



ORIGINAL ARTICLE

Development and Utilization of Rice Bran in Hamburger as a Fat Replacer

Mohammad Mehdi Marvizadeh^{*1}, Neda Akbari²

¹Young Researchers and Elite Club, Damghan Branch, Islamic Azad University, Damghan, Semnan, Iran

²Department of Food Science and Technology, Darab Branch, Islamic Azad University, Darab, Iran

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KEYWORDS

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ABSTRACT: The effect of rice bran (RB) on the physicochemical properties such as fat content, pH, moisture content, color evaluation (L^* , a^* , b^* values), and cooking loss of hamburger was investigated. To this purpose, four groups were processed: a control group and three treatment groups containing 2%, 3%, and 4% RB. The addition of 4% RB to hamburgers decreased the fat content by 25%. The highest rate of cooking loss ($P < 0.05$) was observed in the control group. Chemical tests indicated that hamburgers with RB increased moisture content of samples. Proximate test indicated that the greatest pH in a hamburger was achieved when 4% RB is added. The values of L^* in low-fat hamburger (LFH) were decreased using RB replacer. Therefore, healthier hamburger can be manufactured by RB as fat replacer without product's quality loss.

INTRODUCTION

Hamburger is the traditional products produced throughout the world. Hamburgers are comprised from beef meat, soy protein and fat, certain level of water, and flour fillers and spices. Hamburgers negatively affect health due to their high cholesterol and high level of saturated fatty acids [1].

Fats are good carriers for essential fatty acids and fat soluble vitamins, and they have a significant effect on energy supply [2, 3]. The unique properties of fat to create desirable texture, mouth feel, and flavor are beneficial in production of hamburgers. High fat level in meat products has negative effect on the general acceptability of product [4]. High fat content of foods is associated with cardiovascular disease and diabetes, obesity, myocardial diseases which are related to high level of cholesterol and saturated fatty acids.

Therefore, consumers interest low-fat products of traditional foods [5].

Different ingredients have been added to meat to enhance product general acceptability. The first low-fat meat product was produced with carrageenan, soy isolates, and oat fiber/oat bran [6, 7]. Currently, non-meat proteins such as isolated soy protein, carrageenan, maltodextrin, chitosan and dietary fiber are used as fat replacer in low-fat meat products [8]. The addition of dietary fibers to meat products have been used to produce low-fat meat products and improve stability and rheological properties [9]. Moreover, there is many evidence indicating that dietary fiber can positively affect gastrointestinal and cardiovascular diseases, blood cholesterol reduction, colon cancer, and diabetes [10]. Moreover, authors

*Corresponding author: engmmarvi@gmail.com (M.M. Marvizadeh)
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have shown that dietary fiber can give thickening, gelling and emulsifying characteristic to food products [11, 12]. Dietary fiber is used not only to decrease fat content of meat products but also to improve product texture [9, 13].

Over recent decades, RB has been used in the meat industry as a good source of fiber [14]. Additionally, RB is a good source of minerals, proteins, and vitamin B, and has been used as fat replacer in meat products [15]. Moreover, RB contains different antioxidant compounds such as vitamin E, anthocyanidin, vitamin C, isoflavones, polyphenols, beta-carotene, and oryzanol, which have positive effects on human health [16]. RB is capable of forming bonds between protein and oil /water and represents - good properties to produce emulsion products under high level of salt and sugar [17].

However limited number of studies have been carried out on the addition of RB to hamburgers. Therefore, the present paper was conducted with the aim to estimate the effects of various RB concentrations (2, 3, and 4%) on the cooking loss, chemical and color characteristics of hamburger.

MATERIALS AND METHODS

Hamburger Formulation

Formulation of hamburger consists of compounds like water (30%), soy flour (6%), soy protein (13%), salt (1.05%), pepper, garlic, ginger and nutmeg (0.316%), and hydrogenated oil (8%). All ingredients and cow flank meat (30%) were mixed, and then, RB at different amounts (2, 3, and 4%) was added to the final paste and mixed for 5 min.

All samples were put as flat burgers in special moulds (with thickness of 11 cm× radius of 53 cm) and stored at -18°C for 48h.

