gari is processed by peeling, washing and grating fresh cassava roots. The grated cassava pulp is put in sacks, and the sacks are placed under heavy objects to drain excess liquid from the pulp while it is fermenting .The dewatered and fermented lumps of pulp are sieved and resulting fine pulp is roasted in a pan. However, enhancement of gari quality during processing to a large extent influences consumption and market potentials of the commodity. Again, processed gari could be improved to make them attractive to consumers without significant increase in the processing cost (Ekwe and Nwachukwu, 2007). On the other hand, the modern and improved techniques for processing cassava into gari requires that the peeled roots are first of all converted into soft, pliable mass of cassava-pulp through manual or mechanical grating. Hence, for the purpose of fermentation, the cassava-pulp is bagged and left under a shade for a period of 3-5 days as recommended by IITA (1990) so that substantial quantity of cyanide content of the pulp could be lost by process of microbial activities. Effective fermentation of the cassava pulp as well as expressing the cyanide water content of the pulp are very necessary in achieving high quality gari (Ekwe, 2004).

Fermentation is indeed a very important stage in gari processing because it is a means of detoxifying the hydrogen cyanide content of cassava. According to Nweke *et al* (1999), hydrogen cyanide can be eliminated by leaching in water and hydrolysis in to less stable compounds. Microorganisms present in cassava pulp during fermentation create conditions favourable to leaching and hydrolysis (Bokanga, 1992). Therefore, the longer the period of fermentation, the lesser the cyanide content of gari and the safer it becomes to consume gari too. A period of 3-5 days have been recommended as the appropriate duration for the fermentation of cassava pulp so to achieve a safe level of cyanide content of 1mg HCN/100g of gari (IITA, 1990). However, in some areas in South-eastern Nigeria, keeping cassava pulps some days for fermentation to occur is no longer in practice among farmers. Rather, fermentation duration is only limited to the period cassava pulp is placed under dewatering machine for expression of water. The result is substantial cyanide content in processed gari which is not sufficiently safe for consumption (Ekwe, 2004). A technical report by Collaborative Study of Cassava in Africa (COSCA) (1999) revealed that fermentation period for cassava products especially gari had declined in the previous five years among 30% of selected villages across the African continent it studied. The report also indicated that decline in fermentation period was closely attributed to commercialization of gari, high population density as well as mechanization of gari processing techniques.

In Southeastern Nigeria, gari processing is a major off-farm activity among farmers in the zone. Infact, gari processing and marketing are two enterprises that serve as livelihood strategies for many farm households in the area. As important as gari processing could be to the livelihoods of cassava processors in the study area, detoxification of the cyanide content of cassava pulp remains a major challenge in maintaining high quality standard of the commodity in view of the risks associated with consumption of poorly fermented gari.

The main objective of this study is to determine factors influencing fermentation period of cassava-pulp during gari processing among cassava processors in Southeastern Nigeria. Specifically, the study examines the following:

a) the socio economic characteristics of cassava processors in the study area
b) gari processing practices among cassava processors in the study area
c) factors influencing cassava-pulp fermentation period for gari processing among cassava processors in the study area.

METHODOLOGY

The Study Area

The South East Agro-ecological Zone of Nigeria lies between latitudes 4^0 20' and 7^0 25' N and longitudes 5^0 25' and 8^0 51' E covering a land area of about 109524 sq.km or 11.86% of the total land area of Nigeria. It is bounded on the South by Bight of Bonny, on the East by the Republic of Cameroun, on the West by River Niger and on the North by Benue State. The zone has a an approximate population of about 18.29 million people (FSON, 1998; NPC,1991)

Sampling Procedure

In 2003, a survey was carried out to examine factors associated with processing of gari in the Southeast agro-ecological zone of Nigeria. To achieve this, five out of nine states that constitute the Southeast Agro-ecological zones of Nigeria were purposively sampled for the study because they were identified as notable cassava growing states. The sampled states included Abia, Akwa Ibom, Ebonyi, Enugu and Imo. In each state, two agricultural zones were selected by simple random sampling method. By same random sampling method, two blocks from each agricultural zone, two circles from each block and then eight cassava processors from each circle were also selected for the study. Thus, 64 cassava processors were selected from each state which summed up a sample size of 320 respondents for the entire study area.

