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RESEARCH ARTICLE

DEVELOPMENT OF DAIRY PROCESSING SYSTEMS IN URBAN AND PERI-URBAN AREA: THE CASE OF SMALL-SCALE PROCESSORS IN SOUTHERN BENIN.

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Abstract

Milk and dairy products contains important source of nutrients for human well-being. This dairy sector continuously subjected to economic and socio-structural changes plays an important role in Benin's economy. Restructuring and implementation of appropriate conditions are two fundamental targets of dairy processing development policies, which will increase the level of production, ensure high quality of products and improve livelihood of local population. The main objective of this study was to determine the factors curbing the development of small-scale dairy processor units located in urban and suburban zone in southern Benin. Data were collected through individual interviews and group discussion based on structured questionnaire, which were designed to collect information relating to: socio-structural, processing capacity, packaging and preservation, marketing, supports and major constraints faced by dairy units. It was observed that processing units using fresh milk and powder milk have a daily capacity ranging between 21-50 L and 11-20 kg respectively. The most important dairy products are Yogurt, Wagashi and Deguè. None of dairy processors units performed the qualitative analysis (microbiological, chemical or nutrient content). Because of the packing and conservation default, the cheese is sold as soon as produced then they have no preservation methods applied, this could cause losing the quality of cheese. Lack of governmental regulations and difficulties to access loans are the main constraints restraining the business activities. The finding of study provided information that should be taken into account when implementing new policies to ensure an industrialization and sustainable development of this vital sub-sector.

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Introduction:-

Development of dairy processing systems takes place in different ways for various needs. The content of this development plan differs according some characteristics (regulations, the level of development and the vision of the country) will be established. The common purpose of development plan of dairy processing systems is to archive a better processing standard in terms of food safety and consumer well-being.

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Milk and dairy foods are one of the most important nutrients (energy, protein and fat) sources for human consumption. Referring to Durand et al. (2015), dairy sector involved in this study were the different stakeholders, whose dairy processing units. In Benin, it was determined that there were a few numbers of dairy industries. The large share of dairy market is controlled by the unorganised and informal small processors. According to Alkoiret et al., until 2009 there was only one mini dairy industry in Benin. This mini dairy created by the National Association of Ruminants' Farmers had been located in the district in of Gogounou, Northern Benin. Its production has based on using raw milk collected locally in the commune and not on milk reconstituted from the imported milk powder (Alkoiret et al., 2009). Given that the development of small-scale industries is the necessary basis for the development of formal standardized food chain (Giangiacomo, 2003); implementation of development policies was indeed pertinent. From this standpoint, in recent years, the successive governments have undertaken a number of incentives to intensify milk production and processing. These actions mainly aimed the reorganization of milk collection by launching vast program or projects of construction and equipments of collection plants; and making them available to producers. For instance throughout the project PAFILAV (Projet d'Appui aux Filières Lait et Viande) the government built four other mini-dairy producers (Anonymous, 2017). Unfortunately, the investments made did not brightly succeed. Indeed, several problems mainly related to milk storing, its transportation to the collection points by farmers and the entire organization still need to be solved (Anonymous, 2017).

Milk in Benin is sold as raw through informal markets, and they are processed into various dairy products, this forms a relatively important socio-economic activity (Giangiacomo, 2003). Several studies have been carried out on the characterization of dairy herds in the Benin Northern. However, studies assessing the performance and competitiveness of the processing sub-sector in general and particularly in urban and peri-urban areas in Southern Benin practically do not exist. Therefore, this study was carried out to better understand the organization, management, operating mode and factors limiting the competitiveness of small-scale dairy processors.

Materials and Methods:-

Study Area

This study was conducted in five cities (Cotonou, Abomey-calavi, Allada, Tori, Ouidah) located in the Department of Littoral and Atlantique, Southern Benin. Cotonou is the economic capital of the country sheltering two thirds of the industries of the country. As for the other cities viz: Abomey-calavi, Tori, Ouidah, they are located in suburban area and constitute dormitory cities of which the majority of the population goes every day to work in Cotonou. Although these cities are far from being the important stronghold of dairy farming in Benin, they have been selected in this study because of their population estimated at over 2.2 million people (INSAE, 2015) constituting the important consumers' market for dairy products. Beside, based on information received from livestock and agricultural service offices, these cities host some dairy cow keepers and a considerable number of small-scale dairy processors that faced essential problems notably the limited fresh or raw milk supplying.

