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EFFECT OF STRIP DIMENSIONS ON DRYING CHARACTERISTICS AND ORGANOLEPTIC PROPERTIES OF BEEF AND PORK

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ABSTRACT

The aim of this study was to investigate the effect of strip thickness on drying time and sensory properties of beef and pork. Study was arranged in a 2x3 factorial, in completely randomized design. From the two types of meats, strips of lean pork and beef of 1cm, 2 cm and 3 cm were made. Meat drying occurred at 70^{o}C to 0.1 g weight difference observed in 2 hours interval. Rehydration of dried meat strips was done in water at room temperature for 7 hours using a solid to liquid ratio of 1:30. Sensory parameters for the dried and rehydrated meat strips were obtained through the use of 10 untrained panelists, using a 9-point hedonic scale. All data were analyzed using a general linear model analysis of variance with significant means ($p<0.05$) separated using Tukey pairwise comparisons as contained in Minitab 2017 analytic software.

Beef dried faster (22.67 hours) than pork (27.33) and the drying time increased (16.00, 25.00 and 34.00 hours respectively) as the strip thickness increased (1cm, 2cm and 3cm respectively). Dried beef had a darker color than dried pork and the color and; the state of rehydrated strips improved as strip thickness increased. The result indicated that as drying time increased with increase in strip thickness, the color also became darker and that leaching of solutes occurred during rehydration of dried meats.

Keywords: Beef, Pork, Strip thickness, Drying time, Rehydration, Organoleptic quality

INTRODUCTION

Meat, flesh of animals suitable for food, is one of the most important food items in the world. In some countries, it is an essential product with high consumption rate (Guerrero *et al.*, 2013). Despite its many dietary benefits, it is perishable because of its high moisture and protein contents- making it an ideal medium for the growth and multiplication of a wide range of micro-organisms (Mayr *et al.*, 2003).

Even under the most controlled conditions, meat cannot be guaranteed as free from micro-organisms. The infestation of microbes in the presence of moisture increases the respiration rate of the micro-organisms thereby causing liberation of heat and water and resulting in further increase in moisture content of the meat in a continuous cycle until it spoils (Dauthy, 1995). In the absence of a cold chain, meat drying remains the most cost-effective means of preventing deterioration and most practical condition in which meat can be stored in developing countries, and is one of the easiest and most effective methods developed (FAO, 2001).

Sun-drying and smoking are increasingly being adopted in meat preservation due to the high cost and skill required for artificial drying methods, as oven-drying. However, sun-drying exposes meat pieces to insects, dust and other environmental conditions that reduce the organoleptic and nutritive quality of dried meat. The action of applying heat to materials in order to dry does not merely remove moisture but changes the physical, nutritional and

sensory qualities of the meat and the longer it takes to achieve drying the more likely reduction in these quality indices (Apata *et al.*, 2013).

Meat-type and size of meat might have a decisive effect on the drying time. In mushrooms, for instance, larger slice thickness led to less dehydration and prolonged drying time (Giri and Prasad, 2007) which in turn led to darkening in color, loss in flavor and decrease in rehydration ability among others in Kiwi fruit (Maskan, 2001). This study was therefore carried out to study the effect of meat strip thickness on drying time and sensory properties of beef and pork.

MATERIALS AND METHODS

Meat Preparation

The semi-membranous muscle from the thigh muscle of hot-boned beef and pork carcasses were used for this study. The beef was sourced from slaughter slabs in Abeokuta, Ogun State while the pork was procured from the piggery unit of the Federal University of Agriculture, Abeokuta. The meat was trimmed free of fat and excess connective tissues. Meat chunks were cut along the muscle fiber into strips of 1cm, 2cm and 3cm using a steel ruler and sharp knife, soaked in 8% salt solution for 5 minutes and drained. Initial strip weights were taken using a sensitive scale. Strip lengths ranged from 10 cm to 24 cm.

Experimental Design

The experiment was carried out using a 2x3 factorial arrangement laid out in a completely randomized design. The factors are two meat types (beef and pork) and three strip thickness of 1, 2 and 3cm. A total of 180 meat strips were dried in 3 runs, with each drying-run having 10 strips of each treatment randomly distributed in the drying chamber.

Drying Procedure

The meat strips were suspended in a conventional dryer using steel hooks and left to dry at a temperature of 70^{o}c undisturbed for 8 hours. Thereafter strip weights were taken at 2 hours interval until an average weight change of 0.1g was achieved between subsequent measurements.

