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CHARACTERIZATION OF PRODUCTION TECHNOLOGIES EMPLOYED BY SELECTED SMALL AND MEDIUM SCALE ENTERPRISES IN THE FOOD AND BEVERAGE INDUSTRY IN SOUTHWESTERN NIGERIA

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ABSTRACT

The study examined the production technologies used by selected small and medium enterprises (SMEs) in the food and beverage industry in Southwestern Nigeria. This is with a view to discovering the features of production technologies and how they promote efficacy of production. The study was carried out in Lagos, Ogun and Oyo States in Southwestern Nigeria where there is high concentration of food processing firms (FPFs). Multi-stage sampling technique was used to select the local governments and towns with high concentration of FPFs in each State. Two hundred and fifty FPFs were selected using purposive sampling technique. Primary data were collected with two sets of questionnaire. The first set, which elicited information on type and nature of production technologies, facilities and the production system, was administered on production managers of the firms. The second set, which elicited information on effectiveness of production technologies, was administered on one randomly selected production employee in each firm. Data collected were analysed using mean and frequency distribution. The results show that technologies of the firms were for baking, filtration and pasteurization unit operations. Furthermore, the firms were also characterized by use of imported automated, mixture of automated and manual machines, while few used locally fabricated machines for batch production. The study concluded that methods used for production by the firms are suitable but may have probably promoted few defects in production. However, the use of imported machines by some of the firms may not aid the sustainable development of Nigeria.

Key words: SMEs, Production, Technology, Food Processing.

1. Introduction

Technology is a critical factor in any production system (Ilori *et al*. (2002); Dussange *et al*., 1992). Small scale firms in Nigeria are characterized by the use of craft or traditional technologies in their production activities (Taiwo *et al*., 1997). Aworh (2010) opined that small and medium enterprises (SMEs) are usually hampered by the adoption of inefficient or inappropriate technologies. Taiwo *et al*. (2002) have equally claimed that SMEs in the food and beverage industry rely on locally fabricated machines and equipment in their operations. The inefficiency and inappropriateness of traditional and local technologies being used by many SMEs have been recognized in literature (Awoh, 2010; Uwaifo and Uddin, 2009). This may be connected with the features of these technologies that do not enhance efficient production.

In the past however, individual and institutional efforts were made to upgrade and improve the processing technologies of SMEs (Taiwo *et al*., 1997). Aworh (2010) corroborated this claim

with the citing of mechanization of *gari* processing, instant yam flour, *soy-ogi*, industrial production of *dawadawa* and upgrading of *kilishi* processing, among others. The SMEs, including firms in the food and beverage industry, are noted for little or no investment in research and development (R&D). Many SMEs have continuously been relying on traditional methods in their production. Very little has been documented about the extent to which the traditional technologies employed by SMEs in the food industry have brought about effective operations. This study therefore has the objective of assessing the features of production technologies of SMEs in the food and beverage industry with a view to discovering the efficiency of the technologies in growing the operations of the firms. This is important in view of the need to know the actual strengths and weaknesses of the production technologies of SMEs. This study provides information that will facilitate capacity enhancement among the SMEs, thereby boosting entrepreneurship development in Nigeria. The study is particularly focused on firms producing biscuit and bakery products, carbonated soft drinks as well as sachet and bottled water. These are the leading firms in the food and beverage sector in Nigeria (MAN, 2014). A focus on these firms will provide information to policy makers, authors and scholars generally on the specific nature, features, strengths and weaknesses of SMEs production in Nigeria.

2. Literature Review

2.1. Small and Medium Scale Enterprises (SMEs)

Small and medium-scale enterprises (SMEs) are a veritable vehicle for rapid economic development of any country (Gbandi and Amissali, 2014; Adejumo, 2011; Adegbite *et al*., 2006, and CBN, 2003). However, what constitutes SMEs differs from place to place and from industry to industry. Monday *et al*. (2015), Gbandi and Amissali (2014), Etebefia and Akinwumi (2003) and CBN (2010) submitted that there is no universally acceptable definition of SMEs. The Small Business Administration agency of the United States of America (USA) cited by Ogechukwu (2012) defined a small business as one that is independently owned and operated and not dominant in its field. Monday *et al.* (2015) viewed SMEs as enterprises whose total assets (excluding land and building) are above five million naira, but not exceeding five hundred million naira, and between 10 to 199 employees. The CBN (2010) described a small-scale business as a business with annual income and assets of less than half a million Naira (₦ 500,000 or $1,381 @ N362 = $1). Section 37(b) 2 of Companies and Allied Matters Act (1991) viewed small business as one with an annual turnover of not more than ₦ 2 million naira ($5,525) and net asset value of not more than one million naira ($2,762.50) (Gunu, 2004).

