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RESEARCH ARTICLE

HYGIENIC CONDITIONS FOR THE PREPARATION OF MEAT PRODUCTS ON THE STREETS OF ABÉCHÉ (CHAD)

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ABSTRACT

To improve the hygienic quality of meat products, the safety alimentary and sanitary of consumer, the most important population is the developing inside and outside to the trade of meat products. It is just necessary to know hygienic practises into laboratory, markets, restaurant, and establishments for transformation of meat and fish. The aim of this study is to evaluate the know ledge of the hygienic and the quality to preparation of meat products into city of Abéché, and to study the relation between the associated factors into hygienic practises our investigation was realised to data collection on 129 targets. The test board window between age, matrimonial situation, educated level, sanitary examination, experience, and hygienic practises. The results to show that the population target maximum is the 71 old, with four wives and 26 children and them experiences is 28 old, minimum age is 26 years old and them experience 0,15 old with pass mark 41,91% old with 1,76% of wives and 7,26% children and they experience 5,15 old. most infrastructures visited were not respected the hygienic conditions. the measures for sanitary prevention are must to be lead for improving the hygienic conditions which are not respecting for the most target investigation.

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INTRODUCTION

In most developing countries, the food hygiene problem is a lack of political will for most decision makers. Meat is the main source of protein and essential nutrients, including high quality proteins: iron, zinc and B vitamins. However, due to its nutritional value, meat is a favorable substrate for development of proteolytic microorganisms. Meat has traditionally been believed to be responsible for a significant number of foodborne illnesses occurring in humans. The continuation of the problem has been amply demonstrated in recent years by monitoring human studies for contaminants in meat, such as *Escherichia coli* (Doutoum et al., 2013). The quality of meat products is a major issue for all sectors. It is considered a necessary step for manufacturers and distributors and a due for consumers. The various food crises have called into question not only the approach to intrinsic and extrinsic qualities, but also the product / market strategies of the various players in the meat sectors.

From breeding to product processing, from marketing to consumption, consumer's express new expectations in terms of perceived and desired quality (Ackah et al., 2011; Dumont, 2015). The processing, transformation and packaging activities of meat products are still underdeveloped in Abéché, firstly considering the low volume of animal production, especially meat and fish but also the high costs of equipment and energy and finally lack of credit facilities. The mode of consumption of grilled meats is booming in the town of Abéché (Bernard et al., 2007; Tidjani et al., 2013). Dried meat is traditionally made in Abéché and represents the only reasonable form for preserving meat. It comes in the form of dried meat "charmout" in local Arabic and is a predominantly female activity. Another form of preserved meat is "Kilichi" which is of Nigerien origin. This transformation is the emanation of men. The dried meat processing process exists in the form of small workshops where smoked meat is prepared mainly for the Abéché market.

Dried meats provide people with valuable protein and provide them with economic income (Tidjani *et al.*, 2013). In the meat sector, we find retail butchers, wholesalers, semi-wholesalers, and exporters (FAO, 2009). Abéché is a Sahelian town where meat is found in abundance, but its population consumes only poor quality because much of this meat comes from reformed animals, and this can constitute a serious public health problem if the rules elementary hygiene is not observed. According to Tidjani *et al.*, (2013) "Laboratory analyzes have revealed faecal germs on grilled and dried meats sold in the city. In addition, mold has been discovered in both grilled meats and fish as well as in dried ones. These fungi expose consumers, butchers and vendors who are unaware of the danger to which they are exposing themselves. The latter do not respect the minimum of hygiene rules ". In this context, it seemed very important to me to study the hygienic conditions for preparing meat products. To identify the contours of this problem, we have set a general objective. Thus, the general objective of this work is to assess the hygienic conditions of preparation of meat products. More specifically our work aims to

- Evaluate the risks of contamination of meat products;
- Determine the socio-demographic characteristics of the production and processing of meat products;
- Identify the infrastructure from preparation to points of sale through transformation.

This work is subdivided into two parts: a first part devoted to the bibliographical summary describing the hygiene of meat products and a second part on the equipment and method, the result and discussion of a survey among restaurateurs in the town of Abéché. on hygiene practice

MATERIAL AND METHODS

Material

Study framework: Located in eastern Chad, the city of Abéché is the capital of Ouaddai Province. It lies between 13 ° 48'584 "N latitude and 20 ° 50'139" E longitude. The study area is influenced by the intertropical climate with a 9-month dry season and a 3-month rainy season.

