Antioxidant Activity of Rice Bran Added Goat Meat Sausages.

Fatemeh Malekian and Margarita Khachaturyan,

Southern University Agricultural Research & Extension Center, Baton Rouge, LA 70813.

Abstract

A scientific consensus on the relationship between diet and obesity related diseases such as diabetes, heart disease, stroke, and some forms of cancers have emerged. Obesity, a growing problem in the United States, is a major risk factor *for cardiovascular disease, which is due to the* consumption of the primary red meats, pork and beef. Goat meat has the potential to replace these traditionally consumed meats due to the fact that it is low in fat and saturated fatty acids, but high in unsaturated fatty acids. The unsaturated fatty acids are proven to possess hypocholesteremic properties that improve the health of susceptible population without taking meat products out of their daily diet. Rice bran, a byproduct of the rice milling process, is a naturally rich source of antioxidants, vitamins, and minerals. Rice bran is a good source of Vitamin E, which has antioxidant activity, and can lower cholesterol and prevent cardiovascular diseases. In this study, 0%, 1.5% and 3% of stabilized rice bran was incorporated into the formulation of goat meat sausages. The proximate analysis, fatty acid composition and antioxidant activity of fresh and cooked sausages was determined using AOAC approved and the DPPH radical scavenging methods. For antioxidant activity, the absorption of 2, 2-diphenyl-1-picrylhydrazyl (DPPH) radical was measured at 515 nm on UV-Vis Beckman Coulter spectrophotometer and result expressed in terms of micromole equivalents of Trolox (TE) per 100 grams of sample. The results show the effect of cooking on the nutritional content and antioxidant activity of the products.

Introduction

A scientific consensus on the relationship between diet and obesity related diseases such as diabetes, heart disease, stroke, and some forms of cancers have been documented (F as in Fat, 2010). In the United States, Louisiana ranked 5th with an obesity rate of 28.9% (F as in Fat, 2010) and in the top seven states in obesity-related medical expenditure.

Obesity related diseases such as cardiovascular disease and stroke are the leading cause of death in African American men and women, claiming the lives of over 100,000 annually (Health Tidbits, 2004).

Dietary habits are major factor in development of obesity and cardiovascular heart diseases. Foods from animal source have been a part of human diets for years. Blood cholesterol level depends less on intake of cholesterol from foods and more on the amount of saturated fats consumed, especially the ratio of polyunsaturated to saturated fats (Addrizzo, 2002). Lean goat meat is low in fat and saturated fatty acids, but high in unsaturated fatty acids such as linoleic and oleic acids, which are proven to possess hypocholesteremic properties (Dawkins et al., 1999; Mahan and Escott-Stump, 1996; McMillin and Brock, 2005). Having similar protein content, goat meat cuts lower fat contents than similarly prepared beef, lamb and veal, respectively (James et al., 1990). Considering its high nutritional value and its greater unsaturated to saturated fatty acid ratio, goat meat has the potential to improve health of susceptible population without taking meat products out of their daily diet by replacing traditionally consumed meats (pork, beef).Goat meat is a hot trend that is just beginning to be identified as available at the fine dining level (Packaged Facts, 2007). Thus, goat production is an opportunity for small farm producers in the U.S. to target ethnic and designer food markets and diversify their farm products.

Currently, there is an increased interest in the use of dietary antioxidants, including vitamins C and E, to prevent cardiovascular diseases (Giugliano, 2000). Rice bran, a byproduct of the rice milling process, is a naturally rich source of antioxidants along with vitamins, and minerals. (Saunders, 1985). Nutritional studies in animals and humans have shown the cholesterol lowering potential of rice bran and rice bran fractions (Hegsted et al., 1993; Nicolosi et al., 1991). Substituting saturated fatty acids in the diet with unsaturated fatty acids such as oleic, linoleic, and linolenic acid lowered low-density lipoprotein-cholesterol in human subjects (McDonald et al., 1989). Also, the protein in rice bran does not contain gluten, therefore it is a healthier food choice for people with celiac disease (Saunders, 1985). In June 2008, the United States Department of Agriculture (USDA) approved stabilized rice bran as a binder (maximum of 3.5% inclusion level) in various meat products (Prabhu, G. 2008). It can hold moisture up to three times of it's weight which can contribute to the juiciness of the goat meat products. Also rice bran has a meat-like texture when it is cooked (Prabhu, G. 2008).

