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Editor's Note

Dear readers,

We are so happy and enthusiastic about presenting the Third Issue of Volume First (Volume 4 Issue 02 "April 2019"). It is not an easy task to maintain and preserve academic publishing. Not finding an academic article that worth publishing and the lack of financial support are the two major obstacles in publishing academic journals. Our Organization Director kindly provides us with support of any nature, first and foremost, by sparing no expense on financial support. Moreover, the considerable improvement both in terms of quality and quantity of the articles submitted to our journal for evaluation encourages us to think positively about the future of our journal. Therewithal, since we have already met the quota for the next issue evidently shows that we are on the right track.

Although we intend to include a higher number of academic articles in the next issues of our journal, we only allow for maximum 30 articles in each issue in order not to digress from journal format or exhaust our dear readers. The excess of articles submitted to our journal drag us to a happy weariness. We need to acknowledge that there are many articles that could not be published in this issue although they have been evaluated and approved by our referees. The articles that are approved but not published in the current issue are put in queue for publication based on their date of submission.

I would like to thank the esteemed academicians and researchers who submitted articles, book reviews; and the referees who kindly devoted their valuable time for reviewing the submitted works. I also would like to extend my gratitude to the members of the Advisory Board and of the Publication Board; as well as the staff who contributed to our journal. With the hope to meet again in the next issue of the International Journal of Agriculture, Environment and Bioresearch, I hereby present my deepest respect to you all.

Editor in Chief

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CONTRIBUTION OF NON-TIMBER FOREST PRODUCTS IN THE ECONOMY OF RURAL POPULATIONS IN SOUTHERN BENIN: CASE OF EDIBLE FUNGI (Volvariella volvacea And Pleurotus abalonus) IN SAKÉTÉ COMMUNE

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ABSTRACT

The production of Pleurotus abalonu on palm stalks and that of Volvariella volvacea on dead palm trees is very little known in Benin. However, few studies have been conducted on these means of production. The purpose of this study is to generate useful information to take advantage of the potential of these non-ligneous forest products. The sample includes 88 respondents, including Pleurotus abalonus producers (9.09%), Volvariella volvaceapickers (88.63%) and hotel and restaurant managers (11.36%). Data collection is based on structured interviews and direct observations. The stakeholders involved in this product include, among others, growers of Pleurotus abalonus, the collectors of Volvariella volvacea, wholesalers and consumers. The marketing of these mushrooms produced and collected brings significant income to these stakeholders. A producer of Pleurotus abalonus earns on average 202.410 F CFA, after the production of 200 kg of mushrooms in three months. The income of a Volvariella volvaceaseller varies between 2000 and 4000 F CFA per day for 1 to 2 kg of Volvariella volvacea picked. The consumption of these, allows the population to fight against protein deficiency and certain diseases such as anemia, thanks to the nutrients they have. The valorization of the production of mushrooms (Pleurotus abalonus and Volvariella volvacea) on stems and dead palms, through awareness, training and supervision, are the essential points for the development of this crop.

Keywords: Sakete, production, edible mushrooms, palm crawl, dead palm

1. INTRODUCTION

For millennia, non-timber forest products (NWFPs) such as wild edible fruits, nuts, vegetables, wild mushrooms and others have been used by indigenous peoples for monitoring and trade (NS Yorou, 2002, p. .614).

In Benin, these products play a very important socio-economic role for local populations. For the majority of people living in rural areas, life would be virtually impossible without the availability of leaves, fruits, wild mushrooms, medicinal plants, natural fibers, and so on. collected in the environment (F. Malaisse, 2010.p.42).

People used to go to the grasslands and forests to harvest edible mushrooms. Today, some edible species lend themselves to a culture intended for consumption. While some species are relatively easy to grow, others require more specific methods and temperatures. In general, the productive

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life of the fungus is rather short (from a few weeks to a few months). After the harvest cycle, spent substrate / compost can be recycled as a soil amendment (N. Bram Van, 2007.p.6).

