Bots. J. Agric. Appl. Sci (2012) 8 (Issue 2) 118-121

BOJAAS

SHORT COMMUNICATION

Effects of substituting rice flour as fillers for wheat flour at varying levels in beef sausage production

Sanwo, K. A., Makanju, M. O., Iposu, S. O*. and Adegbite, J. A.
Department of Animal Production & Health, University of Agriculture, Abeokuta, PMB 2240 Abeokuta, Ogun State, Nigeria

SKA, conceived idea, designed study, collected data & analysis; MMO, collected data & analysis; ISO, design study, statistical analysis, preparation of manuscript; AJA, laboratory analysis

ABSTRACT

To derive optimum benefits from agricultural products is to add value to these products. In the meat industry, sausage making is a well known process of adding value to what could otherwise be considered low quality meats and wheat flour is a commonly used ingredient. In the present study the effects of substituting wheat flour with rice flour in beef sausage was evaluated. Proportions of rice flour in each of the five batches of beef sausage mixture were as follows: Control (Batch 1; 0% rice); Batch 2 (5% rice); Batch 3 (10% rice); Batch 4 (15% rice); Batch 5 (20% rice). Cooking and refrigerated weight losses, nutrient composition and sensory characteristics of the sausages were determined. Data were subjected to one-way analysis of variance in a completely randomized design. Treatment effect ($P < 0.05$) was observed for percentage cooking weight loss and was lowest (1%) in Batch 5 and highest (2%) in the Control. There was difference ($P < 0.05$) in percentage refrigeration weight loss and was found to be highest (5.8%) in Control and lowest (3.2%) in Batch 4. All parameters of sensory evaluation were significantly ($P < 0.05$) different between batches except for saltiness and overall flavour. Batch 4 was most preferred for colour. Tenderness decreased as the level of rice inclusion increased. Batch 4 had the highest score for overall acceptability when compared with the Control of which panellists were indifferent about its acceptability. Proximate composition of the sausages showed that Batch 5 had the highest crude protein, ash and ether extract of 12.4, 4.2 and 2.4 %, respectively. Therefore, beef sausages can be produced using rice flour as flour replacement at 15% inclusion as this favours the product's resistance to diffusion, thus maintaining storage stability. However 20% inclusion favours enhanced nutrient composition.

Keywords Beef sausage, Fillers, Rice flour, Wheat flour, Value adding

*Corresponding author. E-mail: iposuepe@gmail.com ; Tel.: +2347038707226

Publisher: Botswana College of Agriculture, Gaborone, Botswana

INTRODUCTION

There is a wide range of non-meat products that are incorporated into sausages, within the guidelines allowed under the United States Department of Agriculture (USDA) Meat Inspection Regulation. These products, variously called binders, fillers or extenders, include cereals flour, soy products, and eggs. Binders absorb large amount of water causing the ground meat particles to adhere to each other. Although wheat is the conventional flour used as filler in sausage production (Belderok *et al.,* 2000), in order to reduce the formulation cost, Ranken and Kill (1993) suggested that there are various other materials that have good water holding or meat binding properties that can be used, especially cereals such as rice and corn. Substituting the well-known wheat flour with locally available cereal crops would be beneficial for the economics of these crops, especially if wheat is imported or is expensive to use. Therefore, before these locally available cereals can be incorporated into the sausage production there is a need to investigate their relevance to the local consumers' culture and preferences, impact to product quality and cost implications to manufacturers. Thus, this study investigated the effect of using rice flours, an unconventional, less expensive, and locally available resource, as a substitute for wheat flour in beef sausage.

MATERIALS AND METHODS

The experiment was carried out at the Meat Processing Laboratory of the Department of Animal Production and Health, University of Agriculture, Abeokuta, Nigeria. The equipment used was a Kenwood Multipurpose Meat Processing Machine.

Preparation of Beef Sausage

Five batches of beef sausages (1kg *per* batch) were prepared using lean beef from the hind legs of fresh cattle carcasses. Each treatment sample (500g of meat) was run through a 5mm plate in the Kenwood (Hampshire, UK) mincing machine. A combination of vegetable oil, seasoning, water and flour were added according to Table 1 to make up 1kg of each beef sausage batch as follows: Batch 1; 0% rice flour and 20% wheat flour, Batch 2; 5% rice flour and 15% wheat flour; Batch 3; 10% rice flour and 10% wheat flour; Batch 4; 15% rice flour and 5% wheat flour; Batch 5; 20% rice flour and 0% wheat flour inclusions, respectively.

