CHILLING AT DIFFERENT TIME INTERVALS; THE INFLUENCE ON PHYSICOCHEMICAL CHARACTERISTICS OF BEEF

***APATA[1], E.S.[1]ENIOLORUNDA, O.O,[1]KOKUMO, O.E AND [2]APATA, O.C**

Meat Science Laboratory; Department of Animal Production, College of Agricultural Sciences, Olabisi Onabanjo University, Yewa Campus, P.M.B 0012 Ayetoro Ogun State, Nigeria.

Department of Wildlife and Ecotourism Management, University of Ibadan, Ibadan Oyo State, Nigeria.

**Email: ebunoluapata2008@yahoo.com; Phone: 08108177177*

ABSTRACT

This study was carried out at Meat Science Laboratory of the Department of Animal Production College of Agricultural Sciences, Olabisi Onabanjo University, Yewa Campus Ayetoro Ogun State. The aim was to investigate the effect of delayed chilling on physicochemical properties of 3kg of thigh muscle cut (Semi-membranosus muscle) of freshly slaughtered N'dama bull (*Bos taurus*) purchased from Ayetoro slaughter slab. It was sub-divided into 6 portions of 500g and each portion represented a chilling treatment; T0 = (Normal Chilling) control; T1: Chilling after 2hrs delay; T2 = Chilling after 4hrs delay, T3 = Chilling after 6hrs delay; T4 = Chilling after 8hrs delay, T5 = Chilling after 10hrs delay. Data were collected on a completely randomized design experiment and analyzed statistically. The results showed that delayed chilling had significant ($p<0.05$) effects on all the physical and chemical variables tested in this study. It was observed that these variables increased favourably up to 6hrs of delayed chilling (T3) and started to decrease beyond that time. It is recommended therefore, that chilling of beef should not be delayed beyond 6hrs for wholesome beef.

INTRODUCTION

Meat and meat products are consumed in almost all communities of the world as its adjudged the richest source of protein (Williams *et al;* 2006). However, it gets easily contaminated by pathogenic micro organisms immediately after slaughter, therefore, it is important to make meat and meat products safe and wholesome right from the slaughter and processing stages (Singh and Sachan, 2010). The most important and essential step in maintaining meat quality is chilling. It is the method of keeping fresh meat cold enough in order to reduce most of the thermophilic pathogenic micro-organisms before deboning the meat and it is appropriate in the production of wholesome fresh meat (Van Moeseke *et al.*, 2001). In most developing countries fresh meat carcasses are not usually chilled at abattoirs after slaughter, instead meat is displayed for several hours by local butchers and exposed to environmental dirt which speed up microbial build up on the meat and invoke its rapid deterioration. Chilling of meat is usually at temperatures between 4-7^{0}c for 24 hours for muscle to undergo conversion to meat (Razminovicz *et al.*, 2008). Delayed chilling which is holding meat carcass at 15^{0}c for 90 min before normal chilling had been reported to have characteristic effects on meat quantity (Bowater, 2001); fresh meat carcasses and primal cuts quality are compromised without chilling as maximum meat safety and optimized eating quality are not guaranteed. The aim of this study was to investigate the effect of delayed chilling on physicochemical attributes of beef with the view to filling the scanty information on delayed chilling of beef gap in the literature.

MATERIALS AND METHODS

This study was carried out at the Meat Science Laboratory in the Department of Animal Production, College of Agricultural Sciences, Olabisi Onabanjo University, Yewa Campus Ayetoro, Ogun State. Three kg beef from the thigh cut (Semi membranous muscle) of freshly slaughtered N'dama bull cattle (*Bos taurus*) was purchased from the slaughter slab at Ayetoro and used for this study. The meat was sub-divided into 6 portions of 500g, each portion represented a chilling treatment as follows: Chilling immediately after slaughter (control), Chilling after 2hrsr delay; Chilling after 4hrs delay; Chilling after 6hrs delays; Chilling after 8 hrs delay; Chilling after 10hrs delay. The control meat sample was cut, weighed and chilled immediately (Normal Chilling), while meat samples for the delayed chilling were hung on retort stand prior to chilling after 2, 4, 6, 8 and 10 hours delay. The meat samples were chilled at 4^{0}C for 24hours and removed one after the other for physical and chemical characteristics assessments (Apata, 2011, AMSA 1991, AOAC, 2000). Data collected were

analysed using (SAS, 2002) procedures in a completely randomized design. All significant means were separated with Duncan's multiple range test of the same software.