The strains of fungi grown in Africa belong mainly to the species Pleurotus (Pleurotusspp), Auricularia (Auriculaspp), Volvariella (Volvariellavolvacea) and Ganodermalucidum (Chang, 1999, p.291). Numerous agricultural residues are used for the cultivation of oyster mushrooms such as corn stalks, rice husks, straws (I. DiansambuMakanuaet al., 2015.p.241). Of the more than 300 edible fungal species recorded in tropical Africa, very few are artificially cultivated (E. Boa, 2006, p.157). In addition, very few species are grown with traditional methods and very few articles on mushroom cultivation are available (M.S. Dibaluka, 2005.p.200).

Edible mushrooms are among the Non-Timber Forest Products (NTFPs), those with the greatest agronomic potential and a certain economic boom. Today, the focus is on their uses for life-saving purposes for edible fungi and their importance to rural people in developing countries (FAO, 2012).

Long neglected by the public authorities, the production and marketing of wood and non-wood products have always been based on the initiative of small producers and traders. This is the case of fungi (Pleurotusabalonus and Volvariellavolvacea) whose marketing represents an income-generating activity for producers. Mycology specialists in Benin have shown that edible mushrooms have a significant nutritional value; which justifies the relevance of the creation and valorization of the sector. Exploitation of this sector is undoubtedly an effective means of combating diseases caused by food imbalance (P. WeleIdrissou, 2001, p.6).

Nevertheless, the seasonality in the appearance of the carpophores is a limiting factor for their availability, often random and concentrated on a few weeks per year, mainly in the rainy season. Therefore, the cultivation of mushrooms proves to be a profitable activity for African countries. In times of drought, it makes it possible to provide fresh produce by transforming agricultural residues into high quality food protein (C.J. Hounsou-Bo and L. Ahoton, 2017, p.3).

The Commune of Sakété with an area of 432 km2 extends between 6 ° 37'12 " and 6 ° 52'12 " of latitude north then 2 ° 32'20 " and 2 ° 46'50 " of east longitude on the plateau of Pobè-Sakétédans in the department of Plateau. It is a rural commune which is composed of 49 villages and city districts grouped in six (6) districts. The study took place in all localities of the municipality (Figure 1).

Map 1: Situation of Sakété Commune

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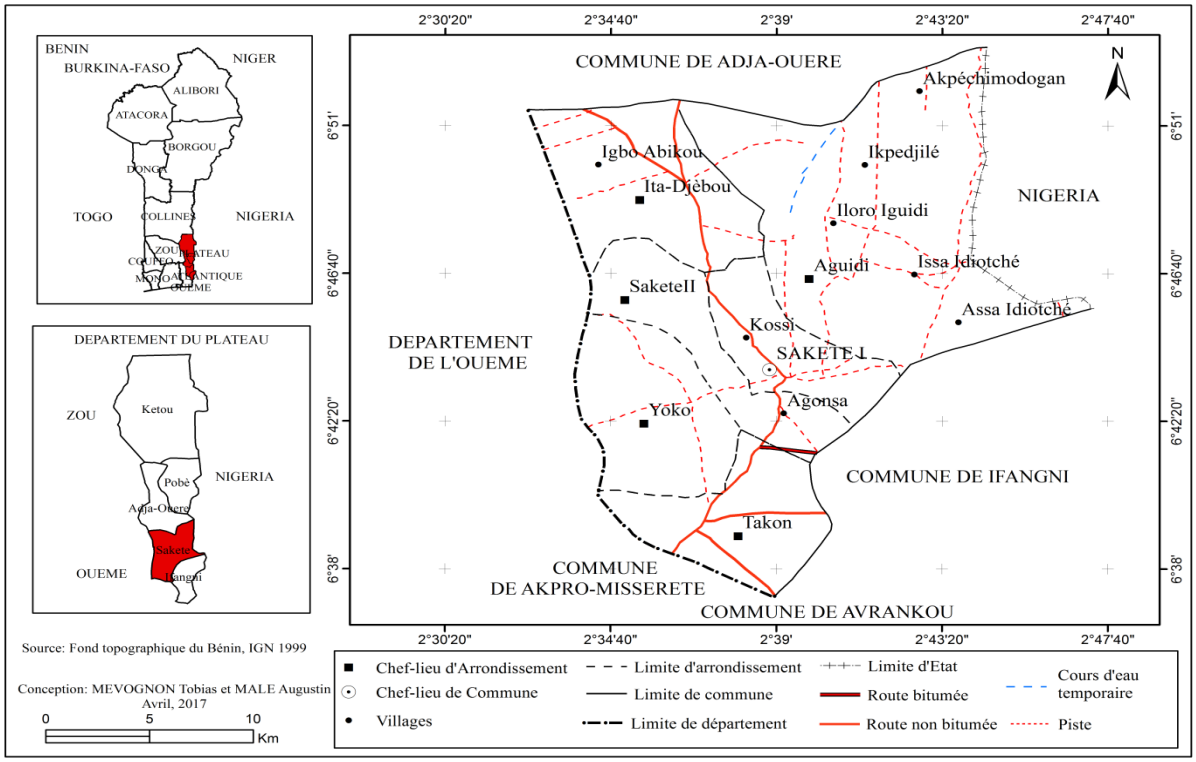