Table 1. Recipe for beef sausage production

Ingredients (%)	Batches				
	1 (Control)	2	3	4	5
Meat	60	60	60	60	60
Wheat flour	20	15	10	5	0
Rice flour	0	5	10	15	20
Vegetable oil	6	6	6	6	6
Seasoning	2	2	2	2	2
Water	12	12	12	12	12
Total	100	100	100	100	100

Determination of Cooking Loss of Beef Sausage

Three replicates of each treatment were cooked in a water bath for 20 minutes at 70^0C and the losses were determined as follows:

Cooking loss (g) = Weight before cooking – Weight after cooking

Cooking loss (%) = (Weight before cooking – Weight after cooking × 100)/Weight before cooking

Determination of Refrigeration Loss of Beef Sausage

The sausages prepared were weighed before and after refrigeration for 24 hours and the weight losses were determined as follows:

Refrigeration loss (g) = weight before refrigeration – weight after refrigeration

Refrigeration loss (%) = (weight before refrigeration – weight after refrigeration × 100)/Weight before refrigeration

Sensory Evaluation

Sensory evaluation of samples of cooked beef sausage was carried out using ten trained panelists. Sensory qualities evaluated were colour, juiciness, flavour, tenderness, saltiness, overall flavour and overall acceptability. Bite size portions of 10g each were served at room temperature to ten trained panelists who awarded scores using a 9-point Hedonic scale of (1 = Dislike extremely, 2 = Dislike very much, 3 = Dislike moderately, 4 = Dislike slightly, 5 = Intermediate, 6 = Like slightly, 7 = Like moderately, 8 = Like very much, 9 = Like extremely; Resurreccion 2003)

.

Statistical analysis

All data obtained were subjected to one-way analysis of variance using SAS (2000) while differences between means were determined by Duncan Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSIONS

Chemical analysis of rice flour showed (on dry matter basis) that it has crude protein, crude fibre, ether extract, and carbohydrate and ash concentrations of 7.48, 0.12, 0.14, 92.0 and 0.30 % respectively. Table 2 shows significant effect ($P < 0.05$) of substituting rice flour for wheat flour in which the cooking weight loss of sausage is reduced at higher inclusion level of rice flour. Observed cooking weight loss in the present study was generally low (1 to 2%). This according to Gerrard (1976) indicate good quality sausage as fresh sausage produced with good ingredients and satisfactory production techniques results in cooking weight loss of less than 10%. The lowest cooking weight loss was recorded in Batch 5 sausages, with a value of 1% while the Control had the highest percentage cooking weight loss of 2%. This discrepancy between the Control and Batch 5 sausages can not be readily explained, besides to speculate that may be high moisture content as shown in Table 5 was responsible for this observation. Higher moisture content would evidently lead to higher weight loss. Significant ($P < 0.05$) weight losses were also observed for sausages refrigerated at 4^0C as shown in Table 3. Batch 1 sausages had the highest percentage refrigerated weight loss of 5.76% while lowest value of 3.20% was recorded for sausages from Batch 4.

All parameters evaluated for sensory characteristics were significantly ($P < 0.05$) affected by rice flour inclusion except for saltiness and overall flavour (Table 4). Although Batch 4 had the highest score for colour (6.82) and overall acceptability (6.58), juiciness and flavour were scored highest in Batch 2 at 7.07 and 6.89, respectively

Table 2. The effect of substituting rice flour for wheat flour at varying levels on cooking weight loss of beef sausage

Batch	Initial Weight (g)	Final Weight (g)	Weight Loss (g)	Weight Loss (%)
1	25.73^{c}	25.21^{c}	0.52^{b}	2.00^{a}
2	28.52^{bc}	28.05^{bc}	0.47^{ab}	1.65^{ab}
3	36.06^{a}	35.54^{a}	0.52^{a}	1.44^{abc}
4	31.13^{b}	30.74^{b}	0.39^{a}	1.27^{bc}
5	30.36^{b}	30.06^{b}	0.31^{ab}	1.00^{c}
±SEM	1.01	1.01	0.03	0.11

$^{a, b, c}$ means along the same column with different superscripts are significantly different (P < 0.05). SEM = Standard Error of Means

Tenderness decreased as the level of rice inclusion increased. Overall acceptability for cooked beef sausages increased as inclusion levels of rice increased. Contributing factors could be lower cooking and refrigerated losses observed as inclusion levels of rice increases in prepared sausages.Proximate composition of beef sausage (Table 5) showed that Batch 5 had the highest crude protein, ash and ether extract content values of 12.4, 4.2 and 2.4 %, respectively, and these could have resulted in the better quality sausage at higher inclusion of rice flour as explained earlier.