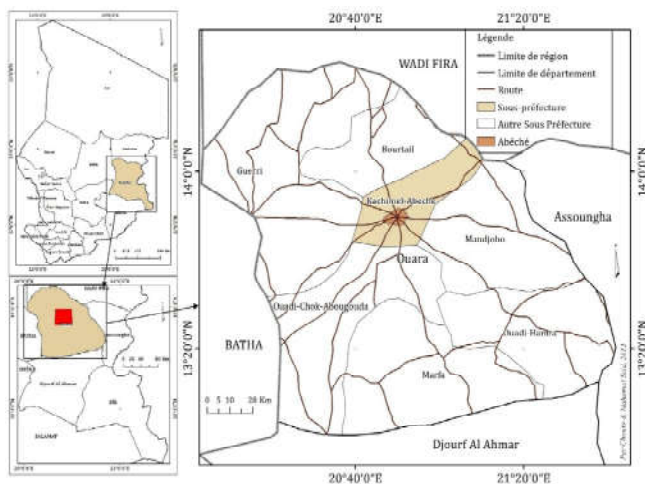


Figure 1. Presentation of the study area (source: Seid, 2015)

The regime of these two seasons is defined by the fluctuations between the masses of dry air in the north (the harmattan) and the masses of humid maritime air in the southwest (the monsoon). The average annual rainfall is around 300 mm. The temperature of the region is variable depending on the period. The annual average temperature in Abéché is around 28 ° C with a variation in the cold season (December to February), between 16 and 35 ° C and in the dry season (April and May) between 25 and 41 ° C.

Slaughterhouse of Abéché: It is a public establishment that slaughters animals intended for human consumption. The slaughterhouse of Abéché is located in the northwest of the city, in the Hillé Kinine district. It is a place where animals (camels, cattle, sheep, and goats) are slaughtered. The slaughtering operation is daily from around 5 a.m. to 10 a.m. The staff is made up of two (2) technicians and seven (7) laborers.

Markets and restaurants in the town of Abéché: The city of Abéché has five markets where meat products are of paramount importance.

The meat products sold are fresh and dried meat, fresh and dried fish, grilled meat as well as grilled fish.

Fresh meat: Meat is the main source of protein and essential nutrients, including high quality protein: iron, zinc, and B vitamins from animals.

Dried meats: The dried meat called "charmout" in local Arabic is a traditional preparation from many parts of the world. It allows meat to be preserved for a longer time and extremely significantly reduces its weight and volume. These advantages have therefore made it a food of choice for travelers, explorers, and nomadic peoples.

Broilers: These are chickens sold in large restaurants ("Ombre d'Afrique" and "Daralsalam")

Pisces: These are fish sold in markets and grilled fish served in large restaurants. Dried fish are sold in piles in the various markets of the city.

Investigations: They are carried out using the survey sheets which are in the Appendices. The rule of ISHIKAWA based on the five M's has always been used. Risk of injury or slaughter bacteremia. The risk of contamination of meat in this situation is quite high.

Methods

Type of study: Our study took place in the city of Abéché, over a period of one month from April 23 to May 23. This is a cross-sectional study aimed at studying the risk factors for contamination of meat products from processing to points of sale (fresh and dried "Charmout" meats, chickens, and fresh and dried fish) in the town of Abéché. Our research began with a first phase during which a good part of the literature was described.

The data was then collected on the survey forms. Finally, the ISHIKAWA rule based on 5Ms completed our method by considering the microbiological characteristics.

Study population: Our study focuses on the men and women of the city of Abéché who process and sell meat products.

Sample size: The sampling was done using a non-probability method. In other words, the selection was consecutive among all the men and women meeting the inclusion criteria (working in the meat sector) but during our survey we were not able to investigate the women for the simple reason that the women did not. no restaurants, grills, eateries, and the socio-cultural heaviness did not allow us to have focused on women. The size of the sample is determined according to the Lorentz formula:

n = sample size;
 α = risk of error ($\alpha = 0.05$);
 p = estimated prevalence;

$z\alpha$: This is the value of the distribution of Z corresponding to the risk α . This value corresponding to a 95% confidence level is 1.96. The estimated sample size is 129 people, all surveys (vendors, butchers, and restaurateurs

Conduct of the study: After explaining to the managers of the sites visited, the purpose of our study, and having obtained their consent, the people meeting the admission criteria were interviewed according to the study protocol.