Various agencies and institutions also have different definitions of SMEs. But, capital employed, turnover and number of employees have generally been used to categorise them (Gbandi and Ammisali, 2014 and CBN, 2003). The CBN communiqué No. 69 of Special Monetary Policy Committee meeting of April 5, 2010 classified SMEs as one with asset base (excluding land) of between ₦ 5 million ($13,812) and ₦ 500 million ($1,381,216) and labour force of between 11 and 300. The 13th National Council Meeting on Industry in 2001 categorised SMEs as one with labour size of 11-300 workers or a total asset of not more than ₦ 200 million ($552,486), including working capital but excluding cost of land (Udechukwu, 2003).

In view of the fact that the definition of SMEs by authors, agencies and institutions has continued to vary with time, this study has taken SMEs as enterprises with capital investment of not more than ₦ 500 million ($1,318,216) and full-time employees between 10 and 300.

2.2. Food processing firms in Nigeria (FPFs)

The importance of SMEs in the food industry cannot be over emphasised as they produce some indigenous foods eaten by most Nigerians. They also provide employment and are a source of income for owners. They are therefore critical to the economic growth and development of Nigeria.

The food industry consists of many small-scale FPFs who have been consistent in their use of traditional food processing methods. The traditional technologies are those that were passed from one generation to another until the emergence of modern technologies (Hall, 1989). Floros *et al*. (2010) and Okwelle (2008) gave examples of traditional food processing technologies to include functions for cooking, fermentation, roasting, smoking, threshing, drying, wet milling, dehulling, and peeling, among others. Another segment of the food industry is the very small, one-person micro food firms (Taiwo *et al*., 2002). This segment usually operates informally, using mostly indigenous technologies and producing mainly traditional local foods.

The medium-scale food and beverage firms owned mainly by Nigerians have been producing a variety of food products with simple and modified technologies. The production technology of these firms has been based on batch production system (Aworh, 2010). For the fact that some of these firms are able to mobilize reasonable capital and foreign support, they have been able to adopt some modern technologies in their operations. They have also upgraded some traditional technologies (Aworh, 2008; Taiwo *et al*., 1997).

The foreign food processing firms (FPFs) that constitute a major segment of the food and beverage industry in Nigeria, are the overseas branches of multinational food companies (MFCs) based in developed countries (Aworh, 2010). These firms have therefore found it easier to import modern technologies from their parent companies overseas. These companies have been known to dominate the food industry by virtue of the application of modern technologies in their production activities (Taiwo *et al*., 2002).

2.3. Production and manufacturing

Singh (2006) defines production as an act of converting raw materials into finished goods or services through the application of different types of tools, equipment, machines and processes. Production is generally used to refer to the process of creating physical goods and services. Heizer and Render (1999) noted that manufacturing refers only to creation of physical goods through the transformation of inputs. Manufacturing is also viewed as the use of techniques and methods by which inputs are physically transformed into outputs (Ilori *et al*., 2002). Manufacturing creates value with the use of technology, and physical and mental labour in the process of changing or transforming raw materials or semi-finished materials into finished goods. Technology, in particular, is a critical factor in manufacturing. It is the totality of knowledge, techniques, procedures, processes and skills that culminate in the production of goods (Ilori *et al*., 2002).

Any production or manufacturing activity must involve a process by which inputs will be converted into outputs (Olaposi, 2010). This process is called production technology. Hoyle (2000) argued that the process of transforming inputs into outputs involves materials, machines, the environment, personnel, documentation and techniques. In this study, production technology is viewed as the methods, processes, facilities, machines or equipment used to produce or manufacture a product (Evans *et al*., 1987). The importance of production technology has been

explained by Prajogo and Sohal (2006) when they submitted that technology is an appropriate resource that could be used to enhance organisational performance, particularly production.