Source: IGN Topographic Fund, 1992

The commune of Sakété enjoys a subequatorial climate, characterized by two rainy seasons during which we observe the picking of Volvariellavolvacea mushrooms, the picking of the palm regimes for the production of palm oil and two dry seasons which are This period is favorable to the pasteurization of the stalks and the drying of these. The average annual rainfall is close to 1200 mm. The amplitude between maxima and minima varies from 32.12 ° C to 23.45 ° C (ASECNA, 2015).

The commune of Sakété is an ecological zone very favorable to the myciculture. Formerly forest, it is replaced today by palm groves because of the climatic and edaphic conditions which it benefits thanks to its geographical position. It is in these palm groves that the collection of Volvariellavolacea is observed.

2. METHODOLOGY

2.1. Material and Tools

Equipment

The equipment used for data collection consists of:

- a digital camera for shooting mushroom species;

- a plastic bag for collecting samples;

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- knife or chisel

Tools

-a map of the geographical situation of the municipality;

-a questionnaire, to interview the respondents.

Data collection techniques

The collection techniques used are: direct interview using a questionnaire, direct observation and participant observation.

2.2. Data collection method

The fieldwork was conducted in two (2) phases: an exploratory and an in-depth phase.

During the exploratory phase which lasted two weeks. It consisted of going through the six (6) arrondissements of Sakété Commune to identify the mushroom production sites and to proceed with the census of the producers. This technique made it possible to obtain general information on the production, collection and marketing of mushrooms. The observations made during this phase made it possible to make contact with the actors. The questionnaire was tested and refined before the thorough investigation phase.

During the in-depth survey phase, data was collected mainly through structured questionnaire-based interviews. These surveys were carried out on the various production sites identified and the picking locations. The identification of the production techniques of the Pleurotus albalolus) and the harvesting of Volvariellavolvacea was made among 86 producers identified in the six districts of the commune of which 8 growers of the Pleurotusabalonus on the palm tree crop or 10.25% and 78 collectors of VolvariellaVolvacea on the dead palm is 90.69%.

The sampling method used in this research is that of the snowball, since no list of modern and traditional producers of edible mushrooms exists at the level of the Communal Agricultural Development Sector (CSAE). This method made it possible to identify all the modern and traditional producers of mushrooms in the commune. To evaluate the socio-economic importance of this activity, 86 mushroom growers representing 96% of the total registered population and 10 restaurant bar managers, were followed for three (3) months of activity. Using a sheet, data such as the selling price of mushrooms and the actors involved in their marketing were collected.

To evaluate the socio-economic importance of this activity, producers of Pleurotusabalonus (9.09%), Volvariellavolvacea (88.63%) and hotel and restaurant managers (11.36%), followed for three (3) months of activity. Using a sheet, data such as the selling price of mushrooms in kilograms, grams and heaps. The actors involved in their marketing have been investigated.

2.3. Data processing and results analysis

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The survey cards were analyzed manually and numerically. The data were analyzed according to a descriptive statistic with calculation of the values. Thus, let RB be the Gross Income; RN: Net Income; D: Expense, QP: Quantity Produced, P / kg: Price of one kilogram of dried mushroom. RB □ (= QP × P / kg); RN = RB-D.