Then, practical hygiene advice was undertaken with our audience, to contribute to behavior, change on food hygiene practices.

Reception of animals: The reception of animals intended for slaughter is the preliminary inspection step, because when the animals arrive, they may show signs of fatigue, illness, or injury, particularly during transport, or be soiled by faeces with a high risk of microbial contamination of meat, hence it is important to perform ante-mortem inspection upon receipt of animals.

Stabulation: Stabling is an important step in the animal slaughter process. It is indeed a period of observation and rest of the animal during which the water diet is carried out. The lack of a water diet practiced in the slaughterhouse we visited can cause bacteremia which will influence the hygienic quality of the meat. The risk of contamination of the meat is therefore very high.

Ante-mortem inspection: The term "ante-mortem inspection" refers to the inspection that takes place before slaughter to determine whether the animal is healthy and whether it can be eaten by humans or not. The animal presenting a legally contagious disease is excluded from the slaughter circuit.

The lead: The transfer of animals from the stall to the bleeding room is a delicate step. It can be the cause of several damages if the professionals are not sufficiently applied. The mistreatment of animals (beaten and forcibly brought in) by slaughterhouse staff causes excitement, fatigue, and trauma with the risk of injury or slaughter bacteremia. The risk of contamination of meat in this situation is quite high.

The bleeding: This is a decisive step in the meat hygiene slaughter process because it is very often a source of depreciation of the sanitary quality of part of the carcass. The risks incurred with a bad bleeding practice are then very high.

There is a possibility of bacterial contamination if it is done on the ground, or by a knife not disinfected and / or washed after each bleeding which is the case in the slaughterhouse.

Dressing and evisceration: This operation requires special attention due to the handling of the meat and its exposure to environmental conditions. The current dressing practices at the abattoir visited expose the meat to very high contamination risks.

These risks are mainly: microbial cross-contamination via hands, knives, protective aprons; the risk of meat contamination from floor evisceration, mouth blowing and forearm dressing.

Post-mortem inspection: The purpose of post-mortem inspection is to ensure the safety of the meat produced at the slaughterhouse. When it is not carried out, the risks to consumers are very high. Indeed, this inspection is carried out at the slaughterhouse, which means that the risk of microbial contamination is low.

Hygiene standard operating procedures (SSOP): This term refers to the operational hygiene control procedures of production processing carried out by an establishment to ensure that it meets food safety requirements.

Hazard Analysis Critical Control Point (HACCP) method: The term "HACCP method" refers to the method for identifying, evaluating, and controlling obvious risks to the safety of food products.

Questionnaire: A structured questionnaire (annex) thus allowing data collection was developed. The questionnaire has several questions.

These questions made it possible to assess knowledge of food hygiene, to highlight socio-demographic characteristics, parameters such as: level of education, age, health examination, other activities, and knowledge of hygiene. meat products. Knowledge of the hygiene of meat products:

Hand washing and handling of meat products;
 On personnel hygiene;
 Preservation hygiene for meat products;
 The mastery of the HACCP system.

Data processing and statistical analysis: Our document was entered in Word 2013 and the data was entered in Excel and we used the XL-STAT software (6.1.9).

The descriptive statistic was allowed to have the dispersion parameters (mean, standard deviation, extremes, and frequency) and the analysis of variance (ANOVA) was performed to compare the means. The comparison with the Newman kheuls test at the 5% level. Significance effects are described as significant ($p < 0.05$) and not significant ($p > 0.05$).

RESULTS AND DISCUSSION

RESULTS

Profile of respondents: The field surveys carried out over a month on 129 subjects enabled us to collect information relating to the various variables and hygiene practices of meat products in markets, restaurants, and slaughterhouses.

Table 1 socio-demographic characteristic

Parameters	Minimum	Average	Maximum
Age (years)	26,00	41,91 ± 0,78	71,00
Nb of spouses (n)	000	1,76 ± 0,07	4,00
Nb of children (n)	000	7,26 ± 0,46	26,00
Experience (years)	0,15	5,15 ± 0,37	28,00

Nb: number

This table shows that the study population has a maximum age of 71 years and a minimum of 26 years with an average of 41 years having at least one woman and 7 children where their experience is 5 years.

