International Journal of Agricultural Sciences ISSN: 2167-0447 Vol. 2 (1), pp. 054- 058, January, 2012. Available online at www.internationalscholarsjournals.org

Full Length Research Paper

Quality Evaluation of Rabbit Meat as Affected by Different Stunning Methods

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Received December 9, 2011; Accepted January, 2012

This study was carried out to evaluate the effects of different stunning methods on the physicochemical and sensory characteristics of carcass and meat of rabbits. Thirty six matured rabbits of mixed breeds and sexes with average weight of 1.5 – 2.0kg were used. The rabbits were randomly assigned to four experimental treatments with their weights balanced as follows; T1 = No stunning (control), T2 = Electrical stunning, T3 = Gas stunning and T4 = Mechanical stunning. Each treatment was replicated thrice and data collected were analyzed using ANOVA. The rabbits were bled after stunning, dressed conventionally, chilled at 4^0C for 24 hours, dissected into 2 halves and fabricated into primal cuts. Carcass characteristics as well as physical, chemical and sensory properties of the rabbit meat were determined. The results showed that carcasses of rabbits stunned with gas gave higher ($P<0.05$) blood loss and lower ($P<0.05$) chilling loss. Also visual colour score, cooking yield, protein, nitrogen free extract, cooked meat colour, flavour, texture and overall acceptability were higher ($P<0.05$), while cooking loss, thermal shortening, drip loss, moisture and pH were lower ($P<0.05$) in meat from rabbits stunned with gas compared with meat from other treatments. Gas stunning was therefore, recommended since it favoured most of physicochemical and sensory characteristics of both carcass and meat of differently stunned rabbits in this study.

Keywords: Quality, Evaluation, Stunning, Rabbit, Meat.

INTRODUCTION

Meat from rabbit is highly digestible, tasty, low-caloried and often recommended by nutritionists over other meat types. For this reason, meat processing industries in most part of the world including Europe are gradually expanding and improving the availability of rabbit meat in a large variety of processed ready – meat in order to meet the demands of consumers (Dallezotte 2002). Meat consumers all over the world are increasingly demanding that food animals be reared, transported and slaughtered with humane practices (Dal bosco *et al*., 1997). Thus, the major concern in the conversion of food animals into edible products is to handle them in a humane and hygienic manner (Mulder, 1999). Therefore, the concern for animal welfare is an important consideration vis – a – vis quality in meat production and is consequent upon the belief that animals can suffer and in turn be detrimental to the wholesomeness of the meat from such animals (Manteca, 1998). The procedures that are necessary to convert tissues of a living animal into edible food are stressful and stress before slaughtering animals causes undesirable effects to the quality of meat such as Pale Soft Exudative (PSE) meat or Dark Firm and Dry (DFD) meat as plasma cortisol, adrenalin and nonadrenalin are affected (Grandin, 1980b; Sams, 1999). However, stunning is one of the important slaughtering procedures in the production of meat for food. It is done on animals prior to bleeding in order to immobilize them and render them insensible to pain or stress (Barbut, 2002).

There are different methods of stunning animals which include the mechanical or percussion method that entails the use of a captive bolt or hammer, electrical stunning that utilizes a low or high voltage alternating electric current as the case may be and gas stunning method which is the use of carbondioxide (CO_2) gas. The most essential and preferable attribute of any stunning method is to confer unconsciousness on an animal when stunned without deleterious effect on the animal's carcass or meat (Dalbosco *et al*., 1997). Grandin (1980a) reported various methods of stunning food animals and their effects on blood and serum, of such animals, with scanty information on the effects of different stunning on the physicochemical and organoleptic quality of carcass and meat. This study was carried out to bridge such gap.

MATERIALS AND METHODS

This study was carried out at the Teaching and Research Farm of the College of Agricultural Sciences, Olabisi Onabanjo University, Yewa Campus, Ayetoro, Ogun State.

