

## Nutritional and Organoleptic assessments of sun dried and solar dried *kilishi*

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### ABSTRACT

This study is aimed at investigating the effect of sun drying and solar drying on the nutritional and organoleptic properties of dried meat (*kilishi*). Nutritional content determined are moisture content, ash content, fat content, crude protein and carbohydrate content by absorption methods. Four hundred grams of meat from beef was divided into two parts (Sample A and Sample B) of two hundred grams each. Sample A was solar dried using a fabricated solar dryer while sample B was sun dried, both were dried for eight hours with respective weight loss recorded hourly. The amount of moisture on wet basis at interval of one hour for solar drying was 12.25%, 21.88%, 27.63%, 33.85%, 37.06, 40.75%, 43.55% and 48.63% , while that of direct sunlight drying had a moisture content of 12.83%, 20.77%, 26.75%, 33.58%, 35.75%, 38.97%, 40.18% 42.65% respectively. Nutritional, Organoleptic and Microbial load count test were carried out with the following results respectively [Nutritional (M.C 9.63%, Fat 1.69%, Crude Protein 50.26%, Ash 24.09%, Carbohydrate and others 12.01%) Organoleptic (Appearance sample A 3.2 and sample B 4.0, Taste sample A 3.1 and sample B 3.2 , Aroma sample A 4.2 and sample B 4.3 , feel sample A 3.9 and sample B 3.5 ) Microbial load count (Sample A  $>2.5 \times 10^6$  and Sample B  $>4.7 \times 10^8$ )]. The results shows that *kilishi* is best produced using the solar drying method, as sun drying method contained large number of micro organisms which poses a threat to the health of the consumer.

**Keywords:** Meat; Kilishi; Organoleptic; Slurry; Nutritional; Drying

### 1. INTRODUCTION

Meat is one of the essential sources of protein and a wide variety of other nutritional value. It has been widely accepted and consumed by humans as a major food since the primitive era. However, as the consumption rate and the production of meat grew perpetually with time, the nature of the product requires that it be preserved for future use. The high water content of meat makes it extremely perishable. Food preservation is employed to prevent unwanted changes in the nutritive value and sensory quality of food by putting the growth of micro-organisms under control and reducing the physical, chemical and microbiological changes, which in turn increase the economic value of the product (Igene, *et al.*,

1990). *Kilishi* is a dried seasoned meat delicacy majorly from the northern part of the country. This delicacy is popularly enjoyed and consumed across the nation. *Kilishi* is produced in almost all the states of the North-west of Nigeria; it is most popular in Kastina, Sokoto, Kaduna and Kano States (Raw Materials Research and Development Council, 2010). It is a traditionally processed intermediate moisture or semi dry, ready-to-eat, meat product made from beef in Northern Nigeria. It is prepared from the pure flesh of de-boned beef which has been trimmed of all visible fats and connective tissues; the cleaned meat is then weighed and sliced into thin sheets of 0.17- 0.20 cm thick and 60-80 cm long. The sliced meat is sun dried and infused with locally available spices, condiments, and other materials such salt, *magi* seasoning, peanut paste and

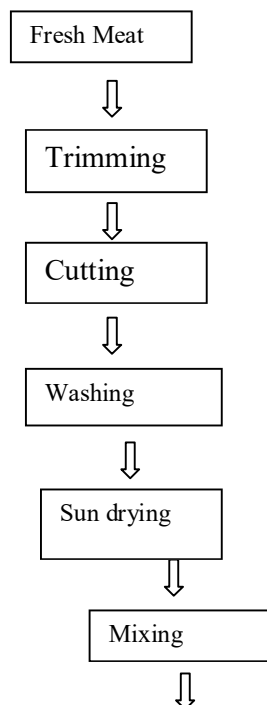


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water. The local spices and condiments used include; onion, alligator pepper, cloves, chilies, ginger, African nutmeg, black pepper, locust beans, groundnut powder and dry pepper (Igene, *et al.*, 1990).

Nigeria is the highest producer of *kilishi* in West Africa among other countries such as Senegal, Mali, Chad and Niger. It appears to have developed amongst the early Fulani and Hausa headsman as a means of preserving meat in order to enhance its shelf life. *Kilishi* has from time immemorial been part of the trans-saharan trade and even beyond, the product has created an informal export to the Holy land during Hajj period over the years (Raw Materials Research and Development Council, 2010).

The product came about as a means of preserving meat in the absence of facilities for refrigerated storage, by the early Fulani and Hausa herdsmen. In Northern Nigeria, the producing states of *kilishi* include: Borno, Kano, Sokoto, Kaduna and Bauchi. This is made possible because the weather is favourable, consumer demand is high and more than 70 % of the Nigerian cattle population of 10 million can be found in these states (Alaku and Igene 1983).