Table 2. Evaluation of the parameters (marital status, educational level, origin, type of meat and holders)

Marital status	number	%
single	18	13,95
Married	102	79,07
Divorced	8	6,20
widower	1	0,78
School level		
koranic school	31	24,03
uneducated	45	34,88
Primary school	31	24,03
Middle and high school	22	17,05
Graduate studies	00	0000
origin		
slaughterhouse	109	84,49
Market	20	15,51
district	00	0000
Type of meat		
Bovine and goat	1	0,78
Bovine	28	21,71
goat and sheep	55	42,64
camel	10	7,75
Full menu	9	6,98
Menu without fish	18	13,95
fish	4	3,10
chicken	4	3,10
holders		
Broiler	80	62,08
foodie	23	17,83
Restaurant	26	20,16

It emerges from this table that more than 80% of meat products sold in Abéché are inspected at the slaughterhouse and stamped. It must be said that 42.62% of the population studied consumes more goat / sheep meat, followed by cattle and camels, it should also be noted that grills are booming in the city. This table shows that 90% of those working in the meat production chain to the consumer's plate have not been vaccinated and 59.39% of the difficulties are linked to water and electricity, which does not favor good hygiene practice. The latter combines this activity with other activities including agriculture, animal husbandry and many others.

Contamination: This figure shows a very high contamination rate at the dressing and evisceration stage of around 40%, followed respectively by bleeding (20%), supply (15%), reception. (10%) and stabling (5%).

Table III. Evaluation of parameters (health examinations, difficulties, other activities, status in the workplace)

Other activities	Number	%
Agriculture	45	34,88
livestock	25	19,38
Others	24	18,60
nil	35	27,13
difficulties		
water and electricity	74	57,36
Water and clients	54	41,76
no profit	1	0,78
Health examinations		
no	117	90,70
yes	12	9,30
Status at work		
broiler and manager	25	19,40
manager	65	50,39
broiler	25	19,38
server	6	4,66
Server and broiler	8	6,20

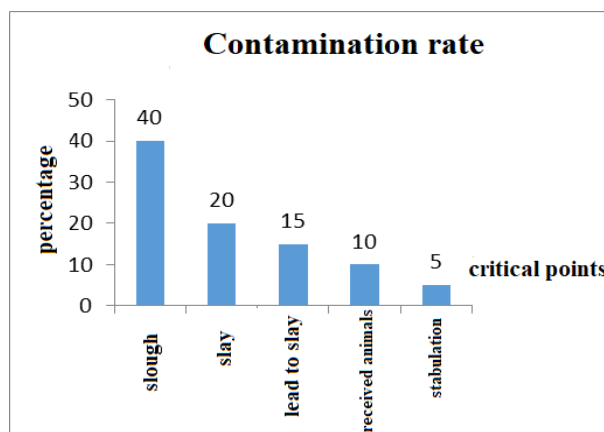


Figure 2. Slaughterhouse contamination rate

Contamination during transport

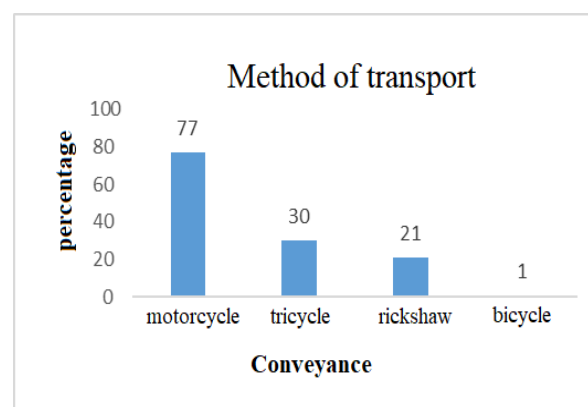


Figure 3. Means of transporting meat

Our surveys reveal that 59.69% of sellers of fresh or grilled meats transport meat using motorcycles, 23.26% using tricycles, 16.28% using pushers and 0.08 % using bicycle. The carcasses are piled up behind these machines, which are most often dirty. This practice without special hygiene measures increases the risk of microbial contamination.

Storage: Our surveys have shown that 87.6% of meat products are stored in the traditional way without refrigerators, the meat is immediately sold. On the other hand, 12.4% are kept immediately in the refrigerators along with the rest of the prepared meat products.