Animals and their management

Thirty six (36) matured rabbits of mixed breeds and sexes with average weight of 1.5 – 2.0kg were used for this study. They were purchased and transported to the University's Teaching and Research Farm from rabbit unit of the Ministry of Agriculture, Abeokuta and were kept in previously cleansed, and disinfected house and hitches. The rabbits were rested for two weeks during which they were fed forages (*Tridax procumbens*), concentrate, clean water ad-libitum with anti – stress and other necessary medication given.

Treatment allocation of animals

The rabbits were randomly assigned to four experimental treatments after two weeks with their weight balanced as follows: T1: control; T2: Electrical stunning; T3: Gas stunning and T4: Mechanical stunning with each treatment replicated thrice.

Stunning of rabbits

In treatment 1 there was no stunning of rabbits and served as control. Rabbits in treatment 2 were stunned with an electric stunner using current 49V for 15secs (Maria *et al*., 2000). Rabbits in treatment 3 were stunned with gas (di-ethylether, 400ml) poured on a large quantity of cotton wool in a dessicator and each rabbit was introduced into the dessicator for 15 secs, while rabbits in treatment 4 were stunned mechanically using a club (Omojola, 2007).

Slaughter of animals

Rabbits were bled by severing both the jugular vein and the carotid arteries below the jaws (Okubanjo, 1997). Rabbit carcasses were allowed to bleed for 30min with their heads down (Facco Silveria *et al*., 1998) and their carcass weights taken after bleeding.

Processing of rabbits carcasses

The rabbits carcasses were skinned as decribed by Omojola and Adesehinwa (2006), opened up eviscerated, washed and weighed (Okubanjo, 1997). The carcasses were chilled at 4^0C for 24 hours and fabricated into primal cuts of leg, loin, rib and shoulder according to Aduku and Olukosi (1990).

Measurement of carcass and meat parameters

Carcass physical parameters taken included bled, dressed and chilled, carcass weights, dressing percentage, percentage blood and carcass chilling loss as well as bleeding efficiency (Omojola 2007).

Meat physical parameters

Cooking loss and Thermal shortening: Meat samples of known weight and length were put into an oven and broiled for 25min between 160 – 180^0C to an internal temperature of 70^0C. They were removed and cooled to room temperature (25^0C) before they were reweighed and their weights lengths retaken. The percentage of the differences between the initial weight and length and the final weight and length were recorded as the cooking loss and thermal shortening of meat (Omojola and Adesehinwa, 2006). Thus

$$\text{Cooking loss} = \frac{\text{Initial meat wt} - \text{Final meat wt}}{\text{Initial meat wt}} \times 100$$

$$\text{Thermal shortening} = \frac{\text{Initial meat length} - \text{Final meat length}}{\text{Initial meat length}} \times 100$$

Cooking yield of meat

This was determined by taking the percentage of the final weight of cooked and initial weight of raw meat (Okubanjo 1997). Thus

$$\text{Cooking loss} = \frac{\text{Wt of cooked meat}}{\text{Wt of raw meat}} \times 100$$

Drip loss: This was determined following the procedures of Insausti *et al*. (2001). Weight of an empty polythene bag was taken (Wp). Meat sample was put into the bag (Wp + M) and was stored in a refrigerator for 48 hrs. The meat sample was removed from the refrigerator and the weight of the bag plus the juice drained by the meat sample were measured (Wp+J). Drip loss was expressed as percentage of the initial weight of the meat sample thus;

$$\text{Drip loss} = \frac{(Wp + J) - (Wp)}{(Wp + m) - (Wp)} \times 100$$

Water Holding Capacity (WHC): This was carried out according to Suzuki *et al*. (1991). An approximately 1g of meat sample was placed between two 9cm Whatman No 1 title papers (Model C Caver Inc. Wabash, U.S.A). The sandwish was pressed between two 10.2x 10.2cm^2 plexiglasses at about 35.3kg/cm^3 absolute pressure for 1 minute using a vice. The meat samples were removed and oven dried at 105^{0}C for 24hours to determine the moisture content. The amount of water released from the meat samples was measured indirectly by measuring the area of title paper watted relative to the area of pressed meat samples.

$$\text{Thus WHC} = \frac{100 - (Aw - Am) \times 9.47}{Wm \times Mc} \times 100$$

Where Aw = Area of water released by meat samples (cm^2)
Am = Area of meat samples (cm^2)
Wm = Weight of meat samples (g)
Mc = Moisture content of meat samples (%)
9.47 = a constant factor

Raw meat visual colour

This was determined following the procedures of AMSA (1991) A 10 – man panel was used to score the colour of meat from rabbit stunned with the three methods of stunning tested on scale 1 – 10 on which 1 = low redness and 10 = high redness.