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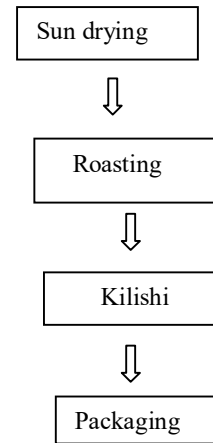


Fig. 1.1; Steps involved in the production of dried meat (Kilishi) (Ogunsola and Omojola, 2008)

## 2. Materials and Methods

### 2.1 Materials and their Source

Six hundred grams of cow meat (Beef) was bought from Minna abattoir located at Tahi village in Bosso local Government Area of Niger State. The meat was purchased early in the morning to ensure that the meat was fresh and relatively hygienic for processing of *kilishi*. The raw meat was then kept inside a polyethylene bag. The ingredients for the slurry and the packaging material (aluminum foil) were purchased from A. A. Kure ultra modern market, Minna, Niger State.

### 2.2 Methods

#### 2.2.1 Cleaning process.

The meat obtained was thoroughly washed with water in order to remove dirt and blood stains. Fat and connecting tissues which are not required for the production of *kilishi* were also removed.

#### 2.2.2. Slicing Process.

After cleaning and trimming of the unwanted materials, the meat is cut thinly into slices measuring 3-5 mm thick and



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up to 20- 40 mm long, the sliced meat was equally divided into two portions (A and B).

### 2.2.3 Drying Process.

The first portion (specimen A) of the thin slices were spread out doors on a platform (called 'gadon kara' in Hausa) made from millet stalk, for sun drying, and the second portion (specimen B) placed inside the solar dryer, both were dried for 8 hours and readings were taken every 20 minutes which gave rise to three readings for every hour on each method. This stage of moisture removal is done so as to enable the meat absorb the moisture contained in the ingredient slurry.

### 2.2.2 Slurry Preparation and Application

The ginger was washed and dried (usually it comes with traces of sand); dried (hot) pepper was grounded together with the other spices including the washed dried ginger, water was then poured into the powder to make a slurry like mixture. The mixture was stirred thoroughly until a red colored paste was obtained. The dried meat was dipped into the slurry for 10 minutes until it completely absorbed the mixed ingredients; it was then spread again on the sorghum stalk mat for a while to drain. This process increased the moisture content of the immersed meat and the surface of the meat is coated with the ingredients. The excess moisture had to be removed using a glowing fire.

### 2.2.3 Roasting of Immersed Meat and Packaging.

In the final drying process, the infused meat was transferred to where it will be gently roasted with a glowing fire. The height at which the meat is placed on the wire mesh allowed the heat of contact on the meat to be around 100-120 °C. This enormously reduced the moisture content. It is during this process that *kilishi* acquires its special flavor from the smoke that was produced from the



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fire wood. The hot, sizzling, brown colored *kilishi* was then removed, cooled to room temperature and ready for consumption. The cooled *kilishi* was then wrapped in an aluminium foil.

## 3. Results

The results obtained from the experiment are listed in Tables 1 to 10

**Table 1: Mean value of the drying rate and Standard deviation of solar dried *Kilishi***

Time (hr)	Standard	
	Mean Value (g)	Deviation
0	00.00	0.141421
1	75.50	0.749533
2	56.25	0.480833
3	44.74	0.282843
4	32.30	0.608112
5	25.88	0.282843
6	18.50	0.636396
7	12.90	1.965757
8	02.74	0.141421



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**Table 2: Mean value of the drying rate and Standard deviation of sun dried *Kilishi***

Time (hr)	Mean Value (g)	Standard Deviation
0	00.00	0
1	74.35	0.070711
2	58.47	0
3	46.50	0.141421
4	32.85	0.59397
5	28.55	3.535534
6	22.06	2.870854
7	19.65	0.46669
8	14.70	0.424264

**Table 3: Proximate Composition of solar dried kikishi**

Sample	Moisture content	Fat	Crude Protein	Ash	Carbohydrate & Others
A1	9.29	6.26	50.37	24.09	9.99
A2	9.41	6.11	50.41	24.20	9.78
A3	10.20	6.17	50.00	23.98	9.65
Mean	9.63	6.18	50.26	24.09	9.81

**Table 4: Proximate Composition of sun dried kikishi**

Sample	Moisture content	Fat	Crude Protein	Ash	Carbohydrate & Others
B1	11.56	5.19	49.13	24.39	5.63
B2	11.01	6.17	52.2	23.87	6.75
B3	11.05	6.17	51.53	24.59	6.66
Mean	11.21	5.84	50.95	24.28	6.35