Figure 4. Transportation of meat by the rickshaw, Motorcycles and Tricycles (source BERTIN 2019)

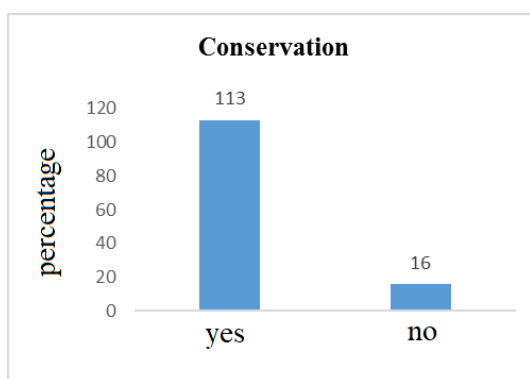


Figure 5. Preserving meat

These products are sold in the evening or the next day in the event of a power cut or refrigerator failure, butchers buy water ice to preserve the meat. In view of these practices, the risk of contamination of the meat during storage can therefore be considered quite high.

Packaging: This is the last step before the meat reaches the consumer. Regarding packaging, the study showed that, sellers deliver meat products in plastics and papers. It must also be said that the same hand that handles the meat takes the money.

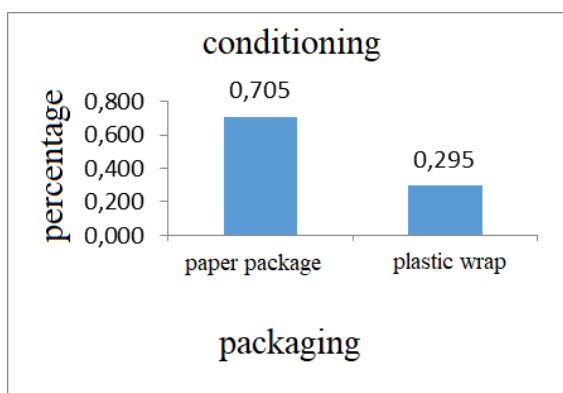


Figure 6. Packaging of meat products by sellers

Observation according to the ISCHIKAWA rule

This rule highlights the 5Ms: Medium, Material, Method, Labor and Means. This allowed us to do an analysis on all the sites visited.

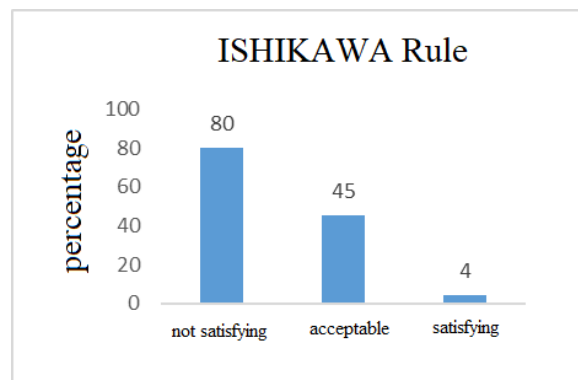


Figure 7. Observation according to the ISCHIKAWA rule based on 5M

Breakdown by district: This graph shows us that restaurants are booming in the 2nd and 3rd arrondissements because this is due to the concentration of the population followed by the 5th; 6th and 4th arrondissements.

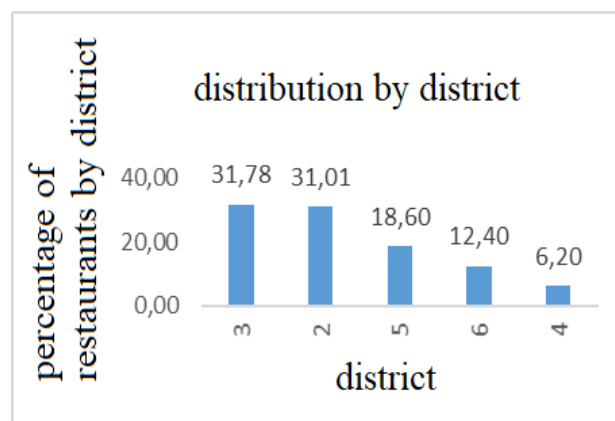


Figure 8. Distribution by district

Consumers: Consumers are men and women, including children, who obtain their supplies directly from slaughterhouses and fresh and / or dried meat markets and in restaurants, grills, and eateries for grilled meat. It must be said that the consumption of fish is not frequent in Abéché due to its high cost

