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RESEARCH ARTICLE

COMPARATIVE STUDY OF PROCESSES FOR MANUFACTURING KILICHI, DRIED MEAT OF NIGER

^{1,*}Sabo Haoua Seini, ¹Aminou Illia Mama Nafiou, ²Bako Aminatou Maazou, ¹Hassimi Sadou, ³Amoukou Ibrahim, ¹Mousbahou Malam Alma, ⁴Ramatou Seini Sidikou, ⁴Mahamane Saadou And ⁵Maman Moussa Ramatou

^{1*}Head of the Quality, Health and Food Safety, Study and Improvement of Traditional Processes Department of Chemistry, Faculty of Science and Technology, Abdou Moumouni University of Niamey, Niger

¹Department of Chemistry, Faculty of Science and Technology, Abdou Moumouni University of Niamey

²Department of Applied Biological Sciences, Faculty of Health Sciences, Abdou Moumouni University of Niamey

³Department of Crop Production, Faculty of Agronomy, Abdou Moumouni University of Niamey

⁴Department of Biology, Faculty of Science and Technology, Abdou Moumouni University of Niamey

⁵Nutritionist, Institute of Public Health, Niamey

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ABSTRACT

In Niger, the valorization of agri - silvo -pastoral products is an urgent necessity, especially in a country where livestock is the second of the economy. The aim of this study is to contribute to the improvement of manufacturing processes kilichi for a better regulation of the sector. To this end, a modern kilichi transformation process is compared with traditional ones. The kilichi is a product made from thin strips of sun-dried beef, coated with a spicy paste and grilled. As such, thirty Kilichi manufacturers chosen for convenience are surveyed. An individual interview guide and an observation grid are used on the different methods and stages of kilichi processing, sources of contamination and remediations and the critical points in the transformation process for their control. In total, six steps are identified in the Kilichi transformation process. We count, an initial state, trimming and cutting, drying, seasoning, second drying, and finally roasting. Several observations are made in comparison with the modern method: the wholesomeness of Kilichi, the gestures of the producers, the cleaning and disinfection of materials, the wearing of adequate clothes, and so on. With the modern method the kilichis are dried on the solar dryer and the traditional ones use the sun's rays. During each step, the modern method has been corrected by the use of good hygiene. Kilichi dried in the sun are consistent, dry, but not friable. The kiln-kilns are also thick, dry, friable, which represents an added value per kilichi. The results of this study can be used to complete the drafting of specifications for Kilichi in Niger, to strengthen the capacity of Kilichi transformers and sellers. The same laws and regulations as other food handlers.

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INTRODUCTION

Livestock contributes more than 15% of Niger's GDP. This is quite considerable since it represents about 2000 billion CFA francs. This sector is experiencing renewed interest at the government level because the share of the national budget allocated to the development of livestock has increased from 1% in 2009 to 15% in 2015. Also some livestock products are very popular with consumers inside but also outside the country.

*Corresponding author: Sabo Haoua Seini,

Head of the Quality, Health and Food Safety, Study and Improvement of Traditional Processes Department of Chemistry, Faculty of Science and Technology, Abdou Moumouni University of Niamey, Niger.

To stay in the international market, producers have to face fierce competition where their pairs are constantly developing new sales strategies by playing on quality and prices (Seybou and Mahamadou, 2014). Programs for the protection and promotion of Geographical Indications (GI) for certain agricultural products characterized by their potential, their reputation, the know-how of the populations, the organization of the production and the opportunities to feed the markets of niche by the African Intellectual Property Organization (OAPI), the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) (Seybou and Mahamadou, 2014). Niger has been engaged since 2010 and 2011 with PRODEX and WAAPP in a process of labeling four (04)

products for their protection namely: Nigerian Galmi Purple Onion (OVGN), Dried Meat (Niger Kilichi), Niger Cheese (Chuku), Maradi Red Goat's Skin (Ja Fata) (Prodex, 2008; Seybou and Mahamadou, 2014). This study is a research and action to contribute in writing the book of c Harges for the benefit of industry players kilichi. The kilichi is made from thin slices of meat dried in the sun, coated with or without a sauce and then roasted (Kalilou, 1997). Indeed, the kilichi is a successful technology that is the pride and even an identity of Nigeriens internationally and is part of the national heritage. Processors have been able to develop a good transformation and preservation strategy by playing on the shelf life and organoleptic characteristics. The difficulties of the process relate on the one hand the lack of control of the quality of the product during its manufacture and storage, on the other hand the low overall production yield related to the considerable losses noted during the draining and roasting of coated meat (Kalilou, 1997; Yacouba, 2009, Seybou and Mahamadou, 2014). In addition, some studies have shown a high microbial load in products derived from traditional methods (Mbawala et al, 2010, FAO, 2014). Also, to meet all these concerns and make the product more competitive, a solar dryer has been designed by an innovative farmer. This study is conducted to standardize this drying device and to propose a standard manufacturing process and also to carry out organoleptic analyzes of dried meat (Kilichi du Niger).

