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Contribution of an Adapted Hygrometer to Measure Moisture Content of Dried Meat (Kilishi)

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ABSTRACT

It is a most for each actor in Niger's food production and distribution chain bears responsibility to take the necessary steps to ensure that the products placed on the market do not pose a risk to the health of consumers. Traditional kilishi products in Niger have evolved from natural drying. This study was aimed to determine the relative humidity of the kilishi in contribution to improve its quality. Three varieties of kilishi (ja, fari and rumuzu) samples were analyzed, using an adapted hygrometer at ambient temperature. The results revealed that from the reading of adapted hygrometer 78±1.42% of relative humidity for the kilishi ja; 62±1.83% for kilishi rumuzu and 53±0.67% for kilishi fari. The kilishi ja level of humidity (78%) found was higher than the normal which is 60 to 65%. The relative humidity results indicated that the evaluation on the kilishi varieties was an indicator of degree of dryness leading to improve its quality. It is therefore recommended that strict aseptic measures and proper drying should be observed during the production of kilishi in order to reduce the microbial load to an acceptable level.

Keywords: Meat, kilishi, adapted hygrometer, drying, relative humidity

INTRODUCTION

Niger, Sahelian country situated in West Africa, with an area of 1 267 000 km². It is a mainly agro-pastoral vocation country whose economy depends essentially of agro-forest-pastoral products. Niger is an excellent country of animal production, well known in the regional and international levels as meat exporter due to its traditional farming style quality (Maïga, 2008). Meat is one of the most popular foods in the world and plays an important role in the human diet because of its nutritional richness (Tom, 2015). Intermediate moisture meat products are produced by lowering the water activity up down to 0.60. Such products are stable at ambient temperature and humidity and are produced in nearly every country in the world, especially in developing areas where refrigeration is limited or unavailable (Castillo et al., 2015).

Various slaughter house facilities exist across the Niger, contributing to the meat chain production in the acceptable conditions of hygiene and health; thus, processing of meat and its marketing are the duties of professionals of meat that is the butchers. A significant amount of meat is produced each year in Niger. However, it is known that the preservation of meat, a perishable product, under the climatic and environmental conditions of this country, favor its rapid deterioration. In addition, Niger lacks adequate low temperature storage infrastructure, which make it difficult to promote the meat value chain. Indeed, this situation has brought professionals of meat to call on the traditional technics and preservation of meat processing. These technics often combine drying which is usually done under the sun, and other methods such as salting, smoking, frying and so on (Rathore et al., 2018; Ndih et al., 2018). Through these processing and preservation of meat, several products are obtained around the world including the kilishi in Niger (Yacouba, 2009).

Traditionally, drying of meat is mainly carried out under open sun. Sun drying represents a low-cost processing technique to preserve meat. Natural sun drying has been used since time immemorial for agricultural products. Open sun drying has limitation to control the drying process and parameter, weather uncertainties, labour, area of drying, insect infestation, mixing with dust and other foreign materials and other inconveniences. However, open sun drying is widely practiced in tropical and subtropical countries such as Niger in order to preserve agricultural products, where solar radiation is convenient (Jain and Pathare, 2007; Bhardwaj et al., 2019). In fact, this is how from memorial time meat is being dehydrated by open sun drying.

Kilishi is a version of jerky, a meat product that originated in the Sahel region mostly carried out by the Hausa community. Usually beef is used in its process where each of the selected muscles is sliced into sheets of 1 m length or less and irregular thickness (±2 mm) for easy drying. The dried sheets of meat are then collected and kept for the next process. The kilishi exists in three different varieties namely ja, fari and rumuzu meaning red, white and crispy respectively, due to the form and coating materials used (Adeboye et al., 2017). The composition of the kilishi all varieties together varies with 7 to 20% moisture content; pH 5.5 to 6.1; 50 to 70% protein; 15 to 20% fat content and around 35% iron content and variable salt content (Yacouba, 2009). Drying rate is a fundamental parameter in the production of dried food materiel. The shelf life of the kilishi depends on its microbiological quality and the moisture content. In addition, due to the limited information available on the diversity of water level content from kilishi; hence the interest of this work was to determine the level of relative humidity in the the kilishi product, as fundamental information for the producers, sellers and consumers in Niger.

