The Effect of Different Time Interval in Micro-Waved Meat On the Meat Quality

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I. INTRODUCTION

Meat is considered a source of high quality proteins. Meat is a very good source of animal protein that consists of essential amino acid, minerals, vitamins and essential fatty acids (Lawrie, 1991*).* Meat provides calories from fat, proteins and limited quantities of carbohydrate *(*Judge *et al*., 1990*).* Lean meat contains from 15 to 20% of protein, which varies inversely with percentage of fat. It is also one of the few foods which provide complete protein as well as being rich source of such essential nutrients as iron, niacin and vitamin B_{12} (Lawrie, 1991).

The major poultry meat quality attributes are appearance, texture, juiciness, flavour, and functionality. With increasing trends in further processing, meat functionality has increased in relative importance, especially because of its key role in determining the sensory quality of complex ready-to-eat products (Fletcher, 2002). A quality grade is a composite evaluation factors that affect palatability of meat (tenderness, juiciness, and flavour). These factors include carcass maturity, firmer, texture and colour of lean meat.

Cooking of meat is essential to achieve a palatable and safe product (Tornberg, 2005). There is very little Vitamin A and ascorbic acid in meat. (Mikkelsen *et al.,* 1984). Lean meat from most animal carcass which consist of muscle, connective tissue, fat and bone and some 75% water in proportions depending on species, breeds, size, age, etc (Ainger, 1991). The muscle (lean meat) is relatively constant in composition in a given species and greatest variable in the carcass is the amount of fat which can range from 2% in some free-living animal to 15 - 40% in domesticated animals intensively reared. (Ramaswany, 1980). It will be noted that the lean meat of various species has similar values for micro nutrient and inorganic constituents. The same is true of the vitamins with the beef meat and chicken meat. (Reiter and Driskell, 1985). Method of cooking determines its compositional, processing determinants and sensory attributes especially appearance and colour and juiciness of the meat product. Some researchers have observed that microwave oven cooked meat products had lower moisture content than conventional oven cooking (Salama, 1993; Hoda *et al.,* 2002). Nath *et al.,* (1996) and Mendiratta *et al.* (1998) reported no moisture difference in microwave oven and conventional oven cooked chicken patties. Meats consist primarily of muscular tissues with the amount of fatty tissue varying not only with the breed, age, sex and diet of the animal but also anatomical location. For example, heating temperatures have been shown to affect the texture of the beef muscle. (Herhon and Hulland. 1980).

II. MATERIALS AND METHODS

The experiment was carried out at the animal products and Processing Laboratory of the Department of Animal Production And Health, College of Animal Science And Livestock Production, Federal University of Agriculture, Abeokuta.

Experimental Procedure

Broiler chickens and beef were purchased from a Commercial market, they were slaughtered and dressed and 1kg of each meat types was assigned to the three treatments cooking at 5, 10 and 15 minutes.

Table 1: The meat type and cooking intervals

Meat type	Cooking time (minutes)		
Chicken meat (broiler)	5	10	15
Beef	5	10	15

Determination of Cooking (Microwave) Losses

Each sample was into sizeable portion, weighed and then microwave at about 900wd for 5, 10, and 15 minutes. Cooking losses were then calculated using the formula below.

Cooking loss (g) = Weight of samples before cooking (g) – weight after cooking (g)

$$\text{Cooking Loss (\%)} = \frac{\text{Weight of samples before cooking – weight after cooking}}{\text{Weight before cooking}} \times 100$$

Determination of Refrigerated Losses

Refrigerated weight losses were determined after the meat types have been microwaved at different time interval (initial weight). Then the microwave meat types were later refrigerated at 4^0c for 24 hours. Refrigerated weight loss was calculated using the formula below:

Refrigerated weight loss (g) =Initial weight (g) - Final weight (g)

$$\text{Refrigerated weight loss (\%)} = \frac{\text{Initial weight – Final weight}}{\text{Initial weight}} \times 100$$

Proximate Analysis

Parameter that were evaluated for each meat types were moisture content, crude protein, crude fat, total ash, water , calcium (Ca), iron (Fe) that were determined for each meat types according to the method described by AOAC(1990).