### 3.2 Organoleptic Assessment of sun dried and solar dried *kilishi*

**Table 5: Scores obtained for Appearance**

PANELISTS											
Samples	1	2	3	4	5	6	7	8	9	10	Mean
A	5	3	4	3	3	5	4	4	4	5	4
B	3	3	3	2	3	4	4	4	3	3	3.2

**Table 6: Scores obtained for Taste**

PANELISTS											
Samples	1	2	3	4	5	6	7	8	9	10	Mean
A	3	4	4	3	3	4	3	3	3	2	3.2
B	3	4	3	3	4	4	3	4	3	4	3.1

**Table 7: Scores obtained for Aroma**

PANELISTS											
Samples	1	2	3	4	5	6	7	8	9	10	Mean
A	4	5	4	5	4	4	4	5	4	3	4.2
B	5	4	5	4	5	3	5	4	4	4	4.3

**Table 8: Scores obtained for Texture**

PANELISTS											
Samples	1	2	3	4	5	6	7	8	9	10	Mean
A	3	5	4	4	3	4	4	5	4	3	3.9
B	2	3	1	3	2	3	3	4	2	2	3.5

NOTE:

A: *kilishi* prepared by solar drying method

B: *kilishi* prepared by sun drying method

### 3.3 Microbial analysis of sun dried and solar dried *kilishi*

**Table 9: Bacteria count in solar dried *kilishi***

Total Aerobic Plate Count (Cfu/m)	Count
Sample	Treatment
A1	$>2.2 \times 10^6$
A2	$>2.5 \times 10^6$
A3	$>2.8 \times 10^6$
Mean	$>2.5 \times 10^6$



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**Table 10: Bacteria count in sun dried *kilishi***

Total Aerobic Plate Count (Cfu/m)	Count
Sample	Treatment
B1	$>5.1 \times 10^8$
B2	$>4.8 \times 10^8$
B3	$>4.2 \times 10^8$
Mean	$>4.7 \times 10^8$

### 3.4 Proximate Analysis of sun dried and solar dried *kilishi*

#### 3.4.1 Moisture content

From Tables 3 and 4, moisture content of solar dried sample of 9.63% was slightly lower than that of the sun dried sample of 11.21 %, this could be as a result of the difference in the drying rate of the solar drying method and the sun drying method, as the solar drying method dried faster.

#### 3.4.2 Fat Content

The values of 5.4 % (sun dried) and 6.8 % (solar dried) for fat content are quite close. The difference is slight.

#### 3.4.3 Crude Protein

Regardless of the distinct processing method employed there was no significant difference in the crude protein content values of 50.95 (sun dried) and 50. 26 (solar dried).

#### 3.4.4 Ash Content

There was also no significant difference in the ash content of the dried samples; 24. 28 (sun dried) and 24.08 (solar dried).

### 3.5 Scores obtained from organoleptic assessment of sun dried and solar dried *kilishi*

#### 3.5.1 Appearance

From Table 5, it can be observed that in appearance, sample A proves to be the highest in terms of acceptability (4.0). The attractive appearance of sample A was as a

result of the drying principle of indirect solar dryer which kept the meat out of direct contact with solar radiation (sunlight) and this ensured the retainment of the true color of the meat.

#### 3.5.2 Taste

Table 5 indicates that there were no significant differences in the acceptability of the taste of both samples. The scores for both were 3.1 for sun dried sample and 3. 2 for solar dried sample.

#### 3.5.3 Aroma

The aroma of both samples were highly acceptable with close values of 4.2 for solar dried and 4.3 for sun dried *kilishi*, this shows that the variation in drying method has no effect on the aroma, as the aroma depends on the spicing of the *kilishi*.

#### 3.5.4 Texture

The feel of sample A (solar dried *kilishi*, 3.9) was slightly higher than that of sample A (sun dried *kilishi*, 3.5), this could be due to the variation in the drying rate, as the solar drying method removed moisture faster than the sun drying method which resulted in the solar dried sample having significantly lower moisture content and being more crispy as compared to the sun dried sample.

### 3.6 Microbial analysis of sun dried and solar dried *kilishi*

The result of the microbial count (Tables 9 and 10) show that the sun dried sample contain significantly higher amount of bacteria as compared to the result of the solar dried sample which also contain bacteria contaminant but in a lower amount, reason being the exposure of the meat to environmental contaminants such as rain, wind/dust, birds ants and rodents during the sun drying process, whereby in the solar drying, the dryer houses the meat and there is no direct impact of sunshine on the sample.



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#### 4.0 CONCLUSION

From the results obtained from the study, it can be seen that the method of drying employed, had little or no effect on the proximate content and organoleptic properties of the *kilishi* produced. The results of the microbial analysis however indicates that the sun dried samples contained significantly higher amounts of microbes compared with the solar dried samples; this poses a threat to the health of the consumer.

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