Data collection

The retrospective interview survey based on questionnaires was used for data collection. Individual interviews and group focus discussions were used to gather information. Based on information received from livestock and agricultural service offices about forty small scale milk processors were identified. However, only twenty four processors have favourably accepted to take part in the present study. Dairy processing constitutes the main income sources and activities of all processors implicated in this study. Thus, questionnaires were administrated to twenty four players from July to September 2018. The questionnaires were designed into three sections and 27 questions:

1. Section 1 took into account stakeholder's dairy processing systems social structural (gender, age, education, experience of processing, employment etc.)
2. Section 2 included the characteristics and performances of dairy processing systems units (type of the used raw milk, contract for raw milk supplying, duration of contact, characteristics of raw milk, transportation of raw milk, processing capacity, packing and conservation of dairy products.)
3. Section 3 summarized the business management and competitiveness parts. In this section, marketing mode, final supports and major constraints faced by dairy processor units were reported in order to propose some approaches of solution to the current status of these dairy units.

Statistical analyses

All records from the field were computerized and statistically analysed with SPSS 20 for Windows. Descriptive statistics were performed for all variables. Frequencies were established for qualitative variables. Additionally, the narrative information collected from group discussion was used in order to analyse further the subsector.

Results and Discussion:-

Structural Characteristics of dairy units

The findings on the socio-structural characteristics of dairy units are given in the Table 1. The majority (83.3%) of the surveyed players was women. Regarding education, 83.33% of the interviewed did not complete education, 4.17% indicated they had completed a university degree. 91.67% of respondents were between 35-40 years old. Women play a leading role in the transmission of dairy know-how, be it milking, fermentation, skimming or churning; especially in Fulani households, where the marketing of milk and products (cheese) goes to women. Most of the respondents have been involved in the dairy processing business for less than five years. These dairy units employed 62.5 %, 50.0% and 25.0% of permanent, familial and seasonal employees. Leaning on the given results it was found dairy units exclusively employed familial labour either combined familial with seasonal or contractual worker.

Table 1:-Socio-structural of the dairy units

Parameters		Frequency	Percent (%)
Gender	Male	4	16.7
	Female	20	83.3
Experience in dairy processing	< 5 years	14	58.3
	5-10 years	7	29.2
	10-15 years	3	12.5
Employment	Familial	12	50.0
	Permanent	15	62.5
	Seasonal	6	25.0

The Table 2 show the data related that milk is the major input of any dairy processing industry, the present study indicated that most 62.5% of the processors exclusively used the fresh cow's milk, while the remainder used imported milk powder and their mixture as raw materials of production. The supplying of the raw materials is not mostly based on any contract form. However, 41.7% and 4.2% of units have a verbal and written agreement with raw milk suppliers. The supplying of raw materials is based on specific criteria defined according the characteristics of the milk. Indeed, 75% and 70.8% of supplying operation are performed using the milk colour and physical aspect as the main criteria. Some dairy units use the expiration date and percentage of dry matter when choosing the raw materials. According to the statement of stakeholders, milk with 26% of dry matter is better than the one with 28% for yogurt production. 79.2% of dairy processors have plastic can that is used to transport of the fresh milk to processing sites. Concerning the processing capacity, packing and conservation practices applied. 45.8% and 20.8% units processing fresh milk and powder milk have a daily capacity ranging between 21-50 L and 11-20 kg respectively. Fresh milk and imported milk powder are processed into various dairy products marketed and consumed. It is important to highlight that a small number of the interviewed dairy units used several criteria for characteristics and transportation of the raw milk at the same time compared to others that use only single criteria that led them to use more than one packaging system for their finished dairy products (Déguè and Yogurt), the details of which Table 2 takes into account. In this study, we found that Yogurt (45.8%) and Déguè (12.5%) are the most widely made forms of dairy products from imported milk powder. Déguè is a local dairy beverage made of boiled sorghum couscous mixed with Yogurt. Among the products resulting from the processing of fresh cow's milk, the local Fulani cheese also known as Wagashi remains the most widespread and consumed (70.8%) in urban areas. The traditional processing, which is found in pastoral households, involves using the remaining milk after direct consumption as drinking milk to make some dairy products, particularly cheese (Fig 1), which is sometimes colored (Fig 2) using colored water with dried sorghum leaves to extend its shelf life (Sessou et al., 2013). This processing is mainly practiced by the women i.e. wives of breeders so as not to lose the milk (Dossou et al., 2006).