These formulas were used as part of the assessment of income from Pleurotusabalonus. As for the Volvariellavolvaceale monthly income was obtained according to the daily income.For the analysis of the results, the model SWOT (Strengths-Weaknesses-Opportunities-Threats).

3. RESULTS

3.1. Varieties of cultivated mushrooms

In the commune of Sakété two varieties of edible fungi are cultivated namely: the Oyster mushroom (Pleurotusabalonus) and the volvaire (Volvariellavolvacea) (Photos 1 and 2).

Photo 1: PleurotusabalonusPhoto 2: Volvariellavolvacea

Shooting: ALI, April 2017

The first picture on the left of Plate 1, shows Pleurotusabalonus pushing on a boot of what? In the fruiting room. This species is obtained from a seed produced in the laboratory. The second photo on the right shows the variety Volvariellavolvacea. This species grows naturally in fields and trunks of dead oil palms.

3.1.2. Production Techniques of the Potspot on Oil Palm Rafts

The production of Oyster mushrooms on the stems of palm trees is done following six (06) stages: the choice of the substratum; pasteurization of the substrate; dripping / drying, larding / seeding, incubation, fruiting / harvesting.

3.1.2.1. Choice of substrate (palm tree stalk)

Several agricultural wastes can be used as substrate (materials on which the mycelium grows) for the production of mushrooms. The agricultural waste used varies according to agro-ecological zones and are among others rice straw, Panicum stalks, oil palm cobs and maize, etc. As part of

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this research, the substrate used by the producers of the Commune of Sakété is the oil palm stump (Photo 3).

Photo 3: Palm flakes

Shooting: ALI, March 2017

3.1.2.2. Pasteurization

The pasteurization of the substrate is not immersion in water to boiling. Considering that oil palm cobs are tough residues, long-term pasteurization (at least one hour and forty-five minutes) is very necessary before larding. The main purpose of pasteurization is to remove unwanted microorganisms from the stalks and soften them. It is done in two steps:

1st step: Soak the substrate in water heated to a temperature of 70 ° C at least. He stays there until the boiling water for one hour. When the stalks contain a lot of oil, it is necessary to add some gram of slaked lime to the boiling water during the first pasteurization. The presence of the oil inhibits the growth of the mycelium.

2nd step: A second pasteurization is necessary. It is made without the slaked lime and lasts 45 minutes from the boiling of the stalks from the first pasteurization.

3.1.2.3. Draining / drying

It consists in drying the previously pasteurized substrates. After cooking, the stalks are placed on the drip tray to dry for 16 hours. This drying is done in expansion in the sun to reduce the amount of water inside the stalks. (Photo 4)

Photo4: Rafles on the drip tray

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Shooting: ODJOUBERE, March 2017

Photo 4 shows the pasteurized stalks that are being placed on the drip tray. After the second baking of the pasteurization stage, the stalks are placed on the drip tray in the sun. These stalks must be dried at sunrise and protected at sunset against dew.

3.1.2.4. Lardage / Seeding

The lardage is done in an aseptic condition. It involves inoculating the seedling white (seed) at the rate of 50 grams per crop and repointing them in its panicles. Once the lardage is finished, the substrates are wrapped in plastic bags. All parts of the substrate must be well covered.

3.1.2.5. Incubation idem

After seeding, packets or boots are placed on shelves, in the mushroom to spend the incubation phase protected from sunlight. This phase lasts 3 to 4 weeks for oyster mushrooms. As soon as the boots are installed in the incubation room, the watering is done on the ground and not on the boots. At the end of this period, a complete colonization of the substrate is done and the different parts take the color of the mycelium. At this stage, the colonized substrates will reveal primordia (young mushrooms). After the exit of the primordia, the watering is done now on the boots carrying mushroom.

3.1.2.6. Fruiting and harvesting

Three to four days after their appearance, the primordia become carpophores " ripe mushrooms ". The harvest is done, as soon as the ends of the hat begin to crenel and tear. When the substrates are completely exhausted, they are released from the mushroom. The yield per boot is at least 1kg the size of the boot. Harvested mushrooms are sold fresh and sometimes sun-dried for 14 hours before being packaged and sold. (Photos)

Photo 5: Fructification Drying **Photo 6: Harvest of PleurotusPhoto 7:**

Shooting: ALI, March 2017

Figure 1 illustrates the process of producing Pleurotusabalon on oil palm stems from substrate selection to conditioning the carpophore.