Reconstitution

The dried beef and pork were rehydrated using the method of Hii *et al*. (2014). The samples were rehydrated in distilled water at room temperature using a solid to liquid ratio of 1:30. At hourly intervals, the samples were removed and carefully drained for 30 seconds, weighed using a sensitive scale and immediately returned into the same soaking water. The dried meat was rehydrated over a period of 7 hours when the weight of rehydrated samples was expected to have stabilized.

Sensory Evaluation

Sensory qualities of dried and rehydrated beef and pork were evaluated by a group of 10 untrained panelists using a 9-point hedonic scale. The value of 1.0 corresponded to the lowest score and 9.0 to the highest for each attribute. Samples were evaluated on the basis of color ranging from extremely light to extremely dark, texture (chewiness) ranging from extremely easy to extremely difficult, flavor (extremely mild to extremely sharp) and taste (extremely bland to extremely tasty) and overall acceptability ranging from extremely like to extremely dislike.

Data Analysis

All data generated were analyzed for significant effects of factors on responses using a general linear model analysis of variance laid out in a 2 x 3 factorial arrangement and significant means ($p<0.05$) were separated using Tukey pairwise means comparisons, as contained in Minitab 2017 analytical software.

RESULT AND DISCUSSION

Effect of strip thickness on drying time of beef and pork

The effect of meat type and strip thickness on drying characteristics of meat is represented in

Table 1 Weight loss (%) was significantly ($p<0.05$) affected by the meat types. Beef lost more ($p<0.05$) moisture than pork and drying time of pork (27.33 hours) was higher than that of beef (22.67 hours). This can be attributed to the difference in the muscle structure of the meat types. Waritthitham *et al*. (2010) stated that species of animals is an important factor that can influence meat quality in muscle structure and meat physiology. It can also be attributed to higher amounts of intermuscular fat present in pork which has the ability to hinder moisture loss (FAO 1990). Although weight loss (g) was significantly ($P<0.05$) affected by strip thickness, it did not culminate in significant ($p<0.05$) percentage weight loss.

Table 1: Main effect of meat type and strip thickness on weight loss of meat

	Meat Type			**Strip Thickness**				
Parameters	**Beef**	**Pork**	**P-value**	**1cm**	**2cm**	**3cm**	**P-value**	**SEM**
Initial Weight (g)	45.78	51.32	-	29.39	40.73	75.54	-	2.45
Final Weight (g)	12.47	15.63	-	8.63	11.58	21.94	-	0.72
Weight Loss (g)	33.31	35.69	0.18	20.76^{c}	29.14^{b}	53.60^{a}	0.00	1.75
Weight Loss (%)	72.78^{a}	69.15^{b}	0.00	70.53	71.36	70.99	0.42	0.34

a,b,c,Means in the same row with different superscript are significantly ($p<0.05$) different.

Figure 1 shows the effect of meat type and strip thickness on the drying time. The lower value for drying time recorded for the thinner meat strips could be because the heat gets to the core of the meat strips faster than it would for thicker strips making diffusion of moisture to occur at a faster rate. This agrees with the reports of Sa-adcom *et al*. (2011), that studied the drying of pork meat slice by superheated steam; and observed that thicker pork slices needed more drying time and produced a darker and redder dried product as compared to the thinner pork slices. Thinly sliced products dried faster due to the reduced distance the moisture traveled and increased the surface area exposed for a given volume of the product (Ling *et al.* 2017).

The interactive effect of meat type and strip thickness (1, 2 and 3cm) on percentage weight loss is presented in Table 2. Weight loss (g) and percentage weight loss were significantly affected ($p<0.05$) by the interaction of meat type and strip thickness. Beef cut to 1cm had the highest value of 73.41% and pork cut at 1cm had the lowest value of 67.64%. More drying time was recorded for pork (18, 26 and 38 hours) compared to beef (14, 24 and 30 hours).

