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Effects of Antibiotic Residue on the Physical Qualities of Beef in Oyo State, Nigeria

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Abstract. A study was conducted to assess the effect of antibiotic residues on physical qualities of beef sold for human consumption in Oyo State – South west Nigeria. Twenty four beef samples were randomly collected from 4 agricultural zones in the state. The samples were analyzed using microbiological assay technique using Bacillus substilis for the detection of the residues of antibiotics. Cooking loss was expressed as percentage change in weight during cooking, while water holding capacity (WHC) of the meat was determined by the filter press method. The study revealed that 11 (46.00%) samples were positive for antibiotic residue detection. The presence of this residue significantly ($p< 0.05$) influenced cooking loss and WHC of the beef. No significant ($p> 0.05$) difference was observed in shear force of the samples. This result has shown that consumers are not only predisposed to health hazards due to the presence of the residues but qualities attributes of the meat are also hampered. This may hinder international meat trade from Nigeria necessitating regulatory authorities to ensure compliance with instructions on drugs usage and establishment of routine drug residues surveillance program in the country.

Keywords: Antibiotic residues, Physical properties, Beef

1. Introduction

The use of antimicrobials in animal agriculture is important for maintaining and improving animal health and welfare through disease prevention and treatment, and arguably for increasing carcass quality, as well as for enhancing the economic efficiency of growth and production. However, the volume of antimicrobials used in food animal production has led to concerns in the public, regulatory, and scientific arenas that antimicrobial use in food animals is contributing to the antimicrobial resistance problem by creating a reservoir of resistant bacteria (Bailar and Travers, 2002 and O'Connor, *et al.,* 2002) constituting health risks to the consumers.

Muhammad *et al.* (1997) and CFIA, (2004) have enumerated several factors leading to the occurrence of antibiotic residues in animal products: which include, failure to observe drug withdrawal period, poor records of treatment, failure to identify treated animals, lack of advice on withdrawal periods, off-label use of antibiotics, availability of antibiotics to lay persons as over-the counter drugs in the developing countries, extended usage or excessive dosages of antibiotics, non-existence of restrictive legislation or their inadequate enforcement and lack of consumer awareness about the magnitude and human health hazards associated with antibiotic residues in the food of animal origin. The most important of these factors, from the tissue residue's

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point of view, is strict adherence to the prescribed withdrawal period of the drug before the animal is sent to market for human consumption.

In Nigeria, like most other developing countries antibiotics are used in animals indiscriminately for the prevention and treatment of bacterial infection (Olatoye and Ehinnowo, 2009). A greater proportion of cattle in Nigeria are reared by the nomadic herdsmen who administer chemotherapeutic agents without veterinary prescription (Alhaji 1976). When such laymen use these drugs, correct dosage are unlikely to be administered and the withdrawal periods are usually not observed.

Meat quality evaluation is important in improving meat production and is the measure of carcass palatability and acceptability to the consumer demand (Renand and Fisher, 1997). In view of this, monitoring of residues of these antimicrobial drugs and its effects on animal products meant for human consumption is highly desirable which has necessitated this study. The study is aimed at evaluating the effect of antibiotic residue on the physical properties of bee in Oyo state, Nigeria.

2. Materials and Methods

Twenty four beef samples were bought at different slaughter slabs at the 4 agricultural zones in Oyo State, Nigeria for antibiotics detection and analysis. The agricultural zones are as follow; Oyo, Saki, Ogbomoso and Ibadan- Ibarapa. Two samples each from 3 markets were however chosen from each zone given 6 samples per zone. Microbiological assay was used in this study, specifically Agar diffusion method, which involved the use of Bacillus subtilis for the zone of bacterial growth inhibition.

2.1. Water Holding Capacity

Water holding capacity (WHC) of the meat was determined by the filter press method developed by Grau and Hamm (1957). Intact meat sample (1 cm x 1 cm x 0.5cm) meat portions from the primal cuts of the treatment samples slaughtered were weighed, placed between equal sized filter paper and pressed between two plexi glass using a vice for a minute. The amount of water released from the sample was measured as the area of the filter paper wetted by pressing, relative to the area of pressed sample using a compensatory planimeter.

$$WHC = \frac{100-(Ar-Am)\ X\ 9.49}{Wm \times Mo} \times 100$$

Where, Ar = Area of water released from meat (cm2)

Am = Area of meat sample (cm2),

Wm = weight of meat sample (mg)

Mo = Moisture content of the meat (%), and

'9.49' is a constant.