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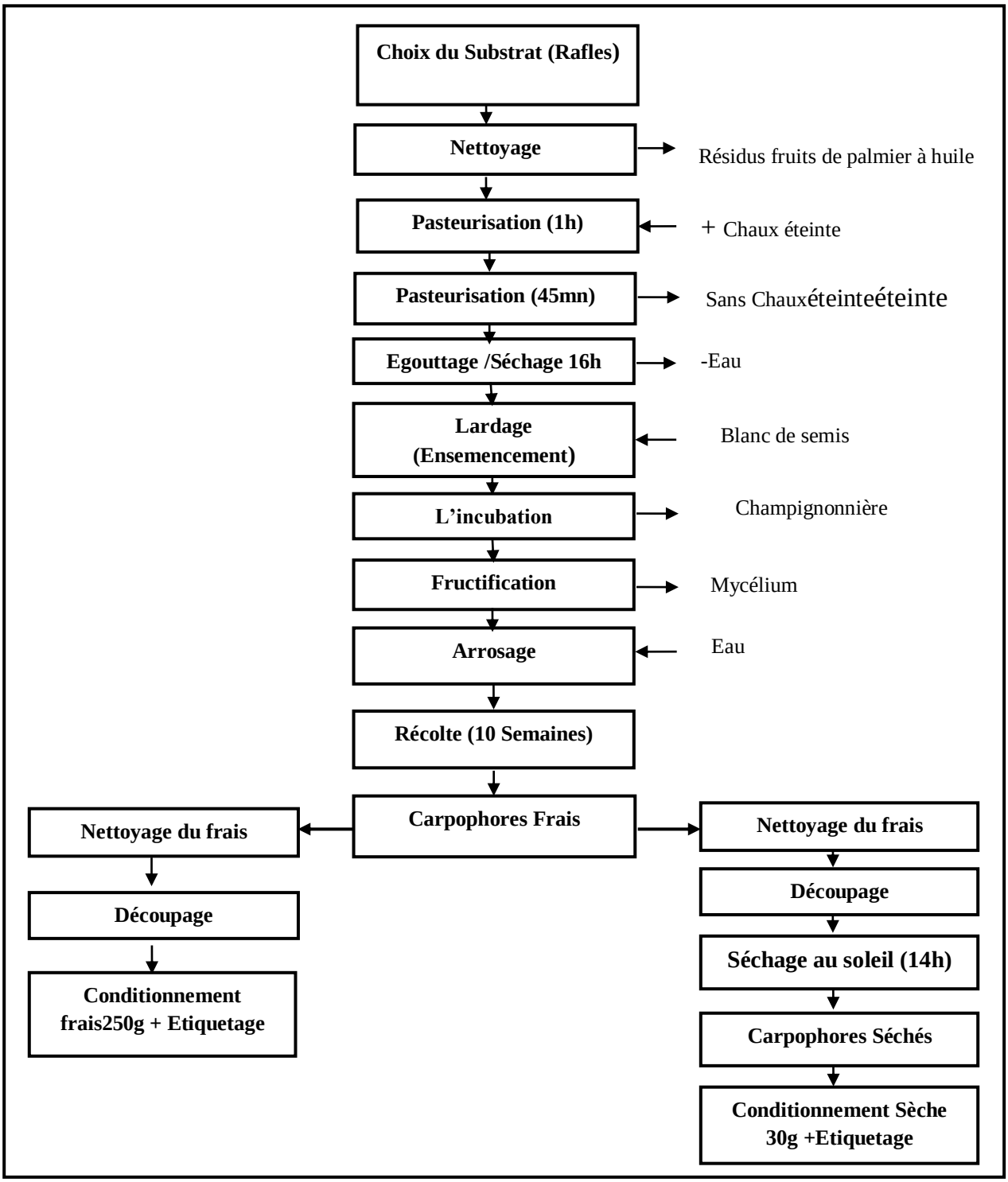

Figure 1: Production stages of Pleurotusabalonus on palm stalks

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3.1.3. Traditional production technique

The traditional technique used is based on the production of mushrooms by watering decaying oil palms (dead palm) in fields and plantations. Women are the main actors in this technique. They explore the plantations of palm groves to identify the palm trees slaughtered. They clean their surroundings, water them with water (dry season) to accelerate their decomposition. Two to three months later, these palms decompose to grow mushrooms. In the rainy season, very early in the morning, women and their children go to gather mushrooms in fields and palm plantations.

