APR -02

Effects of Plantain Peels and Oil Palm Bunch Ash Treatment on the Physicochemical Quality of Beef

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Abstract
The aim of this study was to determine the physicochemical characteristics of beef treated with plantain peel ash and palm fruit bunch ash. The palm fruit bunch and plantain peels were processed into ashes as palm bunch ash (PBA) and plantain peel ash (PPA). Thereafter, the ashes were prepared into solutions by dissolving 500 g of PBA or PPA in 1 liter of clean tap water and filtered. About 1.3 kg lean beef sample was purchased from the abattoir, divided into seven equal parts of 186 g each and used for the ash treatment. The meat samples were treated in 200 ml of the PBA or PPA solutions across four treatments methods in which the first was boiled in 200 ml of clean tap water for 30 minutes and served as control (T1). The second was soaked in ash solution for 30 minutes, removed and boiled for 30 minutes in water (T2), while the third was soaked in ash solution for 30 minutes and boiled in the same ash solution for another 30 minutes (T3). The forth sample was boiled in ash solution for 30 minutes without prior soaking (T4). The samples were thereafter analyzed for their physiochemical characteristics. The ash solution treatment resulted in increased bulk density (BD), Total solid (TS), Ph and swelling capacity (SW) but reduced Oil absorption capacity (OAC), wettability and colour intensity of the treated beef samples, with PBA treatment resulting in greater effects on these parameters than PPA treatment. Ash solutions may serve as enhancement solutions for beef preparation in the meat industry.

Keywords: Palm fruit bunch, plantain peels, ash, beef, ash solution

Introduction

Over the years, several techniques and processes have been researched and applied in search of a solution to the problem of meat-quality variation and in particular tenderness. These include electrical stimulation (Simmons *et al.,* 2008), carcass suspension (Sorheim and Hildrum, 2002) and muscle stretching (Toohey *et al.,* 2012), blade tenderization (Pietrasik and Shand, 2011), marination (Scanga *et al.,* 2000), and explosion (Solomon *et al.,* 1997). Meat-enhancing agents such as phosphates and salts have been investigated and their successes have been documented (Holmer *et al.,* 2009). Phosphates are typical components of enhancement solutions in the modern beef industry, because of their ability to increase the functionality of meat products, particularly via water binding (Trout and Schmidt, 1983).

Ash is the inorganic incombustible part of biomass left after complete combustion, and contains the bulk of the mineral fraction of the original biomass (Nwogu *et al.,* 2012). The physical and chemical properties of ash vary significantly; depending on many factors (Nwogu *et al*., 2012).Wood ash is an economical and readily available source of alkaline material, which has been used successfully to improve the digestibility of wheat straw by ruminants (Nolte *et al*., 1987). Phosphates and sodium or potassium chloride have been reported to increase meat functionality via protein swelling and ionic strength and pH(TroutandSchmidt,1983).This increased functionality leads to increased water retention and improved tenderness and juiciness (Prestat *et al.,* 2002). Therefore, the salts and phosphates left as ash after the combustion of plant biomass may improve the yield and palatability characteristics and affects the colour and shelf-life of meat treated with such ash. The aim of this study was to determine the physicochemical characteristics of beef treated with plantain peel ash and palm fruit bunch ash.

Materials and Methods

The peels of the unripe plantain and the palm fruit bunch were collected Owerri and environ in Imo state and washed thoroughly with tap water in order to remove sand and other impurities before sun drying for two weeks. The dried plantain peel and palm fruit bunch were thereafter burnt to ashes in locally made oven according to the method described by Nwogu *et al*. (2012). This procedure simulated the method of producing edible ash by Igbos at the study location. The ashes were packaged in cellophane bags to avoid water absorption since such ash has been shown to be hydroscopic (Nwogu *et al*., 2012).

The beef used for the experiments was purchased very early in the morning directly from the abattoir. On arrival to the laboratory, 1.3 kg of fresh beef sample was cut out and washed thoroughly with clean tap water and divided into seven equal parts of 186g each. Each of these beef samples was placed on a clean chop board on a laboratory table and sliced into several pieces off at shapes. This was done to allow the ash solution to properly penetrate the cuts during the ash treatment. Five hundred (500) gram of ash (PBA or PPA) was introduced into separate beakers containing 1liters of clean tap water and were thoroughly mixed and allowed to dissolve and settle for 10 minutes. The solution was filtered through a clean filter cloth and the filtrate termed the ash solutions and used to treat the prepared beef samples.

The ash solutions were used to treat the prepared beef samples.Treatment T1 (control), was boiled in 200 ml of water for 30 minutes. (Treatment T2, was soaked in alkaline solution (PBA or PPA) for 30 minutes and thereafter boiled in 200ml of water for 30 minutes. Treatment T3 was soaked in alkaline solution for 30 minutes and boiled in the same solution for another 30 minutes; whereas Treatment T4 was boiled in alkaline solution (PBA or PBA) for 30 minutes without prior soaking. After treating with ash solutions, the beef samples were removed from the ash solutions and placed on flat ceramic plates and were thereafter evaluated for their physicochemical characteristics such as bulk density (BD),total solid (TS),oil absorption capacity (OAC), wettability (WT), swelling capacity (SC) and colour intensity (CI) according to the methods of AOAC (2010). Data generated from the experiments were subjected to descriptive statistics such as means and calculations of percentage differences from control values.