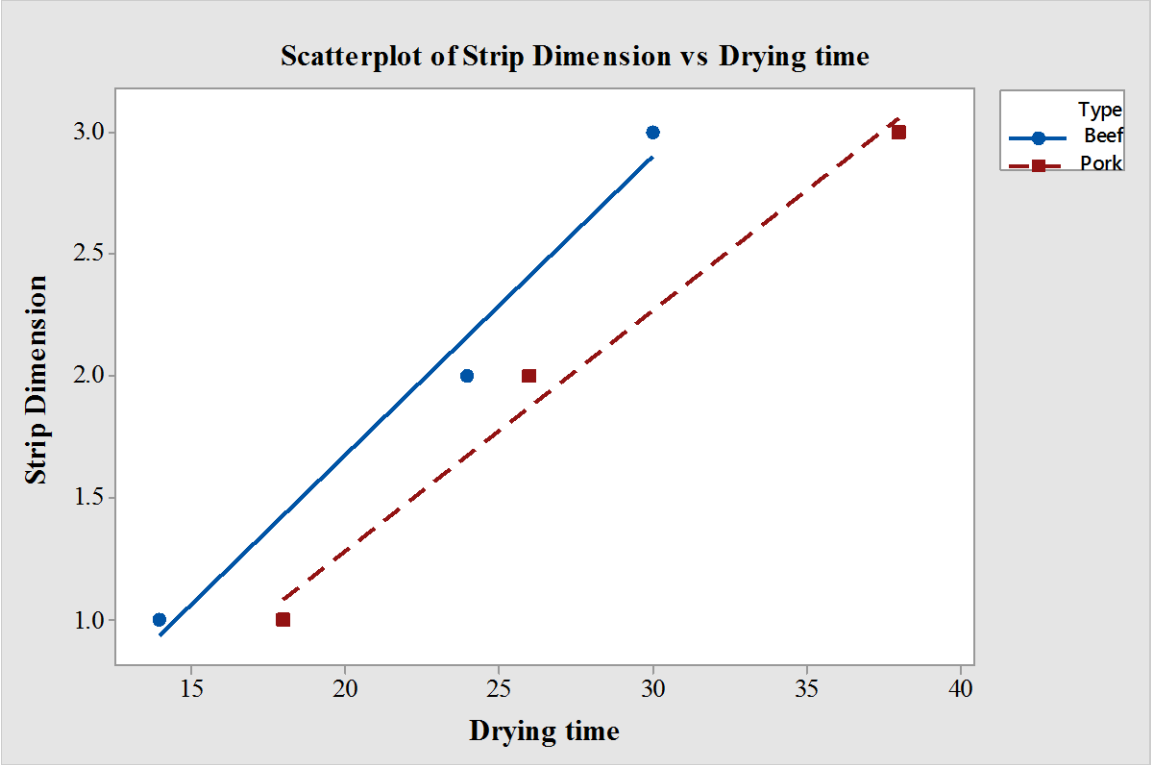


Figure 1: Plot of meat types and strip dimensions versus drying time.

Table 2: Interactive effect of meat type and strip thickness on weight loss of meat

	Beef			Pork				
Parameters	**1cm**	**2cm**	**3cm**	**1cm**	**2cm**	**3cm**	**SEM**	**P-value**
Initial Weight (g)	30.22	40.79	66.33	28.56	40.67	84.75	2.45	-
Final Weight (g)	8.03	10.87	18.50	9.22	12.29	25.38	0.72	-
Weight Loss (g)	22.19^{cd}	29.91^{c}	47.83^{b}	19.34^{d}	28.37^{c}	59.37^{a}	1.75	0.00
Weight Loss (%)	73.41^{a}	73.03^{a}	71.91^{ab}	67.64^{c}	69.74^{bc}	70.07^{bc}	0.34	0.01

[a, b, c]Means in the same column with different superscript are significantly ($p<0.05$) different.

Effect of strip thickness on sensory properties of beef and pork

The main effect of meat types and strip dimensions on the sensory quality of dried meat (Table 3) revealed that only the color was affected ($p<0.05$) by meat type. The beef had a higher color score (7.03) than pork (4.33). This results from the different levels of pigmentation majorly as a result of myoglobin, beef clearly has a darker or redder color (red meat) than pork. Strip thickness did not have an effect ($p>0.05$) on the observed parameters (color, chewiness, flavor, taste, overall acceptance). The interactive effect of meat type and strip thickness also did not have effect ($p>0.05$) on the on the parameters measured, indicating that both beef and pork were similar in the observed parameters.

Table 3: Main effect of meat type and strip thickness on the organoleptic quality of dried meat.

	Meat Type			Strip Thickness				
Parameters	**Beef**	**Pork**	**P-value**	**1cm**	**2cm**	**3cm**	**P-value**	**SEM**
Colour	7.03[a]	4.33[b]	0.00	5.20	5.70	6.00	0.19	0.26
Chewiness	5.13	4.33	0.21	5.15	4.75	4.30	0.55	0.31
Flavour	6.83	6.07	0.14	7.00	6.05	6.30	0.29	0.29
Taste	6.70	6.07	0.14	7.20	6.15	6.45	0.25	0.26
Overall Acceptance	6.07	5.63	0.43	6.00	6.85	5.70	0.90	0.26

[a,b]Means in the same row with different superscript are significantly ($p<0.05$) different.