Cooking loss

Cooking loss test of hamburger was measured according to method of Chiavaro, et al. [18]. Hamburger was weighed to an accuracy of ± 0.01 g

before and after frying (stored at 4°C for 24h). Cooking loss of samples was calculated as follow (1):

$$\text{Cooking loss} = \frac{(\text{uncooked weight} - \text{cooked weight}) \times 100}{\text{cooked weight}} \quad (1)$$

Chemical tests

Lipid and moisture content were determined using Official Methods of Analysis of the Association of Official Analytical Chemists (AOAC) Association of Official Analytical [19].

pH value

A stirrer (Heidolph, MR300 K, Germany) was used to homogenize 5 g of hamburger in 50 mL of distilled water at 750 rpm for 20 s. The pH value of the samples was measured using pH meter (Jenway 3510, England).

Color evaluation

L^* , a^* , b^* values were assessed using a colorimeter (Konica Minolta Business Technologies, Inc., Tokyo, Japan). Colorimeter was calibrated with a white plate ($L^*=97.83$, $a^*=-43$, $b^*=1.98$). L^* value presents the difference between dark and light ($L^* = 0$ and 100). The value of a^* shows the difference between red and green ($+a^*$ and $-a^*$) and b^* value indicates the difference between yellow and blue ($+b^*$ and $-b^*$).

Statistical analysis

An analysis of variance (one way-ANOVA) was applied on cooking loss, fat and moisture content, color evaluation and pH using GraphPad Prism software version 6 (GraphPad Inc., La Jolla, USA). Duncan test ($p<0.05$) was used to measure the differences between concentration means.

RESULTS

Cooking loss

All LFH samples showed a significant lower cooking loss ($P<0.05$) compared to batch control. The cooking

loss reduction in the LFHs containing %2RB, %3RB, and %4RB was about 2%, 9%, and 10%, respectively, compared to the control group. In this test, there was

no significant difference ($P>0.05$) in cooking loss between 3% and 4% RB (Figure1).

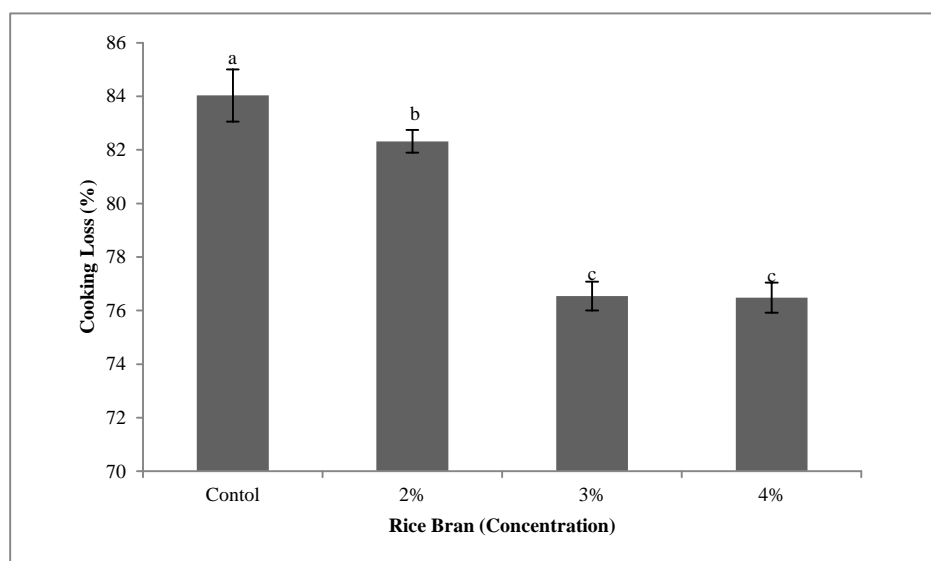


Figure 1. Effect of added rice bran on cooking loss in hamburgers

These findings are in agreement with another study on low-fat meat product [20] In the incorporation of oat bran to meat products, the reduction of cooking loss value is also attributed to fat and water contents of meat products [21].

Recent reports have demonstrated that cooking loss for production of healthier meat products is affected by the type of dietary fiber and vegetable oil used [2]. These trends can occur due to fat and water binding characteristics of fibers, as well as the texture parameters variation [2]. Cooking loss of meat product containing different level of brown rice bran fiber was lower than that of control sample [22].

pH and fat content

Table 1 represents the pH of hamburger samples. Results indicated that the addition of RB to hamburgers increased pH compared to control sample. In this experiment, there was no significant ($P>0.05$) difference in pH between control and 2% RB. These findings are consistent with previous works on healthier food [2, 23].

Recent works reported that the significant increase in the pH value of frankfurters after the incorporation of RB may be related to the presence of minerals such as Ca, Fe, and phosphorus [16].

According to other research [24], the pH of meat batter containing RB increased due to rice bran fiber (RBF) alkalinity. Also, the pH of cooked meat batter with RB and grapeseed oil was higher compared to uncooked meat batter.