3. Research Methodology

The study was carried out in Lagos, Ogun and Oyo States in Southwestern Nigeria. Multistage sampling technique was used to select local governments, and towns in each state. Two hundred and fifty small and medium scale FPFs were thereafter selected using purposive sampling technique. In Lagos State, five Local Government Areas (LGAs) having a high concentration of FPFs were selected, while three and two LGAs that have a high concentration of FPFs were chosen in Ogun and Oyo states respectively. The towns where the FPFs were concentrated in the chosen LGAs were then selected. This was followed by random selection of the FPFs in the towns. Gbandi and Amisah (2014) and Bunu (2004) claimed that there is no reliable comprehensive data on SMEs in Nigeria. Accordingly, based on empirical presence of businesses in the study area, 180, 50 and 20 FPFs were purposively selected in Lagos, Ogun and Oyo States respectively. Primary data were collected with the aid of two sets of questionnaire. The first questionnaire, which elicited information on character of production technologies, was administered on production managers of the firms. The second, which elicited information on the character and effectiveness of production technologies was administered on one randomly selected production employee in each firm. Major variables, which were measured using several multiple-choice questions include nature of production system, nature and types of technologies, types of machines, technologies of production facilities, character of production operations, and effectiveness of production technologies as opined by employees. Interviews were also conducted to complement the questionnaire. Data collected were analysed using mean and frequency distribution.

4. Results and Discussion

Table 1 reveals that majority (73.6%) of the firms used batch production in which units of products are produced in small lots. This agrees with Aworh (2010) who reported that most SMEs in food processing mainly use batch production technique. Stevenson (1999) had also opined that production in small lots is a feature of small-scale firms. This feature might not be unconnected with little capital and limited market scope of many small food firms. This implies that these firms may have little impact on the market dynamics of the food industry unlike foreign FPFs who dominate the market. Table 1 also shows that 25.2% of the firms used continuous process method. Only 1.3% of the firms used mass production method. The low percentage of firms using continuous and mass production methods may be as a result of the inability of the small firms to afford needed specialised machines which the two methods require. Cole (1986) had opined that mass production systems involve the use of costly specialised machines.

Moreover, 39.2% of the firms used fully automated machines, and 41.6% used a mixture of fully automated and manual machines. These may actually be firms producing carbonated soft drinks as well as sachet and bottled water. These are production areas where there has been limited use of locally fabricated machines. The firms in this category may have been characterised by efficiency and high productivity. The study further found that 42% of the firms operate with imported machines while 41.6% use a combination of imported and locally fabricated machines and equipment (Table 1). This implies that many of the firms rely on importation of their inputs with probable negative consequence on foreign reserves. It further shows that these firms may have been producing mainly non-traditional foods which the machines they import may have been made for. Table 1 also shows that only 16.4% are using mainly locally fabricated machines

and equipment. This has been alluded to by Oyeku *et al*. (2005) who claimed that bakers in Nigeria fabricated their equipment, especially, ovens, mixers and milling machines. Oyedoyin *et al*. (2008) have also found that food firms use fabricated machines. This implies that efficiency and high productivity may be a feature of the firms. Among such firms are probably the medium scale firms who have moderate operating capital.

Table 1: Characteristics of Selected Food Processing Firms in Southwestern Nigeria

Variables	F	Percentage
Nature of production system		
Batch	184	73.6
Continuous	63	25.2
Mass	03	1.3
Nature of Technology used in Production		
Full Automation	98	39.2
Semi Automation	45	18.0
Manual	03	1.2
Both full automation and manual	104	41.6
Type of machine used in production		
Imported	105	42.0
Locally fabricated	41	16.4
Both imported and local	104	41.6
Possession of ISO 9000 Certificate		
Yes	13	5.2
No	237	94.8
Possession of NIS Certificate		
Yes	98	39.2
No	152	60.8
Research collaboration with institutions		
Yes	04	1.7
No	246	98.3
Company internal research		
Yes	20	8.0
No	230	92.0
Innovations in last 5 years		
Yes	30	12.0
No	220	88.0

Source: Field Survey (2018)

Majority of the firms had neither international nor local standards certification (Table 1). This could mean that majority of these firms, who may be small-scale and micro businesses, cannot attain the quality standards required for the relevant certifications, probably because of their use of traditional technologies which may have resulted in substandard products. Adegbite *et al.* (2006) opined that products of SMEs in Nigeria are substandard when compared with that of large firms who use modern technologies in production. Ibanga (2007) also gave an indication of this when he claimed that lack of modern technology in processing shea butter in Kainji area of Niger State in Nigeria was a barrier in production of quality shea butter. The lack of technical capability to produce the needed machines and equipment by Nigerian firms could therefore be seen as a setback to sustainable development in Nigeria.