Shear force

Meat objective tenderness (shear force) was determined using a Warner Bratzler v-notch shearing instrument (Honikel, 1998). The meat sample was cored using a cork borer (1.25cm) and was sheared at three locations along the fibre direction and the average values of the shearings taken.

Proximate composition and pH of meat

Proximate composition of rabbit meat was determined following the procedures of A.O.A.C (2000). Moisture was determined by drying 2g of meat in an oven at 100 – 105^{0}C until a constant weight was obtained. Crude protein was determined by using kjedahl method which comprised, digestion distillation, and titration of the distillate. Crude protein value was obtained by converting nitrogen (N%) content obtained with a constant (6.25), thus crude protein was obtained as (6.25 x N%). Fat content of the meat was determined with soxhlet extraction method using petroleum ether. Meat sample was dried in an oven and the fat extracted. Ash content of the meat was determined by igriting it in a muffle farnace at 550 – 600^{0}C to a constant weight.

The pH of meat was carried out by homogenising 10g of meat sample for 5min with 90ml distilled water using a blender (plate 5mm) model 242, Nakai, Japan. The meat pH was measured with pH meter model H18424 micro-computer, Havana Instruments Romania (Marchiori and deFelicio 2003).

Sensory evaluation of mat

This was conducted using a 10 – member semi-trained taste panel (AMSA, 1995). The taste panelists were provided with unsalted biscuts and water for use in between treatments meat samples. The meat samples were coded after broiling at 160^{0}C in an oven for 25 minutes to an internal temperature of 70^{0}C and cooled to room temperature (25^{0}C). The meat samples were presented sequentially to the taste panelists on clean saucers. Meat sample from each treatment was evaluated independently of the other on a 9-point hedonic scale where 1 = dislike extremely and 9 = like extremely for colour, flavour, tenderness, juiciness, texture and overall acceptability.

Experimental design and statistical analysis

Completely randomised design was used for this study and data generated were subjected to analysis of variance (ANOVA) using (SAS, 2002), while significant means were separated with Duncan multiple range test of the same software.

RESULTS AND DISCUSSION

The mean physical characteristics of differently stunned rabbit carcasses are shown on Table 1. Stunning did not have significant ($P>0.05$) effect on live and bled weights of rabbits used. The weight and percentage blood loss were higher ($P<0.05$) in rabbits stunned with gas followed by those of rabbits stunned mechanically, while they were least ($P<0.05$) in rabbits stunned electrically. Dressed weight, dressing percentage, chilled carcass weight and chilling loss were higher ($P<0.05$) in rabbits carcasses stunned electrically, followed by those of rabbits carcasses that were not stunned (control) and least ($P<0.05$) in the carcasses of rabbit that were stunned with gas.

The results showed that gas stunning encouraged high blood drain from the rabbit carcasses, hence lower dressed weight and dressing percentage. In the same vein, lower percentage chilling loss was observed in rabbit carcasses stunned with gas probably much fluid would have been lost with blood during bleeding. In contrast low blood loss was observed in rabbit carcasses stunned electrically which could have encouraged higher, dressed weight dressing percentage, as well as high percentage chilling loss probably due to the fact that more fluid and blood were retained in the carcasses which might have added to their weights.