CONCLUSIONS AND RECCOMENDATIONS

From the results obtained, if refrigeration weight loss, colour, juiciness, flavour, tenderness and overall acceptability are to be considered, substitution of wheat flour with rice flour up to 15% in beef sausage mixture is acceptable. This inclusion rate seem ideal for product's resistance to diffusion, which would maintain storage stability. However, if nutrient composition is important, then 20% rice flour inclusion (Batch 5) could be considered as it had higher amounts of crude protein, ash and ether extract

Table 3. The effect of substituting rice flour for wheat flour at varying levels on refrigerated weight loss of beef sausage

Batch	Initial Weight (g)	Final Weight (g)	Weight Loss (g)	Weight Loss (%)
1	33.70^{a}	31.76^{a}	1.94^{a}	5.76^{a}
2	34.43^{a}	32.50^{a}	1.93^{a}	5.59^{a}
3	28.44^{b}	29.96^{b}	1.48^{b}	5.20^{a}
4	25.34^{c}	24.47^{c}	0.87^{c}	3.20^{b}
5	21.99^{d}	20.88^{d}	1.11^{c}	5.02^{a}
SEM	1.31	1.20	0.12	0.27

$^{a, b, c, d}$ means along the same column with different superscripts are significantly different (P < 0.05). SEM = Standard Error of Means

Conflict of interest None

Table 4. **T**he effect of substituting rice flour for wheat flour at varying levels on sensory properties of beef sausage

Batch	Colour	Juiciness	Flavour	Tenderness	Saltiness	Overall Flavour	Overall Acceptability
1 (Control)	6.22^{b}	7.00^{a}	5.65^{cd}	7.29^{a}	4.23	6.29	5.87^{b}
2	6.22^{b}	7.07^{a}	6.89^{a}	7.15^{a}	4.86	6.29	6.14^{b}
3	6.46^{b}	5.79^{b}	5.79^{bc}	5.79^{b}	4.50	6.14	6.22^{a}
4	6.86^{a}	4.29^{c}	5.15^{d}	4.93^{c}	4.36	6.07	6.58^{a}
5	6.22^{b}	3.72^{c}	6.29^{b}	4.72^{c}	4.44	6.06	6.08^{b}
±SEM	0.08	0.38	0.17	0.30	0.14	0.06	0.08

$^{a, b, c, d}$ means along the same column with different superscripts are significantly different (P < 0.05).
SEM = Standard Error of Means

Table 5. The effect of substituting rice flour for wheat flour at varying levels on proximate composition (% Dry matter) of beef sausage**.**

Batch	Carbohydrate	Crude Protein	Ash	Ether extract	Moisture
1 (Control)	84.08^{a}	9.78^{b}	4.10^{ab}	2.04	11.70^{a}
2	83.97^{a}	10.05^{b}	3.80^{c}	2.18	2.23^{c}
3	83.83^{a}	10.13^{b}	3.90^{bc}	2.07	5.60^{b}
4	83.88^{a}	10.18^{b}	3.80^{c}	2.14	2.20^{c}
5	80.80^{b}	12.42^{a}	4.20^{a}	2.40	1.60^{d}
±SEM	0.34	0.26	0.05	0.06	1.01

$^{a, b, c, d}$ means along the same column with different superscripts are significantly different ($P < 0.05$).
SEM = Standard Error of Means

REFERENCES

A.O.A.C (1995). Official Methods of Analysis. 16th Edition Association of Official Analytical Chemists, Washington DC.

Belderok, B., Mesdag, H. and Donner, D.A. (2000). Bread-Making Quality of Wheat: A Century of Breeding in Europe. Springer. p.3.

Gerrard, F. (1976). Sausage and Small Goods Production: A Practical Handbook on the Manufacture of Sausages and Other Meat Products. 6th Edition Northwood Publications Ltd. London.

Resurreccion. A.V.A. (2003) Sensory aspects of consumer choices for meat and meat products *Meat Science* 66: 11–20

Ranken, M.D. and Kill, R.C. (1993): Food Industry Manual 23rd ed. Blakie Academic and Profession. pp. 23.

SAS. (2000): Statistical Analysis System Version 9, SAS Institute Gary NC. USA