Most of the firms neither had research collaboration with universities and research institutes nor conduct internal research. Ilori *et al.* (1999) had claimed that most firms in food industry in Nigeria were not active in R&D. This is perhaps why 88% of the firms had developed no innovation in the last 5 years (Table 1). These attributes of FPFs, which may be as a result of their informal operation method, limited capital and particularly lack of understanding of the role of R&D in achieving sustainable development, could result in industrial stagnation, underdevelopment, outdated products, inefficiency and low productivity. Aworh (2010) attributed the negative attitude towards R&D by SMEs in the food industry to poor financial background and informal operation.

Table 2 indicates that 48.4% of the firms used baking, 31.2% used filtration while 14.5% used pasteurization technologies. Only 3.6% used technologies for extraction unit operations. Very few firms used cooking (0.4%), evaporation (0.8%), dry mixing and freezing (0.4%) technologies. This finding may have implied that very little research is going on among SMEs in food production because the methods being used to produce are the traditional ones which Floros *et al*. (2010) and Okwelle (2008) had earlier referred to.

Majority (88.8%) of the firms surveyed effected changes in their production technology in the last five years (Table 2). This suggests that the firms may have been responding to frequent changes in technologies, with the understanding that technology is not static. This may have impacted positively on their production efficiency and product quality. Only 11.2% of the firms did not effect change in their production technology. These are probably firms that are incapacitated by paucity of finance. These results could have accounted for why many (62.4%) of the firms claimed that they have improved their production technology in the last five years (Table 2). It is possible that the change in technology initiated by majority of the firms has led to improvement in their production technology. This may have brought better product quality, boost in workers' morale and reduced wastages among others.

Table 2 also indicates that 18.8% of the firms did not experience any improvement in their production technology. This could mean that these firms were among those that could not effect new changes in their technology or have not perfected the change. Table 2 further reveals that 86.4% of the firms either have no defects or very few defects in their products. This suggests that the changes and improvement in their technology are probably paying off in terms of better product quality and reduced wastages. Only about 1% of the firms had many defects in their production. This could be among the firms that have not changed their technology or those that are still complacent about old technology.

Table 2: Production Technologies used by Small and Medium Scale FPFs

Technology items	Frequency	Percentage
Technology of Production Facilities		
Cooking	01	0.4
Pasteurization	36	14.5
Filtration	78	31.5
Evaporation	02	0.8
Extraction	09	3.6
Dry mixing	01	0.4
Freezing	01	0.4
Baking	120	48.4
Change in Production technology in last 5 years		
No	222	88.8
Yes	28	11.2
Improvement in Production technology in last 5 years		
Yes	156	62.4
No	47	18.8
Can't say	47	18.8
Impact of technology on quality		
No defect	101	40.4
Very few defects	115	46.0
Few defects	32	12.8
Many defects	02	0.8

Source: Field Survey **(**2018)

Despite improvement in their technology, Table 3 indicates that only 14% of the firms did not experience any breakdown of machines and equipment between 2014 and 2018. This could mean that majority of firms have either not mastered their technology or that they have not been maintaining their machines regularly. Indeed, majority of the firms (86%) had between 1 and 10 breakdowns with their machines. This could have impacted negatively on the productivity and workers' morale.