Frequency of consumption

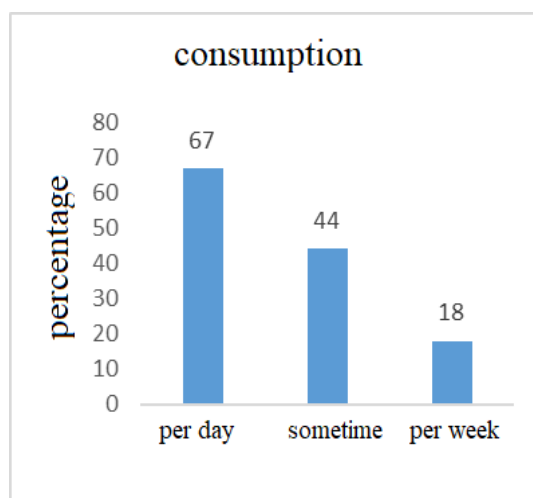


Figure 9. Frequency of meat consumption in restaurants

Assessment

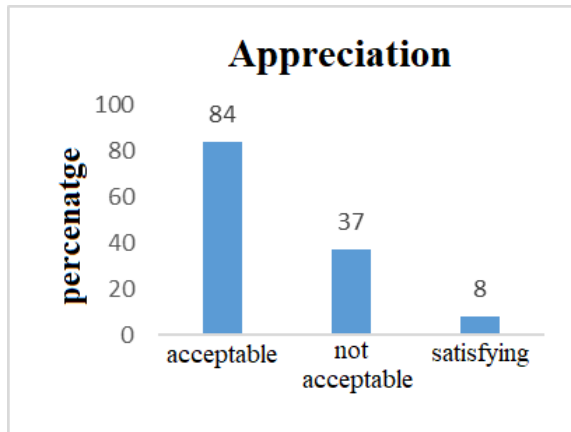


Figure 10. Assessment

DISCUSSION

During our study on "Hygienic conditions of preparation of meat products on the rue d'Abéché", we investigated 129 restaurant subjects (grills, and restaurants) and a visit to the slaughterhouse as well as to the points of sale of the fresh and dried meat, fresh and dried fish to see hygienic practices. We have realized that the lives of peaceful consumers are in danger since basic hygiene rules are not respected. Our results are like Gueye (1999); Rayza *et al* (2016) the latter worked on an old population between 25 and 60 years old, the age of the population seems to influence the practice of hygiene. Theoretically, when a person is very young, he or she has no concept of product hygiene. These results agree with those of Meda *et al.* (1999) in Burkina Faso who showed that the practice of hygiene is related to age. Other work has also shown that people under the age of 20 have poor hygiene practices compared to older or older people (Schol *et al.*, 2004; Chen, 2011). The relationship between the age of the study population and the practice of food hygiene is significant ($P < 0.05$). Our results are like those obtained by Kebede (1986) in Cameroon. In addition, Langtar (2009) and Hadjer (2014) in Chad, reported that the foods sold by men are often safer than those sold by women (72% against 30%). On the other hand, Musengarurema (1983) in Rwanda found that hygiene is quite satisfactory regardless of the gender. These observations were also made by Diarrassouba (2011) in Cameroon.

As for the low higher education level obtained in the study, this is due to the girl's marriage at a young age which, for the parents, is a way of enriching the whole family and the lack of support and follow-up for boys (UNICEF, 2011). In addition, the girls married, are prevented from continuing with their studies because of the occupations of the kitchen and the load of the children as well as in the small businesses. In addition, an educated person is expected to be able to take better care of food hygiene with strict adherence to food safety standards. The relationship between the level of education in hygiene practice is significant ($P < 0.05$). Our results are like those obtained by Ababouch (1995) in Morocco. Non-compliance with the rules of good hygienic practices by food processors and sellers leads to their contamination by coliforms and total flora and Hadjer (2014) in Chad. On the other hand, Langtar (2009) found results different from ours. It appears that 90% of meat products are exposed to the open air and 10% are

exposed in healthy places. The risk of microbial contamination is therefore very high. When exposed to the open air, meat products could be contaminated by the customer, who often handles them with his bare hands, and by the environment (air, flies, insects, etc.). Our results agree with those of Mensah *et al.*, (2002); Bhaskar *et al.*, (2004); Desmarchelier *et al.*, 2004. While according to Tidjani and Doutoum, 2013 Attamar., (2018), several bacteria responsible for Collective Food Toxi-infections (TIAC) can belong to the flora of the digestive tract and be carried by the hands of the wearer (*E. coli* for example).

Suggestions: The guidelines must relate to all stages of meat preparation from the slaughterhouse to the sales posts. The resulting consequences can be unpleasant for the health of producers and consumers. At the slaughterhouse By its hygienic quality, the meat reflects the microbiological results.