RESULTS AND DISCUSSION

Table 1 shows the result of physical characteristics of beef chilled at different periods of time. Raw meat colour was higher ($P<0.05$) and similar in chilling immediately after slaughter, and chilling after 2 hrs followed by chilling after 6 and 8 hrs delay, while chilling after 10hrs had lowest ($p<0.05$) colour intensity. Chilling after 10hrs gave highest ($p<0.05$) cooking loss percentage, while chilling immediately after slaughtering had the lowest ($P<0.05$) but cooking yield exhibited reverse result as chilling immediately after slaughtering elicited highest ($p<0.05$) meat yield and chilling after 10 hrs the least ($P<0.05$). Drip loss, thermal and cold shorteningsas well as shear force showed the same trend; they increased as the time of chilling of beef was delayed, while water holding capacity of chilled meat samples decreased as the time of chilling was delayed. The results obtained in this study were very close to those reported by Apata (2011) on physical characteristics of frozen chevon. Table 2 shows the results of chemical composition of beef as affected by delayed chilling. Moisture content was least ($p<0.05$) in meat sample in chilled after 10 hrs of slaughtering while it was higher ($P<0.05$) and similar in meat samples chilled immediately chilled after slaughtering, 2 and 4 hrs after slaughtering followed by meat chilled 6 and 8 hrs after slaughtering which were also similar. The trend of ether extract and ash result was the same as they decreased as the time of chilling was delayed however protein and nitrogen free extract results were the as an increase was obserbad, while there was no significant difference ($p>0.05$) in the lipid oxidation of beef delayed before chilling and the samples that was chilled immediately after slaughter. These results could be due to decrease in moisture content which eventually increased protein, while fat and ash decreased perhaps as a result of fat degradation and draining of minerals from the beef samples during the delay periods before chilling. This was evident in the increased drip loss as shown on Table 1.

CONCLUSION

The results obtained from this study revealed that delayed chilling caused significant changes in the physical and chemical properties of beef across the treatments. Most of the physical and chemical characteristics tested especially cooking and drip losses, thermal and cold shortenings and colour increased up to chilling after 8hoursof slaughter and started to decrease at ten hours after slaughter. Chemical properties of beef whose chilling was delayed showed similar results. It is suggested therefore, that chilling of beef can be delayed up to 6 hours beyond which the physical and chemical attributes of beef begin to deteriorate.

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Table 1: Physical Characteristics of beef as influenced by delayed chilling

	Chilling time after slaughter (hrs)					
Variable (%)	0	2	4	6	8	10
Raw Meat Colour	9.00±0.01[a]	9.00±0.01[a]	8.00±0.03[b]	8.00±0.03[b]	7.00±0.04[c]	6.00±0.05[d]
Cooking loss	15.10±0.06[+]	20.03+0.06[e]	22.00±0.06[d]	25.05±0.06[c]	28.03±0.06[b]	30.03±0.06[a]
Cooking yield	84.90±0.09[a]	79.97±0.09[b]	78.00±0.09[c]	74.95±0.09[d]	71.97±0.09[e]	69.97±0.09
Drip loss	0.12±0.01[e]	0.13±0.06[d]	0.14±0.01[c]	0.15±0.01[c]	0.15±0.01[b]	0.16±0.01[a]
TS	3.34±0.01[e]	5.01±0.01[d]	7.61±0.01[c]	9.30±0.01[b]	9.41±0.01[b]	11.50±0.01[a]
CS	8.25±0.06[e]	10.27±0.03[d]	11.48±0.04[c]	12.73±0.04[b]	12.76±0.01[b]	14.02±0.04[a]
WHC	75.42±4.01[a]	0.13±0.06[d]	69.23±370[c]	67.16±5.81[d]	67.10±3.80[d]	65.03±5.31[e]
Shear Force (N)	4.32±0.05[d]	5.01±0.01[d]	5.43±0.03[c]	6.45±0.02[b]	6.50±0.02[b]	7.52±0.01[a]

a,b,c,d,e,f: Means on the same row with different superscripts are statistically significant ($p<0.05$) WHC = Water Holding Capacity CS = Cold Shortening TS= Thermal shortening

Table 2: Chemical Composition of beef as affected by delayed chilling

	Chilling time after slaughter (hrs)					
Variable (%)	0	2	4	6	8	10
Moisture	69.73±0.15[a]	69.60±0.12[a]	69.53±0.00[a]	68.45±0.10[b]	68.50±0.15[b]	67.40±0.51[c]
CP	18.15±0.23[d]	19.21±0.15[c]	19.25±0.01[c]	21.32±0.10[a]	21.40±0.23[a]	20.30±0.42[b]
Ether Extract	3.33±0.06[a]	3.27±0.11[a]	3.21±0.06[a]	3.18±0.06[a]	2.11±0.06[b]	1.03±0.06[c]
Ash	2.11±0.06[a]	2.10±0.00[a]	2.05±0.06[a]	2.03±0.06[a]	2.00±0.06[a]	1.00±0.06[b]
NFE	6.88±0.05[b]	5.82±0.05[b]	5.96±0.04[b]	5.02±0.03[b]	5.99±0.04[b]	8.12±0.02[a]
TBARS (meq/kg/fat)	0.01±0.00	0.01±0.01	0.01±0.01	0.01±0.00	0.0110.01	0.010.00

a,b,c,d: Means on the same row with different superscripts are statistically significant ($p<0.05$) CP = Crude protein NFE = Nitrogen Free Extract