Déguè (Fig 3) and Yogurt (Fig 4) are usually packed in plastic sachet or bottle with variable volume. In contrary, the local cheese is not packed. This leads to their immediate sale or keeping them in whey or brine. As for, the produced Yogurt and Déguè, they are commonly conserved at low temperature conditions after cooling or freezing processes.

Table 2:-Processing capacity, packing and conservation of dairy products

Parameters		Frequency	Percent (%)
Type of the used raw milk	Fresh cow milk	15	62.5
	Imported milk powder	5	20.8
	Mixture: Fresh cow + imported milk	4	16.7
Contract for raw milk supplying	Yes/written	1	4.2
	Yes/verbal	10	41.7
	No	13	54.2
Duration of contract	Long term (> 10 years)	1	4.2
	Undetermined	12	50.0
	Owned a farm	11	45.8
Characteristics of raw milk	Colour of the fresh milk (White)	18	75.0
	Physical aspect of the fresh milk	17	70.8
	Acid taste	1	4.2
	Other (expiration date, % of dry matter: 26 or 28%)	5	20.8
Transportation of raw milk	Tank containers of fresh milk	1	4.2
	Plastic can of fresh milk	19	79.2
	Bags of powder milk	9	37.5
Daily processing capacity			
Fresh cow milk (L)	< 20	6	25.0
	21-50	11	45.8
	51-100	2	8.3
Imported powder milk (Kg)	< 10	1	4.2
	11-20	5	20.8
	> 21	1	4.2
Dairy products	Wagashi cheese	17	70.8
	Yogurt	11	45.8
	Pasteurized milk	1	4.2
	Dégùè	3	12.5
Packing of dairy products	Plastic bottle (Yogurt and Dégùè)	12	50.0
	Plastic sachet (Yogurt and Dégùè)	8	33.3
	No packing (Wagashi cheese)	17	70.8
Storage condition of dairy products	Cooling/freezing (Yogurt and Degue)	11	45.8
	Salted water or whey (Cheese)	15	62.5
	No storage (immediate selling)	15	62.5

**Fig 1:-**Wagashi cheese**Fig 2:-**Colored Wagashi cheese



Fig 3:-Deguè packed in plastic sachet



Fig 4:-Yogurt packed in plastic bottle

Qualitative and microbiological analysis of dairy products

Information collected during individuals and group discussion revealed that none of dairy units perform the microbiological, chemical (nutrient content) and sensory analysis of their dairy products. In the absence of appropriate mechanisms to the increasing demand for food, there is danger of starvation. For instance, in 2017, more than 1.09 million people of Benin population were food insecure and 80000 were severely touched by vulnerable to nutrition insecurity (Anonymous, 2017). The supply of healthy and nutritious food is a crucial element of food security. Dairy products need to be carefully analysed in order to ensure food safety for public consumption which will further lead to the products being sold outside of Benin. Because these analyses are necessary characteristics that could reassure consumers, then from that moment the regulation of this sector becomes indispensable. This goal can be achieved through increased rate of production, suitable processing and preservation. As such, information and training sessions should be organized for stakeholders in dairy processing to bring them to understand the importance of these analyses.

Business management and sustainable competitiveness of dairy units

Dairy units spend averagely 587.5 ± 79.1 F CFA¹ or 2173.3 ± 151.3 F CFA to purchase one litre of fresh milk and 1 kg of milk powder respectively (Table 3).