Visual colour score was higher ($P<0.05$) in rabbit meat stunned with gas with 7.20±0.07 (Table 2), followed by those of rabbits stunned mechanically (6.25±0.09) and least ($P<0.05$) in rabbit meat stunned electrically (4.20±0.09). Since blood loss was high in rabbit stunned with gas, less blood might have been therefore, retained in the muscles and there could be little or no blood stain of the meat hence it high visual appeal as against the meat of rabbits that were stunned electrically with high blood stained muscles. This result was in line with the report of Maria *et al*. (2000). Cooking loss, thermal shortening and drip loss were lower ($P<0.05$) in meat from rabbits stunned with gas, while they were higher ($P<0.05$) in meat from rabbits stunned electrically, whereas cooking yield values were higher ($P<0.05$) in meat from rabbits stunned with gas and lower ($P<0.05$) in meat from rabbits stunned electrically. The shear force values were higher ($P<0.05$) in meat from rabbits in treatment 1 while they were lower ($P<0.05$) in meat from

Table 1: Carcass characteristics of differently stunned rabbits

Treatments Variable	1	2	3	4
Live weight (g)	1350.00±0.06	1370.00±0.03	1360.00±0.03	1380.00±0.02
Bled weight (g)	1310.00±0.05	1350.00±0.02	1280.00±0.05	1330.00±0.03
Blood loss (g)	40.00±0.75^{c}	20.00±1.07^{d}	80.00±0.32^{a}	50.00±0.56^{b}
Blood loss (%)	2.56±0.20^{c}	1.46±0.26^{d}	5.88±0.08^{a}	3.62±0.10^{b}
Dressed weight (g)	690.00±2.59^{b}	790.00±1.73^{a}	580.00±2.83^{d}	620.00±1.97^{c}
Dressing (%)	51.11±0.06^{b}	57.66±0.04^{a}	42.65±0.15^{d}	48.55±0.14^{c}
Chilled carcass weight (g)	675.00±0.12^{b}	760.00±0.11^{a}	578.00±0.18^{c}	660.00±0.13^{b}
Chilling loss (%)	2.17±1.08^{b}	3.80±0.61^{a}	0.35±1.87^{d}	1.49±1.26^{c}

abc: Means on the same row with different superscripts are statistically significant (P<0.05)

Table 2: Physical properties of differently stunned rabbit meat

Treatments Variable	1	2	3	4
Visual colour	5.30±0.09^{c}	4.20±0.09^{d}	7.20±0.07^{a}	6.25±0.09^{b}
Cooking loss (%)	35.75±1.55^{b}	36.81±1.20^{a}	32.04±1.71^{d}	34.25±1.88^{c}
Thermal shortening (%)	40.84±6.58^{b}	43.89±3.29^{a}	35.09±3.44^{d}	38.30±5.36^{c}
Cooking yield (%)	64.55±1.71^{c}	63.19±1.88^{d}	67.96±1.20^{a}	65.75±1.46^{b}
Water Holding Capacity (%)	50.20±0.05^{c}	60.80±0.01^{b}	62.37±0.03^{a}	60.45±0.05^{b}
Drip loss (%)	1.30±0.07^{b}	2.47±0.07^{a}	0.80±0.11^{c}	1.23±0.08^{b}
Shear force kg/cm^{3}	3.45±0.05^{b}	2.20±0.05^{b}	2.05±0.07^{b}	2.25±006^{b}

abc: Means on the same row with different superscripts are statistically significant (P<0.05)

Table 3: Proximate composition and pH of differently stunned rabbit meat

Treatments Variable	1	2	3	4
Moisture (%)	65.13±0.05^{c}	70.43±0.02^{a}	60.80±0.09^{d}	67.48±0.05^{b}
Crude Protein (%)	22.25±0.12^{b}	22.20±0.09^{b}	23.50±0.02^{a}	22.35±0.07^{b}
Fat (%)	2.80±0.05	2.63±0.07	2.45±0.03	2.65±0.03
Ash (%)	1.33±0.00	1.30±0.02	1.25±0.05	1.23±0.03
Nitrogen Free Extract (%)	8.49±0.07^{c}	3.44±0.07^{c}	12.00±0.03^{a}	6.29±0.04^{b}
pH	5.85±0.05^{ab}	6.20±0.05^{a}	5.20±0.07^{b}	6.15±0.07^{b}

abc: Means in the same row with different superscripts are statistically significant (P<0.05)

rabbits in treatment 2, 3, and 4 respectively. These results could be due to the fact that WHC was high in pre-rigor muscle of rabbits stunned electrically because of high pH in the meat water could escape in form of drip and cooking losses. Though pH was low in meat from rabbits stunned with gas still the meat was able to retain its water contents from escaping due to the fact that less water was lost in form of drip and cooking loss which culminated in low Warner Bratzler value.