In this work, stabilized rice bran (Malekian et al., 2000) was incorporated into the formulation of goat meat sausages.0%; 1.5% and 3% of stabilized rice bran was added in to the goat meat sausages. Goat meat, stabilized rice bran, spicy, fresh and cooked sausages was analyzed for %fat, %protein,% ash,% moisture, fatty acids and antioxidant activities. Carbohydrate was calculated using equation: 100 – (% protein + % fat + % ash + % moisture).

Materials and Methods

Goats were raised at the Southern University Agricultural Research and Extension Center's goat farm until harvesting and preparation of products. All meat obtained was prepared in the state inspected Southern University Meat Processing Laboratory following meat inspection guidelines such as Hazard Analysis Critical Control Points (HACCP) and using standard equipment and methods.

Rice bran was obtained from Planters Rice Mill in Abbeville, LA and stabilized according to the method by Malekian et al, 2000. The obtained rice bran stabilized and sieved with a 20 MESH in order to get rid of broken rice and husk and have a uniform particle size.

Stabilized rice bran at 0%, 1.5% and 3% , salt and spices (chili paper) were added to the goat meat /beef combination sausages. Sausages were cooked at optimized time and temperature to the point that the internal temperature reached 158ºF for at least 15 seconds.

For chemical analysis, approximately 1pound of samples was homogenized in a Robot Coup R2 food processor for 2 minutes. Three aliquots were made. Samples were analyzed using American Official of Analytical Chemists (AOAC) approved methods (AOAC, 1995). For total lipids AOAC # 983.23, Protein AOAC # 992.15, ash AOAC # 920.153, and for moisture AOAC # 985.14. Carbohydrate was calculated using equation: 100 – (% protein + % fat + % ash + % moisture).The fatty acid profile was determined by gas chromatography/mass spectrometry (GC/MS) of the fatty acid methyl esters according to a modification of an AOCS method (Firestone, 1993). The fatty acid profile was determined by a Varian Saturn 2100 GC/MS using a fused silica column (30 x 0.25 mm).

Antioxidant activity was measured using the DPPH free radical scavenging method. Free radical scavenging activity of antioxidants in food was determinate with 2, 2-diphenyl-1-picrylhydrazyl (DPPH) radical. Absorption at 515 nm was measured on UV-Vis Beckman Coulter spectrophotometer and result was expressed in terms of micromole equivalents of Trolox (TE) per 100 grams of sample (Oufnac et al., 2007).

Table 1 Antioxidant activity of Raw and Cooked Rice Bran added Goat Meat Sausages

Sausages	%Bran	TE* /100g sample
Raw	0.0	6.8
Raw	1.5	7.2
Raw	3.0	17.9
Cooked	0.0	13.2
Cooked	1.5	14.3
Cooked	3.0	22.7

•Micromole Equivalent of Trolox (TE)

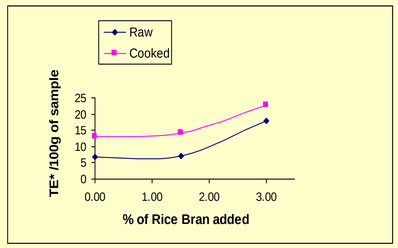

Figure 1.Antioxidant Activity of Raw and Cooked Rice Bran added Goat Meat Sausages

Table 2. Antioxidant activities of Goat Meat, Rice Bran and Spices

Sample name	TE*, per 100g sample
Goat Meat	5.0
Rice Bran	236.9
Spices	60.5

Table 3. Proximate Analysis of Raw and Cooked Rice Bran added Goat Meat Sausages

Sausages	%Bran	%Moisture	%Fat	%Ash	%Protein	%Carbohydrates
Raw	0.0	69.66 1.07a	8.90 0.22a	1.53 0.02a	13.13 1.57a	6.80 1.83a
Raw	1.5	70.93 1.07a	9.67 0.22b	1.50 0.02a	14.06 1.57a	3.80 1.83b
Raw	3.0	70.06 1.07a	10.50 0.22c	1.51 0.02a	17.76 1.57b	0.17 1.83c
Cooked	0.0	63.60 1.07b	13.13 0.22d	2.09 0.02b	20.50 1.57c	0.70 1.83d
Cooked	1.5	62.86 1.07b	12.30 0.22e	2.04 0.02c	21.13 1.57c	1.67 1.83e
Cooked	3.0	58.26 1.07c	15.13 0.22f	1.99 0.02d	21.60 1.57c	3.03 1.83f