Data Collection and Analysis

Using structured interview schedule, data regarding the respondents' age, sex, educational statuses, membership of cooperative societies, years of experience in gari processing, influences of cassava processors' culture and social statuses, were collected and analyzed with descriptive and quantitative statistics. Specifically, Probit model statistics was used to determine variables that influenced cassava pulp fermentation among farmers in the study area. The Probit model is implicitly expressed thus:

Yi* = Bi Xi…n + E
Yi = if yi* <0
Yi = 1 if Yi* >0 where
Yi* = an underlying variable indexing cassava pulp fermentation period.
Yi = Observable variable indexing fermentation period. (eg….1,2,3,4,5) days(s).
Bi = Vector of estimated parameter (Liao 1994)
E = the error term while
Xi…n = Outcomes of individual variables considered in the study. These were as follows

Age (X_1) = Age of cassava processors in years
Educational status (X_2) = Number of years spent in school
Years of gari processing experience (X_3) = Number of years of gari processing experience
Marital status (X_4) = Marital status of cassava processors (married = 1 otherwise = 0)
Membership of cooperative societies (X_5) = Membership of cooperative societies (Yes = 1, otherwise = 0)
Cultural influence (X_6) = Influence of culture on pulp fermentation period (Yes = 1, otherwise = 0)
Social status (X_7) = influence of social status on pulp fermentation (Yes 1, otherwise = 0)

RESULTS AND DISCUSSION

Socio economic Characteristics of the Cassava Processors

The results in Table 1 revealed that 34% of the respondents in the entire study were between 31- 40 years of age followed by 28% of the respondents who were between 41-50 years of age. The respondents were made up of both youthful and ageing cassava processors. Also, results in Table 1 indicated that there was relatively no much difference in the proportions of male and female farmers involved gari processing in the study area. While 52% of the respondents were males, 48%were females. However, there were more female cassava processors in states like Imo (59%) and Enugu (55%) than in Abia (40%), Akwa Ibom (47%) and Ebonyi

(31%). The large proportion of male folks in gari processing is indicative of the gradual shift of the gari enterprise from women to men probably because of the involvement of machines mostly operated by men as well as the economic potentials of gari as sustainable income source in the area. Traditionally, gari was usually processed as means of livelihood mostly by women of low economic status (Sanni *et al,* 1995). Again, many (41%) of the respondents obtained secondary education while 18% of the respondents had post secondary education. The results indicated that there was relatively high level of education among the respondents (60%) considering also the proportion (19%) that had post secondary education. Furthermore, results in Table 1 showed there was long years of experience in gari processing among farmers in the study area. For instance, 42% of the respondents had up to 11-20 years experience while 22% had 21-30 years. From results in Table 1, most (70%) of the respondents were married while 19% were single. This implies that gari processing was predominantly carried out among the married farm folks. Using gari to fend for household members might have endeared the product to the married ones.

Table 1: Percentage Distribution of Respondents According to Age, Educational Status, Years of Gari Processing Experience and Marital Status

Variable	Abia	Akwa Ibom	Ebonyi	Enugu	Imo	Mean
	N = 64	N = 64	N = 64	N = 64	N = 64	N = 320
Age						
<20 years	3.13	0.00	0.00	0.00	3.13	1.25
21 – 30	12.50	6.25	20.31	9.38	21.88	14.06
31 – 40	20.31	32.81	43.75	32.81	42.19	34.38
41 – 50	29.69	35.94	26.56	29.69	20.31	28.48
> 50	34.37	25.00	9.38	28.12	12.51	21.88
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Sex						
Male	59.37	53.12	60.94	45.31	40.62	51.88
Female	40.63	46.88	39.06	54.69	59.38	48.12
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Educational Status						
No Formal School	6.25	6.25	17.19	10.94	4.69	9.06
Primary School	40.63	35.94	23.44	37.50	17.19	30.94
Secondary School	39.07	40.09	46.87	31.25	48.43	41.25
Post Secondary School	14.06	17.19	12.50	20.31	29.69	18.75
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Years of Gari Processing Experience						
<10 years	29.69	17.19	25.00	39.06	56.25	33.44
11 – 20	34.38	59.17	40.63	42.19	32.82	41.87
21 – 30	34.38	21.88	28.12	17.19	9.32	22.19
>30	1.56	1.56	6.25	1.56	1.56	2.50
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Marital Status						
Single	18.75	4.69	34.37	7.82	31.25	19.38
Married	71.88	85.94	46.87	81.24	65.06	70.31
Widowed	7.81	6.25	9.38	6.25	4.69	6.56
Divorced	1.56	3.13	9.38	4.69	0.00	3.75
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Source: Field Survey, 2003