To do this :

- The fight against illegal slaughter;
- Training butchers on good practice in their profession;
- Health control of all slaughterhouse staff who handle the meat and who could carry pathogenic germs;
- Capacity building for all active staff without discrimination;
- Improving the means of transporting meat and installing refrigeration equipment are essential;
- The preparation of animals for slaughter must be done in such a way as to avoid any stress because it influences the quality of the meat. Rest becomes a priority;
- Bleeding on the discharge channels is preferable to that on the ground, which always results in stains on the meat;
- The dressing and evisceration operations will be carried out suspended to avoid contact of the carcass with the ground. Moreover, the latter must be done in a complete way to avoid soiling the carcass by the presence of possible germs (fecal coliforms, Salmonella);
- The carcasses will be transported to the inspection room by rails;
- Cleaning and disinfection must be provided to ensure the cleanliness of work instruments, premises and employees' hands at the end of each working day;
- Throughout the chain, the movement of people must be limited to avoid intersection of healthy and soiled areas;
- Have a permanent drinking water point for washing;
- Arrange the blood drainage channel at the end of each day;
- Those in charge of the slaughterhouse must educate clogs about good hygiene practices and call them to order whenever necessary;

Transportation

- Carcasses must be kept in an environment which allows the "cold chain" to be respected. For it :
 - Transport will be provided by refrigerated vehicles fitted with hooks for hanging carcasses;
 - Insulated vehicles must be airtight and clean;
- To sellers and restaurateurs
- The environment in which the sale is made must be healthy;
 - The construction of the premises must be done in such a way as to prevent the access of animals;

- All work instruments must be designed so as to facilitate cleaning and disinfection;
- Personnel should avoid certain behaviors such as blowing their nose, wiping off sweat on their hands, scratching without washing their hands or speaking too much when handling. Thus, the return to "common sense" becomes essential

To the State and to consumers

The public authorities, through unannounced visits, must ensure compliance with certain provisions:

- The cleanliness of the sales premises;
- Daily performance of cleaning and disinfection of the floor, walls or roofs;
- The use of equipment adapted to the work carried out;
- The hygiene of depreciable and consumable material;
- Toilets, sources of faecal contamination, must be cleaned and disinfected daily. To do this, the establishment concerned must necessarily have a potential source of drinking water;
- The staff, reservoir of disease and a sure source of contamination of foodstuffs, must imperatively respect the concepts of forward movement, even if the premises are generally cramped, have a valid medical certificate which reflects reality. Wearing a gown and hat must be made compulsory for all people working in sales positions. It is also necessary to ensure the clothing and body cleanliness of the personnel;
- The town hall must control the ownership of food and environmental hygiene;
- The State must periodically carry out microbiological and organoleptic checks on finished products;
- Consumers must demand quality every time, even if it comes at a cost. Indeed, they must not forget the fact that health is priceless and that the customer is king and will be forever.

Outlook: It is essential that controlling the qualities of meat products requires controlling the variability of microorganisms. It therefore seems important to us to continue the work we have started.

- From a microbiological point of view, it would be very important for us to assess the presence of germs that can alter the state of health of consumers.
- From a technological and nutritional standpoint, the issue deserves to be tackled with new approaches.

The physico-chemical analysis will verify whether there are comparable differences observed in meat products. It seems important to us to extend this approach to a larger number of samples, over wider ranges of variation of pH, viscosity, and acidity. The nutritional study could be approached from the angle of the expression of nutritional values between fresh and grilled meat.

CONCLUSION

At the end of our study, our results lead us to say that in Chad in general and Abéché in particular, establishments for the sale of raw or prepared meat products are set up to meet the needs

of consumers. Indeed, this lucrative activity endangers the health of consumers when hygiene measures are not respected. Our study was conducted in the city of Abéché to assess the hygiene practices of meat products in collective catering (restaurants, grills, taverns, etc.) markets and slaughterhouses. Thus, 129 subjects were surveyed on the hygienic practices of meat products to highlight the contamination factors linked to poor hygiene practice. The results showed that the largest part of the population studied at an age of over 26 years is a rate of 58.91% of uneducated and 24.03% of those with a primary level. The cross-tabulation test showed that the relationship between the age of the study population and the practice of food hygiene is significant ($P < 0.05$). Thus, the relationship between the level of education in the practice of hygiene is significant ($P < 0.05$).

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