Sensory Evaluation

Sensory evaluation of the microwave beef and chicken meat at different time intervals was carried out using ten trained taste panellist. Some of the meat qualities estimated include colour, juiciness, meaty flavour, tenderness, saltiness, overall flavour and overall acceptability. Bite size portions of the microwave beef and chicken meat weighing 10g each were served at room temperature to the trained panellists who awarded scores using a nine point hedonic scale as described by (Cross *et al*., 1986). Like extremely =9, like very much=8, moderately=7, like slightly=6, neither like nor dislike=5, dislike slightly=4, dislike moderately=3, dislike very much=2, and dislike extremely=1.

A preliminary briefing session was held and the panellists were told as follows: Water was served to them for rinsing of their mouth after scoring each sample. Samples were independent of one another.

Statistical Analysis

All the data generated was subjected to 2x3 Factorial Arrangement in Completely Randomised Design using the statistical package (SAS 2010), while difference between means was determined by Duncan Multiple Range Test (1995)

III. RESULTS AND DISCUSSION

Table 2 show the main and interactive effect of microwave weight loss of broiler chicken and beef meat microwave at different time interval. Considering the interactive effect, the weight loss was observed to be higher in beef than in chicken at the longest time microwave interval of 15 minutes this goes to show that chicken has a higher water holding capacity than beef. Which agree with the finding of (Ruiz *et al.,* 2000). It was observed that the longer the micro-waved time, the higher the cook loss.

Table 2: Effect of microwave weight losses of chicken meat and beef

Cooking interval	Initial weight(g)	Final weight (g)	Wt loss(g)	Wt loss (%)
5minutes	50.35±0.09	28.01±2.23^{a}	22.35±2.30^{b}	44.35±4.51^{b}
10minutes	50.38±0.12	27.783±.55^{a}	22.60±3.58^{b}	44.83±7.10^{b}
15minutes	50.180±.06	16.65±2.23^{b}	33.53±2.28^{a}	66.79±4.48^{a}
Meat types				
Broiler chicken	50.19±0.04^{b}	28.402±.71^{a}	21.79±2.70^{b}	43.42±5.40^{b}
Beef	50.42±0.08^{b}	19.892±.13^{b}	30.53±2.11^{a}	60.57±4.21^{a}
Microwave temp X meat type				
Chicken at 5mins	50.230±.12^{ab}	34.47±0.87^{a}	15.77±0.96^{b}	31.38±1.85^{b}
Chicken at 10mins	50.20±0.06^{ab}	32.94±0.49^{a}	17.25±0.52^{b}	34.37±1.02^{b}
Chicken at 15mins	50.13±0.03^{b}	17.80±1.51^{b}	32.33±1.51^{a}	64.50±3.01^{a}
Beef at 5mins	50.500±.12^{ab}	23.07±0.52^{b}	27.43±0.06^{a}	54.32±1.10^{a}
Beef at 10mins	50.53±0.18^{a}	21.10±4.21^{b}	29.43±4.04^{a}	58.30±8.22^{a}
Beef at 15mins	50.23±0.12^{ab}	15.50±4.61^{b}	34.73±4.72^{a}	69.10±9.26^{a}

Mean along the same column with different superscript are significantly different ($p<0.05$)

Table 3 Shows the main and interactive effect of weight loss of chicken and beef meat microwave and refrigerated after 24hours shows no significant in gram and percentage. There was significant different on final weight. Which agree with the findings of (Whiting *et al.,* 1987). This is as a result of increase in water losses maybe be due to incorrect water gelling.