MATERIALS AND METHODS

Framework of the study: Previously located in the regions of Maradi, Tahoua and Zinder, Kilichi has been manufactured nationwide for several decades. But our study focused on Kilichi's high production niches in Niger's capital Niamey.

Animal material: The main raw material is boneless red meat. Beef or camel meat, the age of which is between 3 and 6 years old, is preferably better suited for processing. The typical animal intended for the slaughter and manufacture of Kilichi must be an animal with a well-covered general appearance. The rump should be well covered or even bunched, the caudal strait well filled, the ligaments barely visible or invisible, the tips of the buttocks are covered and difficult to locate them. The musculature of the thighs must be powerful and well developed and finally, the ribs must not be detectable to the touch. This is good quality meat from the stuffed animals with a good carcass yield, which makes good Kilichi. However, it is necessary to avoid animals which have a proportion of fat too important compared to the meat, because the kilichi made with this type of meat, is not preserved well. Based on all these criteria, that the meat for the implementation is purchased at the slaughterhouse.

The ingredients: The main ingredients used in the making of Kilichi are: peanut paste or nutmeg paste, water, spices composed mainly of black pepper, anise, fake nutmeg, garlic, chili, soumbala, ginger, onion, cooking salt, red dye, bellflower nail, aroma (Maggi aroma). The different spices are crushed to turn into powder, mix with peanut or nutmeg paste and adding water to knead the mixture

METHODS

Sampling method: Producers are chosen for convenience at the time of the production site survey.

Sample size

The sample is composed of:

- A kilichi transformer using modern techniques ;
- Thirty (30) kilichitrans formers using traditional techniques

Data collection techniques: Data collection techniques used is: an individual interview with Kilichi producers and observation

Data collection tools: Two (2) tools were used for data collection: an individual interview guide and an observation grid.

Type of study envisaged: This is a comparative study comparing a modern Kilichi transformation process with that of a traditional process.

Analysis of data: The processing of the collected data was done with the SPSS software.

RESULTS AND COMMENTS

The process of transformation of Kilichi is almost identical for all variants, but all the time, there are some differences depending on the products. The stages of transformation are similar in both traditional and modern processes except for the drying which is done by solar kiln in the modern process.

✓ Step 1 : Initial state

- Step 3 : Drying
- Step 4 : Seasoning
- Step 5 : Second drying
- Step 6 : Toasting

As far as Rumuzu is concerned, it is the same processing technique with the exception of sauce coating, from which it is exempted. On the other hand, the slices of dried meat are soaked with an oily solution containing a mixture of lesser spices and light salt before being roasted for 3 to 5 mm.

Middle: From the barn to the consumer's table, the Kilichi processing environment is a real source of contamination that must be mastered in order to achieve a healthy food that meets the sanitary standards set. Animals slaughtered for kilichi processing are bred in traditional conditions and not easy to trace. (Ministry of Animal Resources, 2005). The environment has a direct influence on the health of the animal and the quality of the meat. As a result, biotic or abiotic pollution of water and fodder affects the quality of the meat and thus the health of the consumer. Apart from a few modern livestock farms, Niger is done in a traditional way. Most farmers are unaware that a stressful, polluted or contaminated breeding environment can make the meat unfit for consumption. At the slaughterhouse in Niamey visited as part of this study, from the relaxation area to the exit of the carcasses the meat transits in an environment that deserves more attention from the actors and the inspectors. In the market, carcasses are exposed to the open air, which could increase Kilichi's microbial load. To master all these aspects, it is necessary to accelerate the modernization of the breeding and the valorization of its products.