Table 4: Interactive effect of meat type and strip thickness on the organoleptic quality of dried meat.

	Beef			Pork				
Parameters	**1cm**	**2cm**	**3cm**	**1cm**	**2cm**	**3cm**	**P-value**	**SEM**
Colour	7.10	6.90	7.10	3.30	4.50	4.90	0.15	0.26
Chewiness	5.30	4.90	4.20	5.00	4.60	3.40	0.54	0.31
Flavour	6.80	6.80	6.90	7.20	5.30	5.70	0.27	0.26
Taste	7.00	6.70	6.40	7.40	5.60	6.50	0.47	0.26
Overall Acceptance	6.40	6.10	5.70	5.60	5.60	5.70	0.83	0.26

Effect of strip thickness on sensory properties of rehydrated beef and pork

Dried products need to be rehydrated before consumption or further processing (Pezo *et al.*, 2014). The effect of meat type on the quality of rehydrated meat is seen in Table 5. Meat type affected ($p<0.05$) the color. However, the color score was higher in dried strips than rehydrated strips. This indicates that a degree of modification occurred during hydration and that the uptake of water by dried strips caused a dilution of the color intensity.

The strip thickness also influenced the color of rehydrated meat. The color score increased as the strip thickness increased. (Sa-adcom *et al.* (2011) in their study of drying pork meat slice by superheated steam observed that as the drying time increased with slice thickness, it produced a darker and redder meat product.

Chewiness which is a sensory description of texture similar to juiciness is one of the most important sensory attributes in dried meat (Hernández *et al.*, 2016). It serves as the sensory manifestation of the structure of meat and the manner in which this structure reacts to the force applied during biting and the specific senses involved in eating (Moloney, 1999). The value for chewiness in rehydrated meat was

generally not significant (p>0.05). There was however an indication that the sorption of water into dried strips gave it an elastic nature making it slightly difficult to chew.

The taste was also significantly influenced (p<0.05) by rehydration of dried meat. Thicker meat strips were tastier (5.90) than thinner ones (4.50) after rehydration. This is a signal that during rehydration, absorption of water into the tissue results in an increase in the mass and simulations leaching out of solutes could have occurred (Pezo *et al.,* 2014) and that more leaching of solutes took place in thinner meat strips during rehydration.

Table 6 shows that all the sensory parameters measured were not affected by the interactive effect of meat type and strip thickness on the quality of rehydrated meat.

Table 5: Main effect of meat type and strip thickness on the organoleptic quality of rehydrated meat.

	Meat Type			**Strip Thickness**				
Parameters	**Beef**	**Pork**	**P-value**	**1cm**	**2cm**	**3cm**	**P-value**	**SEM**
Colour	6.37[a]	3.37[b]	0.00	4.00[b]	4.95[ab]	5.50[a]	0.01	0.28
Chewiness	5.70	5.97	0.55	5.45	6.00	6.05	0.48	0.22
Flavour	5.10	5.40	0.59	4.90	5.40	5.45	0.67	0.27
Taste	5.10	5.70	0.21	4.50[b]	5.80[ab]	5.90[a]	0.03	0.25
Overall Acceptance	5.87	6.53	0.18	5.65	6.65	6.30	0.25	0.24

[a,b,]Means in the same row with different superscript are significantly (p<0.05) different.

Table 6: Interactive effect of meat type and strip thickness on the organoleptic quality of rehydrated meat.

	Beef			**Pork**				
Parameters	**1cm**	**2cm**	**3cm**	**1cm**	**2cm**	**3cm**	**SEM**	**P-value**
Colour	5.60	6.60	6.60	2.40	3.30	4.40	0.43	0.28
Chewiness	4.70	6.30	6.10	6.20	5.70	6.00	0.14	0.22
Flavour	4.80	4.70	5.80	5.00	6.10	5.10	0.30	0.27
Taste	4.30	5.10	5.90	4.70	6.50	5.90	0.46	0.25
Overall Acceptance	5.40	6.30	5.90	5.90	7.00	6.70	0.97	0.24

CONCLUSION

In this study, the effect of meat type and strip thickness on drying time and sensory properties were investigated. Beef dried faster than pork and the drying time increased as the strip thickness increased. Percentage weight loss was influenced by meat type and the interaction of both factors. Knowledge of sensory properties of food materials is important for development of the quality of the final product. Dried beef had a darker color than dried pork. Color and taste improved as Strip thickness increased in rehydrated meat strips. There were indications that as the drying time increased with increase in strip thickness, the color also became darker. Also, there were pointers that leaching of solutes occurred during rehydration of dried meats.

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