Results and Discussion

Results of different physical characteristics of beef treated with PBA and PPA and their percentage differences from the control values are shown in tables 1 and 2 respectively. Generally ash treatment resulted in increase in the bulk density (BD) and total solid (TS) values of the treated beef. This improvement in total solids of treated beef may have also translated to the observed increases in the BD of the treated beef.There was higher percentage reduction in oil absorption capacity (OAC) of PBA treated beef than the PPA groups across all treatment groups, although the OAC of PBA treated beef was less than that of PPA by a difference of 38.89%. This substantial reduction in OAC of treated beef may be a positive attribute of such meat products, especially since it may confer on such products the ability to cook in oil without absorbing much of the cooking oil. This may also lead to the achievement of longer cooking time needed to tenderize such meat.

Table 1: Physicochemical characteristics of beef treated with PBA

Parameter	T_1(Control)	T_2	T_3	T_4	Range
Bulk density	0.74	0.91 (22.97)	1.19 (60.84)	1.04 (40.54)	0.74 – 1.19
Total solid	53.85	74.26 (37.90)	70.00 (29.99)	65.05 (20.80)	53.85 – 74.26
Oil absorption capacity	110.28	59.05 (-46.41)	35.78 (-67.56)	31.78 (-71.18)	31.78 -110.28
Wettability	3.00	0.00 (-100.00)	0.00 (-100.00)	0.00 (-100.00)	0.00 -3.00
Colour intensity	0.64	0.24 (-62.50)	0.41 (-35.94)	2.34 (265.63)	0.24 – 2.34
Swelling capacity	139.58	365.97(162.19)	329.87 (136.33)	223.74 (60.30)	139.58 – 65.97
Ph	6.30	9.90 (57.14)	10.10 (60.32)	8.60 (36.51)	6.30 – 10.10

( ) = Percentage differences from the control value

Table 2: Physicochemical characteristics of beef treated with PPA

Parameter	T_1(Control)	T_2	T_3	T_4	Range
Bulk density(g/ml)	0.74	1.01 (36.49)	0.85 (14.82)	1.03 (39.19)	0.74 – 1.03
Total solid (%)	53.85	74.04 (37.49)	61.39 (14.00)	65.69 (21.99)	53.85 – 74.04
Oil absorption Capacity	110.28	66.36 (-39.83)	46.79 (-57.57)	40.00 (-63.73)	40.00 -110.28
Wettability(sec)	3.00	0.00 (-100.00)	0.00 (-100.00)	0.00 (-100.00)	0.00 -3.00
Colour intensity	0.64	2.13(232.81)	0.24(-60.94)	0.17(-73.44)	0.17 – 2.13
Swelling capacity	139.58	305.60(118.94)	277.78(99.01)	210.70 (50.95)	139.58 – 305.60
Ph	6.30	8.90 (41.27)	10.20 (61.90)	10.10 (60.32)	6.30 – 10.20

( ) -Percentage differences from the control values

The present results on wettability showed total reduction in the wettability characteristics of beef which was3.0secondsinthe untreated (control) group. This increase in wettability implies that the ash treatment destroyed existing surface tension on the treated beef, thereby causing unhindered water absorption or binding of water molecules by the meat tissues. The ability to produce value–added and water-added beef has created a growing market opportunity in the beef industry (Scanga *et al*., 2000). Presta *et al*. (2002) stated that salt and phosphate improves the colour of beef contrary to the findings of this study that colour intensity of treated beef was drastically reduced at the T3 and T4 of PBA treatment but significantly enhanced at the T2 of PPA and T4 of PBA treatment. The swelling capacity of the treated meat increased from the control meat to that recorded in T2 of PBA treated meat and PPA treated meat. The present result is attributed to the fact that minerals in the ashes improved the ability of the meat to bind water (Boleman *et al*., 1995). Values ranged from the slightly acidic pH in control beef to the alkaline values in T3 of PBA and PPA treated beef. Poulanne *et al*. (2001) stated that when the alkalinity of meat is increased with alkalinizing agents, the WHC of the treated meat is also improved. Such an agent usually aids the salt induced solubilization of myosin and augments water binding by increasing the pH (Young *et al*., 2005).

Conclusion

This study showed that ash solution treatment of beef resulted in increased bulk density, total solid, swelling capacity, wet ability and pH but reduced oil absorption capacity and colour intensity. PBA treatment resulted in greater effects in these parameters than PPA treatment. Ash solutions may serve as enhancement solutions for beef preparation in the meat industry.

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