Photo 1. and 2. carcass of cattle and boned meat for the manufacture of Kilichi in Tessaoua

Table 1. Initial state according to the traditional or modern method

Traditional method	Modern method
Live animal of good weight; Good quality meat; shoulders, thighs, fillet of cattle, camel and sheep are commonly used; boning fresh meat;	At this level the fresh meat is deboned with materials (table, knives, basins and others) previously washed and disinfected. The worker wears work clothes that include a blouse, hat and bib. Before starting work, he washes his hands thoroughly with detergent and wears gloves. The most common parts of the carcass are the shoulders, thighs and fillets of cattle, camel and sheep.

Table 2. Trimming and cutting according to the traditional or modern method

Traditional method	Modern method
parry (extraction of fat, tendon and fascia); cut the fresh meat into slices or very thin slices;	There it is necessary to extract fats, tendons and fasciae fresh meat and cut into slices or very thin slices. It's a real work of artist who can take up to five years of learning.

Table 3. Drying according to the traditional or modern method

Traditional method	Modern method
to dry the slices of meat in the sun or on mats in stalks taking care to return the meat constantly for a uniform drying of both sides; R assemble the slices of dried meat by placing them on top of each other while pressing them so that they have a flattened lateral surface;	The slats are exposed and stretched on the screens, all is stored in the drawers of the solar dryer. The latter is plugged in and is allowed to work for six to ten hours.



Photo 3: drying slices of meat in the sun at Safo Tchicagi

Table 4. Seasoning according to the traditional or modern method

Traditional method	Modern method
P to repair grilled peanut pasta or grilled nutmeg sauce to which are added the various spicy and salted ingredients;	The seasoning differs depending on the type of Kilichi desired. For "ja" the slices are soaked in a mixture of diluted peanut paste to which are added spices, salt, aroma /, garlic, and a red powder called "jawa" which gives the color red in Kilichi. For the "fari" it is the same seasoning except for the red powder. So it's the peanut paste that gives the whitish color of the white Kilichi. For "rumuzu" the slices are dipped in salted oil simply.



Photo 4. seasoning slices of meat in Doutchi

Tremper dried meat slices into the sauce and sécher again for Kilichi May yagifari;
Prepair the dye with annatto or Jawa (*Bixaorellana*) and dilute to have a uniform color; to have the kilichija, the slices of Kilichi fari are dipped in annatto solution and then dried again;

Table 5. Second drying according to the traditional or modern method

Traditional method	Modern method
Dry the coated meat slices again, flip the slices several times during the day;	The seasoned strips are drained and dried a second time in the dryer. After which they are folded and stored while waiting to be grilled. This second drying does not take as much time as the first one.

Table 6. Toasting according to the traditional or modern method

Traditional method	Modern method
Grill the meat on a wire for 2-6 minutes, taking care to return constantly to avoid burning the meat.	On high heat the dry slices are roasted on two sides for five to ten minutes. They are now ready to be eaten, and that's the end of the transformation.



Photo 5. Roasting slices of meat in SafoTchicagi



Photo 6. Critical points related to the five "m" and their control

Table 7. The organoleptic characteristics of Kilichi from modern and traditional methods

Feature	kilichi
flavor	good, slightly spicy, the use of nutmeg gives a sweet taste
odour	grilled peanut or grilled nutmeg, appetizing
color	variable according to Kilichi variant as mentioned above
salt content	Variable

It is in this context that the actors organize themselves through training courses for breeders and butchers. Also a project to build a new slaughterhouse that meets food safety standards is underway.

Raw material: The raw material of Kilichi is meat. However, it has been shown above that the medium affects the quality of the meat. Obstacles outside the middle are the health of the animal and the preservation of the meat. To improve the quality of Kilichi meat safety must be guaranteed from the beginning to the end of the process.

Workforce: Sick workers who handle meat are the most common sources of contamination of food-borne diseases. They must also adopt good hygiene and sanitation behaviors. Simple actions such as hand washing, wearing work clothes, medical visits, and compliance with hygiene rules help prevent contamination by staff.

Equipment: From the knife used to slaughter the animal to the plate in which the Kilichi is served by passing the means of

transport, the tables, containers, knives, the displays of the transformers and all the rest must be sanitized to avoid direct contamination. Kilichi. Cleaning and disinfection of all equipment will prevent contamination.

Method: The kilichi transformation method has not changed much over the years. To ensure the safety of the Kilichi, training on hygiene rules for processors should be organized, ideally to move to the professional education of processing kilichi in schools of food technology. Seeing the two groups look alike.