2.2. Cooking Loss

Cooking loss was determined using the method described by Mahendraker *et al.*, (1988). All the primal cuts from 2 samples within each slaughter weight were individually placed in a heat resistant polythene bag, immersed in already boiling water and allowed to boil for 20 minutes using electric stove. The weight and length of each sample was recorded prior to cooking, the bags were taken out and muscles were allowed to cool to room temperature. The meat length and weight changes due to cooking were the thermal shortening and cooking loss respectively.

2.3. Shear Force Determination

Warner Brazter shear force (WBSF) determination was performed on the boiled meat samples using the modified Warner Brazter Shear Force procedure (Bouton and Harris, 1978). Three cores (1 cm2 in diameter) were removed using an electrical coring machine. Each core was sheared at three locations parallel to the orientation of muscle fiber

2.4. Data Analysis

Data collected were analyzed with descriptive analysis and student t-test using SPSS (2006).

3. Results and Discussion

As shown in this study (Table 1) antibiotic residue was found in 46.00% of the beef samples collected across the different agricultural zones of the state. This was in line with Dipeolu et al., (2000) and Dipeolu and Ayinde, (2001) who reported the presence of antibiotics in commercial eggs, turkey meat and market pork in Nigeria. This could be an indication of higher dosage of administered drugs, non- compliance with withdrawal periods and incomplete metabolism and excretion of this antibiotic before the animals were slaughtered as mentioned by Muhammad et al., (1997). Moreover cattle rearing in Nigeria are done by the nomadic herdsmen who have access to veterinary drug and always purchase drug over the counter for administration to their animal without veterinary prescription and supervision and this have led to the values reported for the antibiotic residues (Olatoye and Ehinnowo, 2009).

Higher ($p<0.05$) cooking loss and lower ($p<0.05$) water holding capacity as revealed for the positive samples (Table 2) gives an expectation of a loss and is of a great economic importance to the meat industry. Water holding capacity (WHC) is the ability of any meat to retain its water content during application of external force such as cutting, heating, grinding or pressing (Omojola and Adesehinwa, 2006). It largely determines many of the physical properties of meat such as appearance (colour), texture and juiciness of raw meat and tenderness vis- a- vis the shear force and overall acceptability of cooked meat (Omojola and Adesehinwa, 2006). Cooking loss refers to evaporative or drip losses when meat is cooked. This is due to protein denatureration and lowering of the WHC which leads to loss of juices and eventual loss in weight or shrinkage. Lower WHC and higher cooking loss indicate losses in the nutritive value through exudates that are released and result in drier and tougher meat (Dabes 2001) it is of interest because it is expected to explain part of the variation in juiciness of meat (Fakolade, 2009). Muscle with higher shear force will have longer cooking time although no difference was shown here. The need for information on meat quality is important as to maintain high level of demand by consumer. Coata *et al.,* (2007) have however reported higher cooking loss with higher shear force with muscle of birds treated with tylosin at both sub-therapeutic and therapeutic.

In conclusion, the safety of most of the beef sold for consumption in the state is doubtful because of the presence of the antibiotic residues. The consequences are enormous because of the health hazard associated with it. The quality parameters of the meat (beef) were not spared as the presence of residues has resulted in shrinkage and toughing of meat when cooked.

Table 1: Presence of antibiotics residues in meat samples in Oyo state, Nigeria.

	Frequency	Percentage
Positive	11	46.00
Negative	13	54.00
Total	24	100.00

Table 2: Effect of antibiotic residues on physical properties of beef samples in Oyo state, Nigeria

Treatment		
Cooking loss (%)	Positive	$37.23^{a} \pm 0.89$
	Negative	$35.41^{b} \pm 0.40$
WHC (%)	Positive	$62.70^{b} \pm 0.72$
	Negative	$64.57^{a} \pm 0.69$
Shear force (kg/cm^3)	Positive	5.82 ± 0.83
	Negative	5.81 ± 0.56

a,b. Mean along the same row with different superscripts are significantly different ($P<0.05$).

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