Factors influencing cassava pulp fermentation period

Gari processing practices among Cassava processors

Results in Table 2 revealed that majority (60%) of respondents fermented cassava-pulp for only 1-2 days while 39% fermented cassava-pulp for as long as 3-5 days to ensure full detoxification of the cassava pulp. Results from the individual states showed that majority of respondents in Abia (64%), Akwa Ibom (56%) Ebonyi (69%) and Imo (66%) also fermented cassava-pulp for only 1-2 days. This short duration in fermenting cassava pulp among majority of cassava processors in the study area does not indicate sufficient safety for gari consumers considering high cyanide content in poorly fermented gari. The trend could be explained by the fact that over the years, gari has merged as both food and income sources for most farm households. Following appreciation in market value and demand for gari, cassava processors cash in on the opportunity to make quick cash income. The consequence is that instead of the recommended 3-5 days of fermentation, only a period of one or two days is now given for fermentation of cassava pulp thereby sacrificing gari quality and safety for money (Nweke*, et.al,* 1999, Ekwe, 2004).

Table 2: Percentage Distribution of Respondents According to Cassava-Pulp Fermentation Period, Membership of Cooperative Society, Influence of Culture and Social Status

Variable	Abia	Akwa Ibom	Ebonyi	Enugu	Imo	Mean
	N = 64	N = 64	N = 64	N = 64	N = 64	N = 320
Cassava Pulp Fermentation Duration						
1 – 2 days	64.06	56.25	68.75	48.44	65.62	60.62
3 – 5 days	35.94	43.75	31.25	51.56	34.38	39.38
Total	**100**	**100**	**100**	**100**	**100**	**100**
Membership of Cooperative Society						
Yes	20.31	45.31	21.88	53.12	32.81	34.06
No	79.69	54.69	78.12	46.88	67.19	65.94
Total	**100**	**100**	**100**	**100**	**100**	**100**
Culture Encourage Many Days Fermentation						
Yes	81.25	95.31	68.75	98.44	81.25	84.37
No	18.75	4.61	31.25	1.56	18.75	15.63
Total	**100**	**100**	**100**	**100**	**100**	**100**
Whether Social Status affects the Fermentation Practice						
Yes	84.37	85.94	59.37	84.37	81.25	79.06
No	15.63	14.06	40.63	15.63	18.75	20.94
Total	**100**	**100**	**100**	**100**	**100**	**100**

Source: Field Survey, 2003.

Furthermore, results in Table 2 indicated that majority (66%) of respondents did not belong to any farmers' cooperative societies, while only 34% belonged. In most sampled states like Abia (80%), Akwa Ibom (55%), Ebonyi (78%) and Imo (67%), proportion of respondents who did not belong to farmers 'cooperatives societies were more than those who were members except in Enugu(53%). This implies that majority of respondents did not benefit from the advantages accruable to members of cooperative societies such as credits, extension advice, access to farm inputs.

Enquiry was made on whether the farmers' culture encouraged fermenting of cassava pulp for many days to ensure safety. Results in Table 2 showed that the people's culture strongly stipulated long period fermentation of cassava pulp as indicated by most (84%) respondents in the study area. This overwhelming affirmative response suggested that cassava processors themselves were quite aware of the presence and dangers of the poisonous cyanide in poorly fermented gari. For example, in the study area, it was regarded as a taboo to consume cassava meals especially fufu that was fermented within a day or two. Similarly, enquiry was made on

whether cassava processors social statuses affected cassava-pulp fermentation practice in the area. Results in Table 2 also confirmed that the fermentation practices were affected by the social statuses of the cassava processors as evidenced by 79% of respondents that indicated so. However, 20% of respondents indicated otherwise.