Table 3: Employees' assessment of machines and equipment in the last 5 years

Number of times machine breakdown (between 2014 and 2018)	F	Percentage
No breakdown	35	14.0
1 – 3 times	101	40.4
4 – 6 times	37	14.8
7 – 9 times	67	26.8
Above 10 times	10	4.0

Source: Field Survey (2018)

Table 4 indicates that the production system of many of the firms is being fairly supervised and controlled, with a mean score of 3.28 on a 5-point scale. This is probably due to personal involvement of owner(s) in production operations who see the success of the operations as their personal success. However, many of the firms in Table 4 slacked off in the areas of regular maintenance of machines, constant addition of new machines and regular training of employees in machine handling with 1.59, 1.59 and 1.56 mean scores respectively. These factors may have created some problems in their production system, such as constant breakdown of machines and facilities due to irregular maintenance (as testified to by employees in tables 3) and low

productivity arising from employees not being trained to gain new knowledge and skills that could make them experienced and effective on their jobs. Low rate of adding new machines resulting from low operating capital, implies that they were working with old machines which may have a negative effect on productivity. These may have created problems in their production system, such as constant breakdown of machines and facilities (as evidenced by employees in Table 3) and low productivity among others. Many of the firms do not have a clear understanding of their production system hence low mean of 2.35 (Table 4). This may have been a result of lack of technical knowledge needed in operating the production system. The result of this could be poor quality, low productivity, breakdown of machines etc. Similarly, many of the firms do not constantly update their work rules. This implies that these firms operate informally and do not respond to changes in their work conditions.

Furthermore, the analysis in Table 4 also shows that firms do not give opportunity to their employees to introduce new ideas. With a mean score of 1.56 in a 5-point scale, FPFs many have not realised the importance of workers as the most precious asset of any organisation. Since majority of firms surveyed are small businesses managed by owners, the firms may have seen the ideas of employees as secondary and not important. This disregard for employees' ideas was frequently mentioned during interview by employees.

Table 4: Characterisation of production operations of FPFs

Type of Improvements	Mean	Standard deviation
Regular maintenance of machines and facilities	1.59	0.95
Constant addition of new facilities and machines	1.59	0.95
Regular training of employees on machine handling	1.56	1.66
Clear understanding of production system	2.35	1.41
Constant updating of production work rules and procedure	2.07	1.20
Available opportunity for employees to introduce new ideas	1.56	1.66
Effectiveness of supervision and control of production system	3.28	1.41

Scale = 1- 5
Source: Field Survey (2018)

Table 5 indicates that about half (49.6%) of the firms are attaining their daily production targets. This could be firms that are introducing new technology and improving their operations. However, 42% of the firms are having problems in achieving their daily production targets. This could suggest that these may be firms that do not improve their technology or those who pay less attention to maintenance of facilities and importance of workers.

Table 5: Effectiveness of production technologies of the firms

Attainment of daily production target	F	Percentage
Yes		
No	124	49.6
No response	105	42.0
	21	8.4

Source: Field Survey (2018)

Summary and Conclusion

The findings of this study reveal that the technologies of the FPFs are characterised by dependence on importation, lack of regular maintenance of the imported machines and negative attitude towards R&D. Majority of the firms still use batch production system because of their low operational scale, lack of capital and limited scope of their market. Some of the firms are however relying on fabricated local machines. Many of the firms do not recognise the possible potentials of their workforce as they give limited recognition to their ideas. This study concludes that many of the characteristics of SMEs in food industry, such as reliance on importation of inputs, non-maintenance of equipment, batch operation and negative attitude to R&D cannot promote sustainable development in Nigeria.

REFERENCES

Adegbite, S.A., Ilori, M.O., Irefin, I.A., Abereijo, I.O. and Aderemi, H.O.S. (2006) "Evaluation of impact of entrepreneurial characteristics on the performance of small-scale manufacturing industries in Nigeria." *Journal of Asia Entrepreneurship and Sustainability,* Vol. 94, no. 1, pp 90 – 133.

Aworh, O.C. (2008): "The role of Traditional Food Processing technologies in National development – The West African experience," *International Union of Food Science and Technology*.

Aworh, O.C. (2010): *Food Technology and National Development: A global perspective,* University of Ibadan Press, Ibadan.

Bunu, U. (2004). Small scale Enterprises in Nigeria: Their start-up, Characteristics, Sources of Finance and Importance. *Ilorin Journal of Business and Social Sciences,* 9 (1 and 2), 16-43.

Dussange, P., Hart, S., and Ramanantsaa, B. (1992): Strategic Technology Management, John Wiley and Sons, New York.