MATERIALS AND METHODS

Materials

Kilishi ja, fari and rumuzu were purchased from retailers in local market of Niamey, Niger (**Fig. 1**). The samples from each type of kilishi were at least from three different retailers. The adapted hygrometer device (Purdue University, USA) for determining the relative humidity; was given by Sahel Bio® Maradi, Niger. All other reagents were of analytical grade.

Calibration of the hygrometer

The calibration of the hygrometer was carried out using saturated salt (NaCl) solution (**Fig. 2**). After 24 h the hygrometer should read related humidity between 70 - 74%.

Measurement of kilishi's relative humidity

A small piece of kilishi was placed in a plastic bag air tight along with the adapted hygrometer as humidity sensor (**Fig. 3**), for 15-30 min in order to get the direct readings (device manufacturer notice).

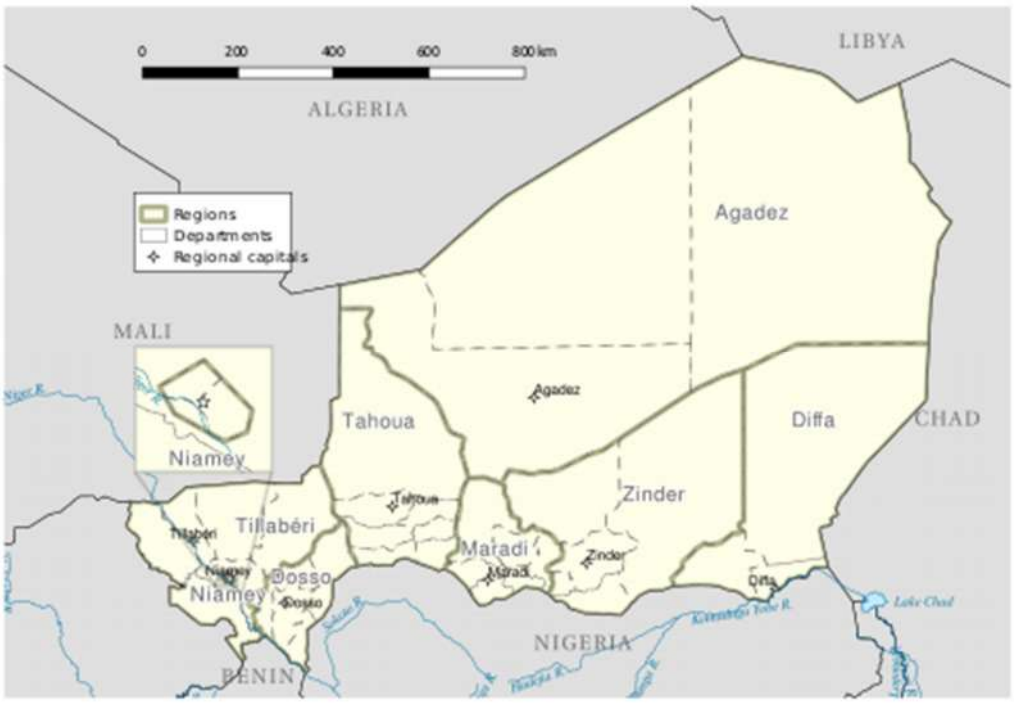


Fig. 1. Adapted from Niger region.png (https://googlemap/Niger)



Fig. 2. Calibration of hygrometer (Adapted Hygrometer-Notice, Perdue University, USA)



Fig. 3. Kilishi's relative humidity analysis

RESULTS AND DISCUSSION

The kilishi drying is often done in the sun, at the mercy of dust and flies, without any control of the parameters of drying. The drying time is highly variable and dependent on weather conditions. For example, during the raining season, with the reduction of the sunshine and the increase in moisture, the drying time is longer. It is difficult to obtain a product of good quality considering the parameters during its process of production sometimes it could take up to 2 to 3 days of drying (Mani et al., 2018; Jones et al., 2001). Adeboye et al. (2017) reported optimization of drying-Infusion-drying processes in kilishi production; they show the laboratory scale drying under varying conditions using moisture loss and yield was determined. Fresh meat (beef) is being slice into sheet of about 3 mm thickness, followed by first sun drying, this depend on the sun shining intensity and relative humidity. The second steep is coating the dry meat sheet using a solution of peanut butter mixt with some spices for the kilishi ja and fari while the kilishi rumuzu remain coated with just spices and salt. Those are followed by second sun drying and fire wood grilling to obtain the final kilishi.