Table 3:-Marketing of dairy products and business management of dairy units

Production expenses (F CFA)	Mean	SD	Min.	Max.
Fresh milk	587.5	79.1	500	700
Imported powder milk	2173.3	151.3	2100	2560
Other expenses (Sugar. Aroma, water, electricity, woods etc.)	49300	27287.73	18600	84900
Mode of marketing or sale	Frequency	Percent (%)		
Shop or unit gate	6	25.0		
Local market	22	91.7		
Retailers	14	58.3		

The surveyed respondents stated that the price of fresh milk changes according to the season. During rainy season, the price is lower (usually 500 F CFA) than drought season, when the price reaches 700 F CFA. These findings are consistent with the price reported by Dossou et al., (2012). The seasonal fluctuation of prices may be due to the seasonal variation of fodder and feed resources in terms of nutritional value and quantity for lactating cows in farms (Agossou et al., 2017). Indeed, evidence demonstrated that due to high nutritive value and abundance of feed during rainy season, lactating cows produce more milk than during drought season (Soule et al., 2017; Alkoiret et al., 2016). The processing costs are averagely 49,300 FCFA per month. These expenses cover input costs including sugar, aroma, water, electricity and woods used during the process of production. The dairy products are directly sold either in the local market (91.7%) or shop at the gate (25%). Nevertheless, for better marketing possibilities, 58.3% of dairy units delivered their products to retailers, who send the dairy product to the nearest local market for sale. At the market, 1 litre

¹Currency of Benin defined as: Franc de la Communauté Financière Africaine (\$1 USD = 564,77 F CFA)

of Yogurt, pasteurized milk or Deguè use to be sold at 1000 F CFA. As for the unit price of cheese, it varies between 500 to 1000 FCFA depending on the size. At the farm or unit level the selling price of cheese to retailers varies from 350 to 800 F CFA.

The study indicated only 37.5% of respondents are provided with financial supports as loan (Table 4).

Table 4:-Financial Supports

Parameters		Frequency	Percent
Financial supports as loan	Yes	9	37.5
	No	15	62.5
Institution	Government	2	8.3
	Private Financial institutions	7	29.2
Frequency of support	Yearly	8	33.3
	Frequently	1	4.2
Sufficiency of support	Yes	3	12.5
	No	6	25.0
Importance of financials support	Increase of business capital	5	20.8
	Improving of production level	9	37.5
	Purchasing of new equipment	4	16.7
	Purchasing of inputs	8	33.3

These supports are mainly granted by private financial institutions. The surveyed respondents reported that these supports are not sufficient because of the high interest rate and the infrequency of the loan. Even though these are insufficient, the supports help to increase the investment capital, improvement of production, the purchasing of new equipment and inputs.

Local milk production faces a number of constraints that prevent its competitiveness. Concerning the major difficulties faced by dairy processors 24 people were asked and the answers agreeing are presented in the Table 5.

Table 5:-Major constraints faced by dairy units

Major constraints	Frequency	Percent
Lack of governmental supports	21	87.5
Difficulties to access sufficient loans and high interest rate	20	83.3
Low price of dairy products	20	83.3
High price inputs (sugar. aroma. etc.)	15	62.5
Poor sales of dairy products	7	29.2
Lack or irregular raw milk supplying	6	25.0
Lack of investment capital	1	4.2

Respondents reported the lack of governmental regulations, and difficulties to access loans which is the main constraints restraining the business activities. Besides these problems, producers complain about the low price of dairy products and high production cost. Indeed, the competition of imported milk which has many advantages over local milk: price, quality, availability, and popular use (Mas Aparisi et al., 2012) depresses the milk producers, this can lower down the capacity of local milk production henceforward could lead to the disappearance of this sector of activity.

In addition, there are some other problems which are irregular supply of raw fresh milk and the lack of investment capital. The lack of fresh cow milk may be due to a number of factors. These factors can be summarized as the low productivity of local breeds, inappropriate supplementary feeding of the dairy cattle, poor nutritive value of pastures and forages offered to the animals (Agossou et al., 2018). Therefore, milk policies need to be regulated as they have some critical roles to play in the restructuring sectors.

Conclusion:-

Milk and dairy foods are one of the most important nutrients (energy, protein and fat) sources for human consumption. Dairy sector involved different stakeholders whose dairy processing units. This study highlighted the structural organization, production practices and constraints limiting the good functioning of small-scale dairy processors in Southern Benin. Although, small scale milk processing is mostly traditional and irrelevant as the bulk of milk in Benin is sold raw through informal markets, the processing of milk, into various dairy products, has become a relatively important socio-economic activity. Therefore, the implementation of new development strategies to resolve the identified constraints of this sector would lead to a more powerful industrialization of the dairy sector, opening windows of livelihood opportunities.

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