Table 3 shows the results of proximate composition and the pH of differently stunned rabbits. Treatments 1 and 2 gave higher (P<0.05) moisture content to rabbit meat, followed by treatment 4 while treatment 3 gave the least (P<0.05) moisture. The high moisture content observed in treatment 2 could have contributed to high cooking and drip losses observed in the meat from rabbits in this group. However, meat from rabbits stunned with gas had higher (P<0.05) protein and Nitrogen Free Extract (NFE) values as well as lower (P<0.05) pH. Moisture and protein contents of meat are inversely

Table 4: Sensory scores of differently stunned rabbit meat

Treatments				
Variable	1	2	3	4
Colour	3.50±0.04[c]	2. 03±0.05[d]	5.35±0.03[a]	4.13±0.04[b]
Flavour	4.18±0.05[c]	3.13±0.08[d]	6.83±0.01[a]	5.20±0.03[b]
Tenderness	3.23±0.06[d]	5.30±0.03[b]	6.35±0.11[a]	4.26±0.08[c]
Juiciness	3.30±0.07[d]	4.20±0.05[c]	6.53±0.08[a]	5.3±0.06[b]
Texture	4.60±0.04[c]	3.43±0.07[d]	6.58±0.05[a]	5.40±0.05[b]
Overall acceptability	4.65±0.05[c]	3.50±0.10[d]	6.70±0.04[a]	5.52±0.06[b]

abc: Means in the same row with different superscripts are statistically significant (P<0.05)
Sensory variables were rated on a 9-point hedonic scale where 1 = dislike extremely and 9= like extremely.

related (Aduku and Olukosi, 2000) since protein concentration increases as moisture content decreases. High NFE in meat of rabbits in group 3 could be due to the fact that the onset of glycolysis was delayed in the rabbits carcasses, but could have started earlier in rabbits carcasses in groups 1 and 2 thereby depleting the glycogen reserves quickly than in rabbits in group 3 whose carcasses might have attained lower pH within a shortest possible period of time pre-rigor as observed in this study. There were no significant (P>0.05) differences in the fat and ash contents of meat from rabbits across the treatments.

All palatability traits scores were higher (P<0.05) in meat from rabbits stunned with gas (Table 4), compared with the traits of meat from other treatments. High palatability attributes from meat of rabbit in treatment 3 could have been responsible for its high (P<0.05) overall acceptability. It had been reported (Boles and Pegg 1998; Dinh and Nhat, 2006) that colour of meat is the major attribute that gives the first impression that consumers have about meat and influences their selection of meat followed by flavour and texture of the meat. The results of sensory characteristics of rabbit meat obtained in treatment 3 could be attributed to low cooking drip losses, thermal shortening shear force, moisture as well as due to high blood loss, WHC, pH and protein, due to favourable biochemical reactions in the rabbit carcasses stunned with gas.

CONCLUSION

Stunning is important in slaughtering operation prior to bleeding in order to immobilize animals as well as render them insensible to pain or stress, however, it can have profound effect on meat quality. Carcass and meat characteristics of differently stunned rabbits were comparatively better in rabbits stunned with gas (di-ethylether). Although, the use of gas for stunning food animals is under review on the ground of animal welfare, however, gas stunning conferred favourable attributes on both carcass and meat of rabbits in this study. It is therefore, preferred to other stunning methods due to the fact that it furnished high meat quality attributes measured in this study and that meat from rabbits stunned with gas may keep longer than meat from other treatments due to high blood loss from the carcasses, low moisture and pH of the meat.