Humidity measurement is an important aspect because, it affects many properties of air, and of materials in contact with air. Hygrometers are useful for measurements of relative humidity that is a representation of the concentration of water vapour in the air where the value is shown as a percent. Water vapour is a key agent in both weather and climate, and it is an important atmospheric greenhouse gas. The hygrometer is a device for measuring the relative humidity of air (Yoon et al., 2019).

At the ambient temperature (31.5±2 ° C) within 15-30 min; the result shows the reading of hygrometer of 78±1.42% of relative humidity of the kilishi ja, 62±1.83% kilishi rumuzu and 53±0.67% of kilishi fari. The relative humidity results indicated that the evaluation on the kilishi varieties was an indicator of degree of dryness likely to minimize microbial growth. Therefore, it is indicated by the hygrometer conception that, there are relative humidity suitable for marketing, consumption and storage. Thus, there are levels not to be exceed, as indicated by adapted hygrometer device, relative humidity less than or equal to 60% is proper for the market; a relative humidity less than or equal to 65% is destined for stora ge; then above 65% relative humidity proper for consumption (Adapted Hygrometer-Notice, Perdue University). This content also influences the quality of the product for the kilishi rumuzu. The kilishi ja level of humidity (78%) found was higher than the normal which is 60 to 65%; and differs from those found for the kilishi fari and rumuzu mentioned above. Even though, those varieties of kilishi produced in Sahel present diversities of relative humidity that can vary from season to season and from producer to other one according to the research carried out by Kalilou (1997) and Ndih et al. (2018).

The kilishi, in its present form of preservation of meat is highly prized in the Sahel in general and in Niger in particular (**Fig. 4**). Whereas, kilishi find some standardizations in terms of processing in some neighboring countries, yet it remains traditional in Niger. Shelf life depends on the quality of production processes; the more humidity is present in the product the quicker perishable it is. Compliance with good manufacturing practices and hygiene, will open international markets to the Niger kilishi. Thus, reaching acceptable proportions of the level of humidity in the kilishi is needed. It can be concluded that the kilishi ja with higher relative humidity can't be stored for long time because it presents a favorable medium for microorganisms' development. This could be explained by the fact that kilishi ja is been produced with coated peanut plus spices solution mixt together. All that coating materials mostly from peanut base could be the excellent moisture absorbers and retainers. However, kilishi fari found to score a good relative humidity level of 53±0.67% that is below the 60% implying a good materiel for the market as defined by adapted hygrometer device notice information. Whereas, that of the kilishi rumuzu is fell between 60 to 65% humidity which find to be good for storage. Those results corroborate with previous research carried out in the different zonal area of Sahel in terms of processing, drying quality and shelf life of the kilishi (Ndih et al., 2018; Raji, 2006; Shamsuddeen, 2009; Chukwu and Imodiboh, 2009).



Fig. 4. Kilishi in Niger local market.

CONCLUSION

An adapted hygrometer was successfully used to determine the kilishi (kilishi ja, fari and rumuzu) moisture content. The device could be a great help to kilishi retailers to check for different stage of drying or retail for relative humidity of their products. It can be concluded in this work that the relative humidity was used as factor to determine the degree of dryness of kilishi so that to meet the quality requirement for sale or for storage. To maintain the level of relative humidity in the kilishi to an acceptable proportion, it is necessary to find simple and rapid way to reach that. Therefore, adapted hygrometer could be an excellent device to assist kilishi producers/vendors to improve and maintain its quality.

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