Table 3: Effect of refrigerated weight losses of micro-waved chicken and beef

Cooking interval	Initial weight (g)	Final weight (g)	Weight loss	Weight loss (%)
5minutes	28.01±2.23^{a}	27.43±2.23^{a}	0.58±0.20^{b}	2.12±0.69^{b}
10minutes	27.78±3.55^{a}	26.09±3.52^{a}	21.64±0.50^{ab}	5.71±1.36^{ab}
15minutes	16.65±2.23^{b}	14.88±2.33^{b}	2.51±0.83^{a}	13.94±4.52^{a}
Meat type				
Broiler chicken	28.40±2.71^{a}	26.33±2.89^{a}	2.07±0.60	8.32±3.00
Beef	19.89±2.13^{b}	19.26±2.44^{b}	1.08±0.38	6.19±2.52
Microwave temp X meat type				
Chicken at 5mins	34.47±0.87^{a}	31.83±0.44^{a}	2.63±0.45	7.58±1.10

Chicken at10mins	32.94±0.49[a]	32.40±0.15[ab]	0.56±0.37	1.67±1.09
Chicken at 15mins	17.80±1.51[b]	14.78±0.06[c]	3.02±1.49	15.71±7.45
Beef at 5mins	23.07±0.52[b]	22.47±0.38[bc]	0.60±0.25	2.57±1.03
Beef at 10mins	21.10±4.21[b]	20.35±5.38[c]	0.65±0.26	3.83±2.11
Beef at 15mins	15.50±4.61[b]	14.97±5.22[c]	2.00±0.98	12.17±6.61

Mean along the same column with different superscript are significantly different ($p<0.05$)

Table 4 shows the main and interactive effect of proximate composition of broiler chicken and beef microwave at different time interval. For moisture content, crude fat, and total ash it was observed that beef was the highest at 15minutes (9.90) 12.83, 1.62, respectively. While chicken was the highest for crude protein and carbohydrate for 15 minutes (79.39) (0.33) which agrees with the findings of (wood *et al.* 2004) this content composition of meat are of major important for consumers due to important for meat quality and nutritional value

Table 4: Effect of proximate composition of chicken and beef meat microwave at different time.

Time interval (minutes)	Moisture content (%)	Crude protein (%)	Crude fat (%)	Total ash (%)	Calcium mg / 100g (%)	Iron /mg/100g
5	9.23±0.20[a]	16.02±0.69[b]	12.20±0.61[a]	1.33±0.77[a]	0.17±0.01[b]	0.09±0.01[b]
10	8.70±0.33[ab]	16.02±0.67[b]	12.02±0.79[a]	1.71±0.23[a]	*0*.29±0.05[a]	0.13±0.02[ab]
15	8.22±0.23[b]	18.30±0.70 [a]	11.40±0.65[a]	1.47±0.12[a]	0.18±0.02[b]	0.19±0.03[a]
Meat types						
Chicken	8.59±0.21[a]	18.69±0.56[a]	10.65±0.22[b]	1.27±0.06[b]	0.23±0.04[a]	0.15±0.02[a]
Beef	8.83±0.28[a]	15.17±0.55[b]	13.10±0.44[a]	1.24±0.14[a]	0.20±0.02[a]	0.12±0.02[a]
Microwave X Meat type						
Chicken at 5mins	9.25±0.38[a]	16.93±1.04[b]	10.90±0.13b[c]	1.18±0.08[b]	0.16±0.00[b]	0.11±0.00[ab]
Chicken at 10mins	8.00±0.06[b]	19.39±0.51[a]	11.07±0.45[bc]	1.32±0.09[b]	0.38±0.52[a]	0.13±0.01[ab]
Chicken at 15mins	8.53±0.09[ab]	19.74±0.15[a]	9.98±0.12[c]	1.32±0.18[b]	0.14±0.02	0.21±0.06[a]
Beef at 5mins	9.20±0.23[a]	15.11±0.60[cb]	13.52±0.35[a]	1.48±0.07[b]	0.18±0.01[b]	0.08±0.00[b]
Beef at 10mins	9.40±0.23[a]	13.53±0.34[c]	12.97±1.41[a]	2.11±0.32[a]	0.19±0.05[b]	0.13±0.04ab
Beef at 15mins`	9. 90±0.40[b]	16.88±0.60[b]	12.83±0.25[ab]	1.62±0.13[ab]	0.22±0.01[b]	0.17±0.00ab