3.1.4. Socioeconomic importance

In order to evaluate the gross income of a producer, the following procedure was used. In the commune 1kg of dried mushroom is sold at 3500 F CFA. Thus, the gross income of a modern producer is obtained by multiplying the quantity produced by the price of one kilogram of mushroom. In fact, to determine the net income, we take the gross income minus the expense.

The production of edible mushrooms is a source of income for the producers of Sakété Commune. The selling price of mushroom (Pleurotusabalonus) varies according to the customers whatever the season (Table I).

Table I: Variation of the purchase price of the mushroom at the source according to the seasons

		Prix de vente à la source en saison pluvieuse (en F CFA)	Prix de vente à la source en saison sèche (en F CFA)
Consommateurs	Frais (250g)	1000	1000
	Séché (30g)	1000	1000
Grossistes	Frais (250g)	900	900
	Séché (30g)	900	900
Entres producteurs	Frais (1 kg)	2.500 à 3000	2500 à 3000
	Séché (1 kg)	25.000 à 30.000	25.000 à 30.000

Source: Field Investigations, April 2017

From the observation of Table I, it appears that the purchase price of mushrooms is the same whatever the season and the form in which it is sold.

200 kg of mushrooms produced in three months, generates on average a gross income of 700.000 F CFA for an average expenditure of 92.770 F CFA. Its net income is 607,230 F CFA or 202,410 F CFA per month. As far as the traditional producers are concerned their income is every day and is based on VolvariellaVolvacearamassés in the palm groves and products on dead palm trees.

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The pile ofVolvariellavolvaceapese 50g. This pile of 50g is sold in the rainy season 50 F CFA and 100 F CFA in the dry season (Photo 6). A gatherer gets an average of 1 to 2 kg of Volvariellavolvacea per day. The income of each saleswoman varies between 2000 F CFA and 4000 F CFA per day, given the yield obtained.

Photo 6: Volvariellavolvacea exposed in a pile at Takon

Heaps of Volvariellavolvaceaen sale at the edge of the track at Takon.

Shooting: Ali, April 2017

The seasonal daily income of a saleswoman who sells 40 heaps of mushroom is listed in Table 2.

Table II: Daily income according to the seasons of a saleswoman who sells 40 heaps of 50g

	Saison pluvieuse	Saison sèche
Poids unitaire en g	50g	50g
Prix en F CFA	50 F CFA	100F CFA
Revenu journalier	2000F FCA	4000 F CFA

Source: Field Investigations, April 2017

The mushrooms (Pleurotusabalonus and Volvariellavolvacea) are sold fresh or dry in Benin in cities such as Pobè, Kétou, Cotonou, Porto-Novo and Abomey-Calavi.

At the regional level, they converge on Burkina Faso, Ghana and Nigeria, which are major consumer markets for this product.