However, we know that the appearance of the product (color, appearance, smell) and its state of chewing (crispness, hardness) are the criteria for assessing the quality of Kilichi by consumers. The two Kilichi have, according to the variants (fari and ja), a grilled peanut smell, spicy but not very strong. They are dark red (ja), light brown to whitish (fari) and dark brown to blackish (rumuzu) depending on the variant. Kilichi dried in the sun are consistent, dry, but not friable. Those dried at the dryers are also consistent, dry, but friable.

DISCUSSION

This part is devoted to the comparison of the finished products resulting from the traditional method and those resulting from the standard method on the main criteria of quality namely the organoleptic characteristics, the safety, and the price. Several factors determine the quality of the kilichi. The dehydration of red meat and the fifth quarter is a technology practiced for a long time by the different ethnolinguistic groups that populate Niger (S. Beidari and Z. Mounkaila 2013). Kilichi, for example, is part of the inventory of the potential for the recovery of dehydrated meats, hence the mastery of technology by some Nigerians. The availability of the raw material meat is not lacking because produced in Niger and that in all regions of the country. In the same way, the breeding systems practiced in Niger contribute to have a raw material of good quality, because indeed, everything rests on the products of the nature (grass and aerial pastures, water of watering, complementary foods, food mineral, in particular the salt cure) (Ministry of Animal Resources, 2005). The animals are slaughtered at the slaughterhouse or at an appropriate area for this purpose.

Drinking water should preferably be available at the place of slaughter for cleaning the carcass and possibly part of the fifth quarter. The mandated breeding agent must inspect the carcass and fifth quarter before any delivery of the meat. The meat must be of good quality and wholesome. The majority of the transformers carry their choice on the posterior train of the carcass, that is to say the two hind quarters because of the musculature of the thigh and the rump as well as the net and the false net. This posterior train has less fat but especially tendons compared to the previous train. It should be noted that the two hindquarters are better indicated for the manufacture of KilichiDan Kalambé or Rumuzu. On the other hand, some people think that the meat of the whole carcass is suitable for the manufacture of Kilichi provided that it is deboned and trimmed.

Organoleptic characteristics: Based on the color, flavor and appearance the two types of Kilichi have no difference. But when it comes to crunchiness and hardness, sun-dried Kilichi's benefit is that they are crisp and flexible and therefore more malleable. This aspect is explained by the fact that in the sun the slats are periodically turned and folded, which allows them to acquire the desired hardness and flexibility. Action does not exist at the dryer whom once closed; it is not recommended to open to return the slats. This will delay the drying, both sides of the lamellae dry at the same time so no need to return.

Safety: It is the inability of the food product to endanger the health of the consumer. This variable will be evaluated by the results of microbiological analyzes. According to respondents, in response to the question about sources of contamination and means to avoid it, contamination can occur throughout the process of transformation of Kilichi by flies, dust and workers themselves and the only way to avoid it is to respect the rules of hygiene.

Change in the type of process: 83% of respondents agree to move from the traditional method to the modern Kilichi processing method among which 30% prefer to try first, evaluate the results before adopting the new method against 16.7% which are against the idea of change. The reason is that the taste, texture and shelf life of the product will be altered.

The price: The price of the Kilichi Kilogram traditional varies according to the variants and the place of sale. For the " fari " and the " ja " the kilo costs between twenty to twenty-five thousand FCFA and the " rumuzu " between thirty to thirty-five thousand FCFA. The modern Kilichi is in experimentation phase, the solar dryer is not yet popularized so prices will be determined later.

Conclusion

This study will allow food safety professionals to assure consumers of Kilichi a healthy and balanced food. The results from our study show that Kilichi's modern processing method is very effective in improving the safety of this popular product by Nigeriens and foreigners alike. Ideally, Kilichi production units should be set up as bakeries that will be designed to follow the step forward to avoid cross-contamination. Subjecting them to the laws and regulations of catering establishments and qualified agents will make periodic inspections to monitor compliance with food safety standards. In addition, authorities are required to conduct some direct control activities to ensure compliance with the regulations, and to provide information and advice on a wide range of food-related topics that may affect human health. But the task of ensuring the health safety of Kilichi is not easy because for this it is essential that all the actors take note of the fact that the main responsibility rests on the operators of the production, the transformation and the trade of this product. This responsibility covers the entire meat industry farmers and their suppliers, slaughterhouse operators, Kilichi producers, meat transporters, wholesalers and retailers, etc. It is up to these people to ensure that the Kilichi they produce and handle is healthy and does not cause disease.

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