Table 5 shows significant ($p<0.05$) different for main and interactive effect of some sensory properties of broiler chicken and beef meat microwaved at different time interval, the interactive effect of microwave and meat type on colour show that chicken microwaved at 15minutes was scored 6.27 being like slightly while beef at 15minutes was scored 5.70 being intermediate. Juiciness for chicken and beef meat at 10minutes was 6.10 and 4.70 slightly juicy and slightly dry respectively, while at 15minutes was slightly dry. Flavour for chicken at 15 minutes was scored 6.23 being slightly meaty while beef was scored the lowest at 10minutes for 5.03 being intermediate. Tenderness for chicken at 10 minutes was scored 6.40 being slightly tender while beef was scored the lowest at 15 minutes for 3.77 being moderately tough. This agreed with the findings of Obuz *et al* (2003) that the effect of heating rate on the tenderness of meat is greatly influenced by muscle type. The overall flavour for chicken was the highest at 15minutes for 6.50 which were slightly desirable than beef at 5minutes of the lowest of 5.33 intermediate. The overall acceptability for chicken was scored highest of 6.50 at 15minutes like slightly to beef at 10 minutes for 5.30 which was intermediate.

Table 5: Effect of sensory properties of broiler chicken and beef meat micro-waved at different time interval

Time interval	Colour	Juiciness	Flavour	Tenderness	Saltiness	Overall Flavour	Overall Acceptability
5 Minutes	5.42±0.25	4.98±0.24	5.80±0.34	5.33±0.41[ab]	5.0±0.20	5.7±0.26	5.82±0.33
10 Minutes	5.40±0.18	5.40±0.37	5.45±0.37	5.80±0.36[a]	5.10±0.21	5.65±0.23	5.77±0.31
15 Minutes	5.98±0.24	4.50±0.40	5.83±0.25	4.35±0.43[b]	4.93±0.26	6.13±0.26	6.23±0.29
Meat types							
Chicken	5.71±0.25	5.29±0.30	5.96±0.13	5.54±0.33	5.03±0.15	6.16±0.24[a]	6.24±0.30
Beef	5.49±0.13	4.63±0.26	5.43±0.16	4.77±0.38	5.0±0.21	5.50±0.08[b]	5.69±0.16

Microwave Interval X Meat types							
Chicken at 5	5.13±0.47^{b}	5.0±0.50^{ab}	5.77±0.68	5.30±0.53^{ab}	4.80±0.26	6.07±0.43^{ab}	6.0±0.68
Chicken at 10	5.73±0.07^{ab}	6.10±0.38^{a}	5.87±0.70	6.40±0.45^{a}	5.07±0.32	5.90±0.44^{ab}	6.23±0.41
Chicken at 15	6.27±0.43^{a}	4.77±0.43^{ab}	6.23±0.38	4.93±0.49^{ab}	5.23±0.24	6.50±0.46^{a}	6.50±0.61
Beef at 5	5.70±0.10^{ab}	4.97±0.20^{ab}	5.83±0.33	5.37±0.74^{ab}	5.20±0.31	5.33±0.09^{b}	5.63±0.23
Beef at 10	5.07±0.23^{b}	4.70±0.21^{ab}	5.03±0.18	5.20±0.31^{ab}	5.13±0.35	5.40±0.10^{b}	5.30±0.25
Beef at 15	5.70±0.12	4.23±0.75^{b}	5.43±0.12	3.77±0.57^{b}	4.63±0.45	5.77±0.03^{ab}	6.13±0.18

Mean along the same column with different superscript are significantly different ($p<0.05$)

IV. CONCLUSION AND RECOMMENDATION

The higher the microwave time the more the percentage cooking weight losses of broiler chicken and beef meat. Cooking time of meat types in microwaves had little or no effect on crude protein content. Crude fat was more affected by cooking time in beef and independent in chicken meat, while mineral content in the meat types were independent of cooking time in microwaves.

Recommendation

Since cooking time in microwaves has little or no effect on nutrient composition in both meat types, it is therefore, recommended that beef and chicken meat can be cooked in microwaves up till 15 minutes

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