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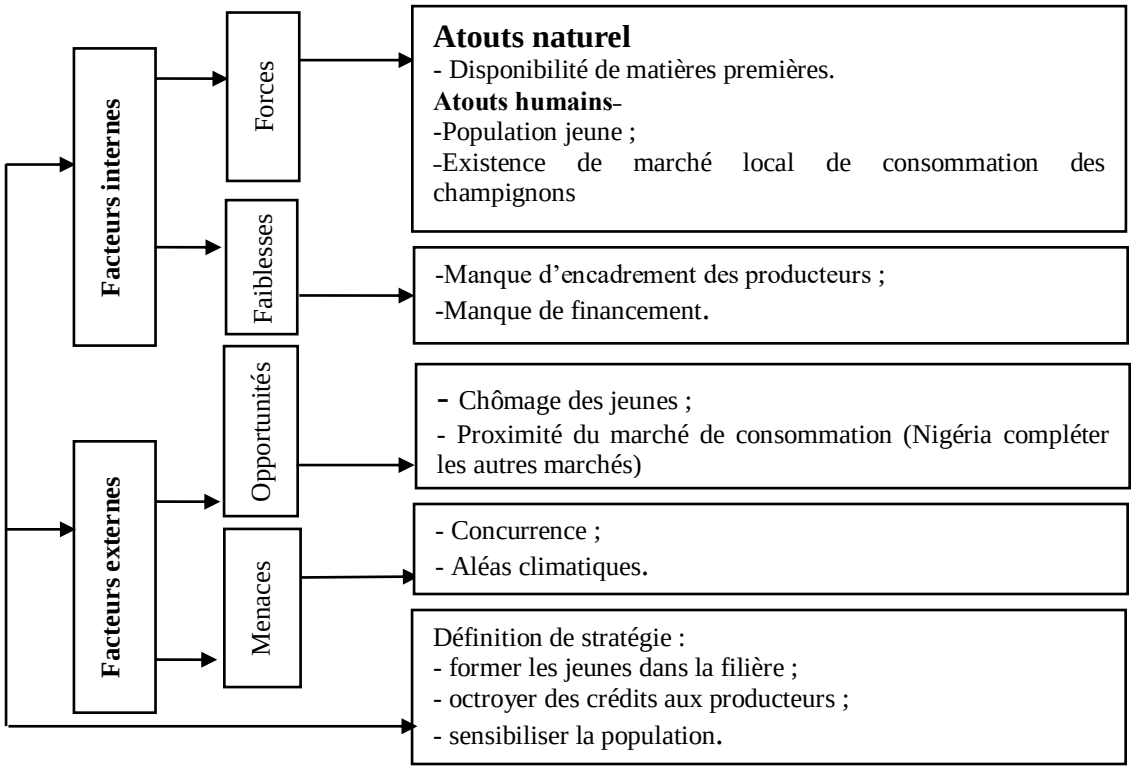
3.1.5. Medicinal importance and culinary taste

This study shows that the various diseases caused by the consumption of frozen meat and the scarcity of bushmeat in the locality are a real problem for the population. The mushrooms called vegetable meat for the peasants constitute the solution to fight against the imbalances of food and to replace the protein deficiency. Of the mushrooms surveyed, Volvariellavolvacea is more appreciated by surveyed consumers than Pleurotusabalonus because of its succulent taste and nutritional value. According to surveys conducted at the Laboratory of the Faculty of Agricultural Sciences (FSA / UAC), reveals that the Pleurotusabalonus mushroom is an important source of vitamins B, minerals, proteins, potassium and phosphorus, etc. The consumption of it strengthens the immune system, protects the heart, prevents asthma, corrects sexual weaknesses and strengthens the blood in children and pregnant women.

4. ANALYSIS OF RESULTS

The results of edible mushroom production were analyzed using the SWOT model as shown in Figure 2.

Figure 2: SWOT Model for Results Analysis



Source: Field Investigations, March 2017

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From the analysis of the results, it appears that the Commune of Sakété has enormous natural potentialities including the availability of the raw material. This raw material through the multiple palm groves available to the municipality for the production of palm oil and palm wine. As human assets, there is a young population and a large consumer market like Nigeria, Ghana and Burkina Faso. Nevertheless, producers face natural difficulties such as climatic and socio-economic hazards, such as competition between imported mushrooms and those produced in the locality, technical and organizational factors such as lack of technical support for producers and financing. which are likely to slow down the development of mushroom production in the commune. To this end, strategies have been proposed for the development of culture through the sensitization of the local population and surrounding area on the socio-economic importance of mushroom production; the training of traditional producers and the granting of refundable credits to producers.

5. DISCUSSION

In the interest of sustainable development, the substrate to be used in mushroom cultivation should take into account the most accessible and inexpensive local resources. To do this, it is appropriate to select among local substrates those which are well suited to mycelial culture to allow their productivity (J.M. Mondo et al., 2016.p.108).