REFERENCES

Aduku AO, Olukosi JO (1990). Rabbit Management in the Tropics. Living Book Series. G.U. Publication Abuja, Nigeria. Pp 2 -5.
Aduku AO, Olukosi JO (2000). Animal Products Processing and Handling in the Tropics. Living Books Series. GU Publication, Abuja, Nigeria Pp 24 – 32.
AMSA (1991). Guidelines for meat evaluation. American Meat Science Association Committee on Guidelines for meat evaluation. Proceedings of the reciprocal meat conference vol. 44.
AMSA (1995). Research Guidelines for Cookery, Sensory Evaluation and Instrumental Measurement of Fresh Meat. National Livestock and Meat Board. Chicago IL, U.S.A.
AOAC (2000). Official Methods of Analysis, 19th Edition AOAC Inter. Inc. Washington, DC Pp 1219.
Barbut S (2000). Problems of Pale, Soft, Exudative meat in broiler chickens. Br. Poult. Sci. 38: 355 – 368.
Boles JA, Pegg R (1998). Meat colour: Montana State University and Saskatchewan Food Product Innovation Programme. University of Saskatchewan USA Pp 10–4.
Dal Bosco A, Castellini C, Bernardini M (1997). Effect of Transportation and Stunning Method on Some Characteristics of rabbit carcasses and meat World Rabbit Sci. 5:115–119.
Dallezotte A (2002). Perception of rabbit meat quality and major factors influencing the rabbit carcass and meat quality. Livestock Prod. Sci. 75: 11 – 32.
Dinh T, Nhat T (2006). Meat quality: Understanding of meat tenderness and influence of fat content on meat flavour. Sci and Tech. Devpt. 9(12): 65-70.
Facco–Silveria ETN, Silviera FA, Beraquet NJ (1998). The influence of stunning techniques on some quality aspects of pig meat. Proceedings of the Inter. Congress of Meat Science and Technology (Barcelona Spain) 44: 1072–1073.
Grandin T (1980). Mechanical, Electrical and Anesthetic Stunning Methods for Livestock. Int. J. Study Anim. Probs. 1: 242–263.
Grandin T (1980b). The effect of stress on livestock and meat quality prior to and during slaughter. Int. J. Study Anim. Probs. 1: 313–337.
Honikel JL (1998). Reference Methods for the Assessment of Physical Characteristics of Meat. Meat Sci. 49: 441 – 457.
Insausti K, Beriain MJ, Purroy A, Alberti P, Gorraiz C, Alzueta MJ (2001). Shelf-life of beef from local Spanish Cattle breeds under modified atmosphere. Meat Sci. 57: 273–281.

Manteca X (1998). Neurophysiology and Assessment of Welfare. Proc. Inter. Congress of Meat Science and Technology (Barcelona, Spain) 44: 146–153.
Marchiori AF, deFelicio PE (2003). Quality of Wild boar meat and Commercial Pork. Sci Agric. (Piracicaba, Braz) 60(1): 1–10.
Maria G, Lopez R, Lafuente ML (2000). Evaluation of electrical stunning method using alternative frequencies in commercial rabbits. Meat Sci. 57: 137 – 143.
Mulder RW (1999). Hygiene during transport, slaughter and processing. In: Poultry Meat Science (Edit. Richardson R. I, Mead, G.C.) CAB, Publishing Pp. 227–284.
Okubanjo AO (1997). Meat Characteristics of Singed and Conventionally dressed chevon carcasses J. Food Sci. Technol. 34(6): 494–497.
Omojola AB (2007). Effect of delayed bleeding on carcass and eating qualities of rabbit meat Pak. J. Nutri. 6(5): 438 – 442.
Omojola AB, Adesehinwa AOK (2006). Meat Characteristics of Scalded, Singed and Conventionally dressed rabbit carcasses World J. Zool. 1(1): 24–29.
Sams AR (1999). Commercial Implementation of Post-Mortem Electrical Stimulation. Poultry Sci. 78:290 – 294.
SAS (2002) Statistical Analysis System. SAS Stat. Version 9 SAS Institute Inc. Garry, NC, U.S.A.
Sukuki A, Kaina N, Ikeuchi Y (1991). Carcass composition and meat quality of Chinese pure bred and European X Chinese Cross bred pigs. Meat Sci. 29: 31–41.