Means following by the same letter in the same column are not significantly different (P<0.05)

Table 4. Proximate Analysis of Rice Bran, Raw Goat Meat and Spices

Sample Name	%Moisture	%Fat	%Ash	%Protein	%Carbohydrates
Rice Bran	18.2	15.6	9.6	11.5	45.1
Goat Meat	70.8	10.9	0.9	13.2	4.2
Spices	4.4	5.2	13.1	10.0	67.2

Table 5. Percent Fatty Acids Composition in Raw and Cooked Rice Bran added Goat Meat Sausages **

Sausages	%Bran	Σ Sat	Σ Unsat	MUFA	PUFA	Unsat/Sat	n6	n3	n3/n6
Raw	0.0	63.23	36.75	32.60	4.15	0.58	3.85	0.30	0.08
Raw	1.5	61.13	38.85	34.03	4.82	0.64	4.36	0.46	0.11
Raw	3.0	58.86	41.14	36.90	4.24	0.70	3.87	0.37	0.10
Cooked	0.0	65.02	34.96	30.68	4.28	0.54	3.96	0.32	0.08
Cooked	1.5	60.99	39.10	33.93	5.17	0.64	4.73	0.44	0.09
Cooked	3.0	61.40	38.60	33.33	5.27	0.63	4.64	0.63	0.14

** Percentage of fatty acids from the total

Table 6. Percent Fatty Acids Composition in Goat Meat, Rice Bran and Spices**

Sample Name	Σ Sat	Σ Unsat	MUFA	PUFA	Unsat/Sat	n6	n3	n3/n6
Goat Meat	62.38	37.62	34.03	3.59	0.60	3.34	0.25	0.08
Rice bran	22.71	77.29	49.80	27.49	3.40	25.79	1.70	0.07
Spices	24.82	75.18	33.27	41.91	3.03	37.97	3.94	0.10

** Percentage of fatty acids from the total

Table 7. Sodium concentration in Rice Bran Added Goat Meat Raw and Cooked Sausages

Sausages	%Bran	Na, mg / 100g of sample
Raw	0.0	311.6
Raw	1.5	253.3
Raw	3.0	269.3
Cooked	0.0	429.0
Cooked	1.5	389.2
Cooked	3.0	346.4

Table 8. Sodium concentration in Goat Meat, Rice Bran, Spices

Sample name	Na, mg / 100g of sample
Goat Meat	111.4
Rice Bran	16.3
Spices	3435.7

Results and Discussion

Goat meat sausages with 0%, 1.5%, and 3% added rice bran were made. The contents of raw (not cooked) and cooked sausages were analyzed. SAS software version 9.1.3 (2006) was used for statistical analyses of raw and cooked goat meat sausages and goat meat sausages with different percentages of added rice bran.

The antioxidant activities of raw and cooked sausages and initial goat meat, stabilized rice bran and chili spices were measured. Results are expressed in Trolox equivalent/100g of samples and presented in Table 1 - 2 and Figure 1. The antioxidant activities of sausages cooked with 3% rice bran increased significantly (P<0.05) compared to initial goat meat. There was no significant difference in 1.5 % rice bran added sausages.

The proximate analyzes of rice bran added raw and cooked sausages in goat meat, rice bran and spices are shown in Tables 3 and 4. The percentage of moisture in cooked samples was decreased as expected. The percentage of fat was decreased in goat meat sausages (without added rice bran). After water, spices and salt were added to the meat, the fat content increased. The reason could be added rice bran which is a source of more fat. At the same time, the protein content increased with higher concentration of rice bran.

Table 5 shows fatty acids content in raw and cooked goat meat sausages with different amount of rice bran. The content of fatty acids in goat meat, rice bran and spices is presented separately in Table 6. The total percentage of saturated fatty acids was increased, while unsaturated fatty acids was increased in goat meat sausages with added rice bran (Table 5). The total polyunsaturated fatty acids in cooked sausages in comparison with initial goat meat were slowly increased. The same trend was seen for n3/n6 omega acids in 3% rice bran added cooked sausages in comparison with initial goat meat.

The concentration of sodium in initial components, raw and cooked samples is presented in Tables 7 and 8. The level of sodium in the samples is presented as mg/100 grams of sample (3 ½ oz serving size).

Based on our results, we recommend goat meat mixed with 3% stabilized rice bran as perspective products with higher antioxidant activity and higher ratio of omega 3/ omega 6 fatty acids. These products can be promising for their health benefits.

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