Factors influencing cassava-pulp fermentation period for gari processing

A Probit model analysis of effects of selected variables on cassava-pulp fermentation in the study area revealed an adjusted R^2 value of 0.4728 indicating that 47% of the factors affecting cassava-pulp fermentation practice in the study area were accounted for by the variables considered in this study. Specifically, the result revealed that respondents' marital statuses (2.236**) were positively related to long period cassava-pulp fermentation at 5% significant level. This implies that the practice of several days of cassava-pulp fermentation was more popular among the married farmers. Considering that the processed gari was essentially for household consumption, the married would endeavour to ferment the cassava pulp for many days to ensure safety of their household members in gari consumption.

Table 3: Probit Model Estimate of Variables affecting Cassava Pulp Fermentation Periods in Southeastern Nigeria.

Variables	Coefficients	T.ratio
Age of Farmers (X_1)	-0.1986	-0.697
Sex of farmers	0.8914	1.577
Educational Status	0.2091	1.075
Years of Gari Processing Experience (X_3)	-.1518	-0.799
Marital Status (X_4)	0.1033	2.236**
Membership of Cooperative Societies (X_5)	0.5506	0.3430
Cultural Influences (X_6)	0.4282	1.960**
Socio – Economic Status (X_7)	-0.4680	-2.466**
Constant	0.8097	1.652**
Adjusted R^2	**0.4728**	

Similarly, cultural influences (1.960**) on the respondents also had significant positive relationship with long period fermentation practice of the respondents. This implies that as many respondents that abided by their cultural stipulation on cassava pulp fermentation would certainly ferment for as long as 3-5 days. Thus the cultural stipulation of the respondents was also cyanide conscious in gari processing and consumption so as to guarantee safety of the rural farm folks. Furthermore, cassava processors' sex (1.577), educational status (1.075) and membership of cooperative societies (0.3430) had no significant relationship with fermentation of cassava pulp in gari processing in the area while age (-0.697) and years of gari processing experience (-0.799) were negative and non significant relationship with fermentation of cassava pulp in the area.

On the other hand, social statuses (-2.466**) of the respondents were observed to have negative relationship with long period fermentation of cassava pulp in the study area. This implies as respondents' social statuses increased, the period of fermentation decreased. This further suggests that short period fermentation of cassava pulp is common among those of high social statuses and vice versa. It could be further explained that those of high social statuses were less cyanide and safety conscious than those of low economic statuses probably because they do not depend so much on gari for livelihoods like those of low socio-economic statuses.

CONCLUSION AND RECOMMENDATIONS

Fermentation of cassava-pulp is a very crucial stage in gari processing for detoxification of the toxic hydrogen cyanide content of cassava roots. 3-5 days period of fermentation was required to reduce the cyanide content of

the pulp through microbial activities to a level safe enough for gari consumption.

However, results of the study revealed that majority of the respondents fermented cassava-pulp for only one or two days thereby producing gari that has propensity for high cyanide content which indeed could be unsafe for consumption. Adequate detoxification of the poisonous cassava pulp was consciously ignored perhaps for some other purposes. The study also revealed that respondents' marital statuses and culture were positively related to long period cassava pulp fermentation practice among cassava processors in the study area while respondents' social statuses had a negative relationship with long period fermentation practice.

It is, therefore, recommended that awareness campaign should be mounted to sensitize farm households on the risk of inadequate fermentation of cassava pulp during gari processing. Cassava processors in the study area should also be encouraged to join cooperative societies so that they could be easily be accessed by extension agents for delivery of current agricultural information. Similarly, extension agents should use occasion of personal visits to farmers to educate them on the importance of adequate fermentation of cassava pulp during gari processing. Again, cultural groups and activities should be explored by extension agents and nutritionists in disseminating information on need for adequate fermentation of cassava pulp during gari processing.

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