Fat content of hamburger is shown in Table1. Results showed that the addition of RB to hamburger reduced the fat content. The fat content decreased from 14.73% for the control batch to 10.95% for the LFH containing 4% RB.

The reduction of fat content in emulsified sausages as increasing of rice flour have been reported by Perera and his colleagues [25]. They reported that the fat content of pork emulsified sausage ranges from 16.61% and 18.7% in healthier bologna and control batch, respectively.

Frankfurters containing 2% RB and 10% vegetable oil decreased fat content of product compared to control sample [2].

According to reports, the addition of xanthan gum and locust bean along with olive oil replacer to frankfurters decreased fat content of product [26].

Table 1. pH and fat of hamburgers containing rice bran.

Rice Bran Concentration (%)	pH	Fat (%)
0.0	5.62±0.03c	14.73±0.50a
2	5.71±0.03bc	13.67±0.58a
3	5.73±0.03ab	11.89±0.41b
4	5.8±0.05a	10.95±0.48b

Values are mean ± SD. Different letters in Ph and fat indicated significant difference at P<0.05

Moisture content

The moisture content of control batch and LFHs is shown in Table 2. The addition of RB to hamburger increases the moisture content of different meat products. Moisture content of hamburgers increased from 66.98% to 68.14%. In this experiment, there was no significant ($P>0.05$) difference in moisture content between 2%, 3% and 4% RB.

The incorporated RB increased the moisture content of hamburger, which is due to positive effects RB on water retention [27].

Recent reports have noted that RB leads to higher water retention, that is, the addition of rice bran fiber increases the moisture content of frankfurter [28].

As shown in previous works, fat replacer such as glutinous rice flour significantly increase moisture content [29].

In other study showed that moisture content of tteokgalbi increased in different samples containing RBF [30].

Table 2. Moisture content of hamburgers containing rice bran

Rice Bran concentration (%)	Moisture content (%)
0.0	66.98±0.18b
2	67.84±0.32a
3	68.27±0.1a
4	68.14±0.19a

Values are mean ± SD. Different letters in moisture content indicated significant difference at P<0.05.

Color evaluation

Color parameters evaluation of hamburgers is shown in Table 3. L^* value, which represents the lightness of hamburger significantly decreased from 56.02 to 49.75, specimens without RB were lighter. These findings are consistent with with other works which, indicated that the lightness value significantly decreased as the RB of frankfurters increased [23].

With regard to a^* , which indicate redness/yellowness of hamburger, the addition of RB decreased the redness of samples. In this test, there was no significant ($P>0.05$) difference in a^* value between 2% and 3% RB.

Results exhibited that the incorporation of RB to hamburgers increased b^* parameter. Greenness of the

samples increased from 14.27 for control to 24.83 for LFH containing 4% RB.

The effect of RB on b^* value for the hamburgers in this work is consistent with those of previous study, as the addition of canola-olive oils, walnut, and RB decreased the redness of frankfurters [15].

Ali and his colleagues [31] reported similar findings of color (decrease in lightness) in pork and duck sausages containing 10% rice flour by increasing protein amounts.

Similar trends have been reported for color measurement of comminuted sausage in relation to color characteristics [32], and the application of fat replacer in low-fat meat emulsion [2] regarding the

color and chemical properties of product by adding RB and vegetable oil.

Table 3. Colorimetric indices of hamburgers containing rice bran.

Rice Bran Concentration (%)	L*	a*	b*
0.0	56.02±0.62a	25.3±3.75a	14.27±2.15b
2	52.91±2.5b	18.88±3.03b	20.17±4.04ab
3	52.30±0.74bc	17.03±1.18b	22.12±3.84a
4	49.75±1.74c	15.91±1.32c	24.83±3.26a

Values are mean ± SD. Different letters in moisture content indicated significant difference at P<0.05

CONCLUSIONS

The incorporation of RB into the hamburgers was investigated. The findings clearly indicated that the addition of RB effectively decreased the cooking loss of the product. Furthermore, a significant increase was observed in moisture content and pH of hamburger with RB addition compared to the control batch. The fat content in hamburgers tended to be decreased by RB substitution. L* value of LFHs was lower (P < 0.05) than the control samples in the specimens formulated with RB.

Thus, replacing fat with RB in hamburger formulation had no negative changes in physicochemical characteristics due to in the reduction of saturated fatty acid. Finally, the quality properties of the healthy hamburger were desirable from consumers' perspective.

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Conflict of Interests

The authors declare that they have no conflict of interest.

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