Cole, G.A. (1986): Management, Theory and Practice. DP Publications Ltd., Eastleigh.

Evans, J.R., Anderson, D.R., Sweeney, D.J. and William, T.A. (1987): *Applied Production and Operation Management* (2nd edition) Western Publishing Company, New York.

Floros, D., Newsome, R., and Fisher, W. (2010): "Feeding the World Today and Tomorrow – The importance of Food Science and Technology," *Institute of Food Technologists Scientific Review,* Vol. 9, no 1, pp. 1 – 28.

Hall, R.L. (1989): "Pioneers in Food Science and Technology: Giants in the earth," *Food Technology*, vol. 43, no. 9, pp 222-233.

Heizer, J. and Render, B. (1999): Production and operation management: strategies and tactics (2nd edition). Allyn and Bacon Publishers, Boston.

Hoyle, D. (2000): ISO 9000: *Quality System Development handbook*. Butterworth, Heinemann Limited, Oxford.

Ibanga, U.I. (2007): "Processing utilization and commercial acceptability of shea butter from vitelleria paradoxa in Kainji Lake areas", *Nigeria International Journal of Food and Agriculture and Research,* vol. 4, no 1 and 2, pp. 241-246.

Ilori, M.O., Oke, J.S., and Sanni, S.A. (1999): "Management of new product development in selected food companies in Nigeria," *Technovation*, vol. 20 no. 2000, pp. 333-342.

Ilori, M.O., Adeniyi, A.A., Oyewale, A.A., Sanni, S.A., and Irefin, I.A. (2002): "Development of a manufacturing-based economy in Nigeria through science and technology," *Technovation,* vol. 22, no. 2002, pp. 51 – 60.

Jones, R.P. (1998): "Management and Technology and what is next". *International Journal of Technology Management,* vol. 16, no. 1/2/3, pp. 37-44.

Okwelle, A.A. (2008): "Chemical and anti-microbial preservation for extending the shelf life of Ugba – A fermented African oil bean seed." *International Journal of Science and Technological Research,* vol. 5, no. 1 and 2, pp. 56-71.

Olaposi, O.O. (2010): Technology Assessment of Packaged Water Production in Osun State Unpublished Ph.D thesis of African Institute for Science Policy and Innovation, Faculty of Technology, O.A.U., Ile-Ife.

Oyedoyin, B.O., Akinola, S.O., Ajuebor, F.N., Omotade, S.A., and Kupoluyi, C.F. (2008): "An economic evaluation of small-scale production of clarified fruit juice from local fruits." *Journal of Industrial Research and Technology,* vol. 2, no. 1, pp. 5-11.

Oyeku, M.O., Kupoluyi, C.F., Osibanjo, A.A., Orji, C.U., Ajuebor, I.D., Ajiboshin, I.O. and Ashiru, W.B. (2008): "An economic assessment of commercial breed production using 10% cassava-wheat composite flow." *Journal of Industrial Research and Technology,* vol. 2, no 1, pp. 13-20.

Prajogo, D.I. and Sohal, A.S. (2006): "Integration of total quality management and technology and R and D management in determining quality and innovation performance," *Omega Journal,* vol. 34, no 3, pp. 296-312.

Reis, D., Pate, N. and Pena, L. (1999): "Problems of Modern Technology," *International Journal of Technology Management,* vol. 17 no. 3, pp. 351-360.

Singh, R. (2006): Introduction to basic manufacturing processes and workshop technology. New Age International (P) Limited Publishers, New Delhi.

Stevenson, W.J. (1999): Production and Operations Management (6th edition), McGraw-Hill, Boston.

Taiwo, K.A., Irefin, I.A., and Ilori, M.O. (1997): "Integration of modern technologies in Traditional Food Processing in Nigeria." *Food Review International* vol. 13, no. 4, pp. 611-621.

Taiwo, K.A., Olalere, W.O., Ilori, M.O., and Akanbi, C.T. (2002): "A study on the Nigerian food industry and the impact of technological changes on the small-scale food enterprises," *Food Reviews International,* vol. 18, no. 4, pp. 243-261.

Uwaifo, V.O. and Uddin P.S.O (2009). Technology and development in Nigeria: The missing link. *Journal of Human Ecology.* 28(2), 107-111.