For the production of Pleurotusabalonus and Volvariellavolvacea, as for the production of mushrooms in general, several substrates are used: mainly rice straw, banana leaves, wheat straw (MS Dibaluka et al., 2010, p.417), cotton production waste (OP Ahlawatet al., 2011.p.2). Apart from known subsoils, palm stalks and dead palm are also used as a substrate for mushroom production in several parts of humid Africa. Indeed, the large expansions of oil palms encountered in West Africa (D. Hoyle and P. Levang, 2012.p.16), and especially in south-east Benin, make this substrate available over a long period of the year. for producers. After exploitation of the oil palm for oil production and palm wine production (T.C. Ndjoguiet al., 2014.p.13), the palm cobs are used as a support for the production of the mushroom fungi. After the vineyard, the dead palm trees are abandoned. It is on these decaying palms that the producers of Commune Sakété produce Volvaceavolvacea. The first works on the production of champignadvised by JC Delmas (1989) and GC Yian (2014, p.47) recognized the dead palm as the natural producer of the mushroom Volvaceavolvacea.The choice of this substrate was approved by the producers of the Commune of Sakété, which estimate that the production of Oyster mushrooms on palm stalks is more profitable than other substrates.

However, despite the importance of the palm tree in the economy of most producing countries and the recognition of the latter as a substrate for mushroom production, few scientists have been led in the direction of valuing palm cobs and dead palm as substrate for the production of mushrooms especially in Africa (E. Boa, 2006.p.157) and especially in Benin.

The economic importance of edible fungi is often overlooked. This is the same observation made by FAO (2004) stating that the importance of this type of product in the world economy is negligible but essential considering that it contributes directly to rural communities. The production of edible mushrooms is enormous and a financial analysis reveals the importance of the gross income that this sector provides (N.S. Yorou, 2002, p.623).

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Indeed, it is difficult to accurately quantify the annual quantity produced by different countries, but their interests are many: the first interest is, of course, their gastronomic value that gives mushrooms the image of luxury product, great value, both in the local markets and in the exploitation. The second is the possibility of developing low-cost local raw materials, sometimes residues from agriculture or the agri-food industry (cereal straw, various leaves, bagasse, paper, etc.) (E. Harki et al. Hammoudi, 2008. p.90).

However, we must not neglect the role of mushrooms (Pleurotes or Volvaries grown on palm stalks and dead palms) in human food in disadvantaged areas, nor forget that non-food applications are particularly in the pharmaceutical field. On the market 250 gram of Pleurotusabalonus is sold Mushrooms are rich in good proteins. Mushrooms are low in fat but high in unsaturated fatty acids. They contain many vitamins, especially those of group B (B1, B2, B6 and B12), mineral elements (Fe, Cu, Zn, Ca, P) and fibers. They are therefore good for people with low sodium diets (C.J. Hounsou-Bo and L. Ahoton, 2017, p.3). Scientific analyzes have shown that mushrooms contain a lot of protein and amino acids more than vegetables. People often benefiting from animal protein but also containing cholesterol and fats major source of obesity and cardiovascular disease, the use of edible mushroom proteins is the solution to these problems. Other factors to consider, the body's ability to digest proteins, carbohydrates and fats is very important. A great consumer interest in edible fungi concerns its protein contents which are readily available to the body thanks to its easy digestibility (L. Zhanxi, 2001.p.11).

For the population of Sakété, the consumption of mushrooms is an effective way to limit the risk of diseases caused by the consumption of bushmeat and frozen. In northern Benin, species such as Pleurotusabalonus, Lantinussquarrosulus, and Lactifluusflammans are the most popular and are foods similar to meat, poultry or fish (J.T.C. Codjaet al, 2014). On the other hand, in southeastern Benin, especially in Sakété Commune, the species most appreciated by the population is Volvariellavolvacea.

6.CONCLUSION

It emerges from this study that several substrates are used and different techniques are used for the production of edible mushrooms in Sakété commune. The properties of a substrate determine the type of mushroom that will grow on it. The choice of substrate for production is according to the agro-ecological zone. The edible mushrooms sector is very promising from a food and economic point of view. It is a poorly developed and poorly organized culture in the commune. Awareness and training are the main axes for the valorization and development of this culture. The development of this culture could contribute not only to the improvement of the living conditions of the rural population, but also to become a large sector of production of edible mushrooms in Benin.

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