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RESEARCH PAPER

Effect of Various Methods of Stabilization of Rice Bran on Its Quality Evaluation

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ABSTRACT

In the present study the effect of different stabilization methods i.e. Hot Air Oven and Autoclaved stabilization methods on physio-chemical properties such as Moisture content, Bulk density, Water Holding capacity, Free fatty acids, lipase Activity, Peroxide value and Colour of rice bran was evaluated. Fresh rice bran was subjected to stabilization treatments namely hot air oven stabilization and autoclave stabilization, while un-stabilized rice bran was used as a control. The present results indicated that the Hot Air Oven stabilization methods effectively inactivated lipase and lower the FFA compared with Autoclaved stabilization. Moisture content of rice bran was observed from 5.263±0.618 %. While bulk density, water holding capacity, Free Fatty Acids, Lipase Activity, peroxide value were 0.378±0.008 g/ml, 1.63±0.069 ml/g, 4.349±0.192%, 5.012±0.699 µmol/g min, 6.6807±0.431 meq/kg respectively. The L^* (lightness), a^* (redness) and b^* (yellowness) values of rice bran were 63.5±1.047, 3.79±0.179 and 23.96±0.384 respectively.

Keywords: Rice Bran, Stabilization of rice bran, Free Fatty Acids, lipase activity, peroxide value

Rice serves as a primary staple food for almost half of the global population. Its importance to the world population's dietary requirements is evident from the presence of rice in the diet of a quarter of world's population (Das *et al.* 2025). Paddy is cultivated globally being one of the most important cereal crops worldwide. India ranks second amongst the top rice growing counties in the world. USDA's Global rice production in 2025-26 is projected at a record 541.6 million tons, up 2.9 million tons from the previous estimate, mainly due to higher output in India. India's production alone is revised up by 3.0 million tons to a record 151.0 million tons (Source: www.usda.gov). Rice is considered the queen among cereals because of its' nutritional quality and higher digestibility (Anjum *et al.* 2007). Rice is an important energy source with versatile functional properties. Paddy itself cannot be consumed in its raw form and it need to be processed into rice to enable it for human consumption. The rice is obtained from paddy grains after many processing operations. Fig. 1 shows the structure of Paddy grains. Rice is primarily consumed as white rice, a refined grain that is generated from the rice milling process which removes the germ and bran and leaves the starchy endosperm. There is a need for the paddy grains to undergo several processing steps before being consumed as food. Paddy processing involves various steps like cleaning, hulling and post hulling processing (whitening, polishing and grading). Processing

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of Paddy in to rice produces several streams of materials such as husk, milled rice, and bran. Milling of paddy yields 70% of rice (endosperm) as the major product and byproducts consisting of 20% husk, 8% bran and 2% germ (Van Hoed *et al.* 2006). During rice milling, rough rice (paddy) is first cleaned to remove impurities such as stones, straw, weed seeds, and soil particles. The husk is then separated from the paddy through friction in shelling machines. Following this, the brown rice is separated from the husk by aspiration, and any remaining unhusked grains are removed using a paddy separator, which also helps distinguish broken rice from whole kernels. The brown rice is subsequently processed in a milling machine (huller), where the bran layer is removed, resulting in a nearly white kernel. Typically, the bran fraction accounts for about 8–10% of the total paddy weight, although this can vary depending on the degree of milling, the type of milling system, any pre-milling treatments, and the rice variety (Tan, 2023).

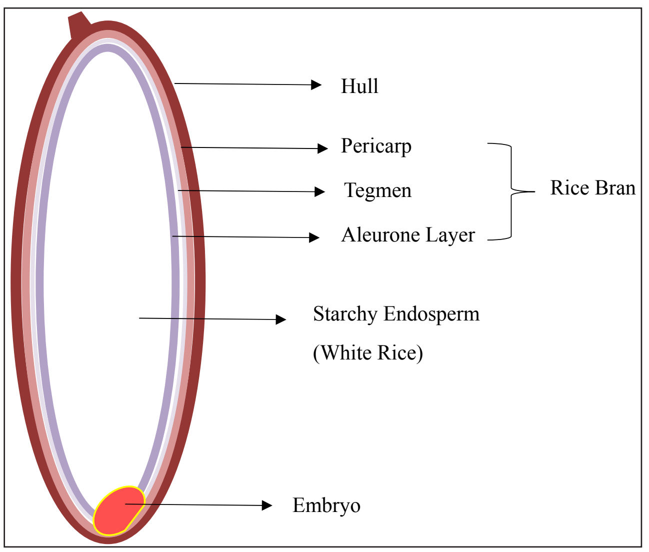

Fig.1: Structure of Paddy Grain(Ferreira *et al.* 2018)

Fresh RB has great potential as a food product. It is highly nutritious and has a characteristic bland flavor and fine texture. However, unprocessed RB becomes rancid very quickly after the milling process, which limits its use as food. The rancidity of RB is predominantly triggered by lipophilic enzymes, mainly lipases. In intact paddy, lipases are primarily found in the seed coat and most of the oil is localized in the aleurone layer and rice germ. In other words, lipolytic enzymes and their substrates are physically separated in unmilled paddy rice. However, the milling process disrupts this individual localization and lipase enzymes come into contact with fat, causing hydrolysis of fat into free fatty acids (FFA) and glycerol. High concentration of FFA causes a rancid soapy taste and induces oxidation and even lipotoxicity (Tunsel, 2023).

Rice bran is the brown, outermost layer of the rice grain, comprising the pericarp, aleurone layer, seed coat, and germ, and is typically removed during the milling process. Rice bran, a nutrient dense by-product produced during the milling process and traditionally considered waste, is now recognized for its significant potential across diverse sectors such as food, pharmaceuticals, cosmetics, and biofuels (Nidhishree *et al.* 2024). Rice bran is the brownish layer removed in fine grain form during the de-husking and milling of paddy. It comprises the hard outer covering of the rice grain, which includes the aleurone layer and the pericarp (Nagendra Prasad *et al.* 2011). Each year 90% of the rice bran produced in the world is utilized cheaply as a feed stock for cattle and poultry and the remainder is used for extraction of rice bran oil.

A major drawback of rice bran is its high susceptibility to rapid rancidity, despite being a nutritionally valuable by-product. As reported by Begum *et al.* (2015), nearly 30 million metric tons of rice bran are generated annually during the milling process; however, much of it is either discarded or utilized as low-grade animal feed due to its poor stability. The high lipid content and potent enzymes such as lipases result in the rapid quality reduction of rice bran by producing Free Fatty Acids. Soon after milling, lipase enzymes catalyze the hydrolysis of triglycerides into glycerol and free fatty acids (FFAs). This reaction takes place shortly after rice milling. However, the hydrolysis process produces harmful free fatty acids that make rice bran unfit for human ingestion. Stabilization procedures are used before additional processing in the industry to get over this barrier (Aluthge *et al.* 2023).

For rice bran to be utilized as a food ingredient rather than as animal feed, it is necessary to inhibit its lipolytic activity through a process known as stabilization. Stabilization essentially involves the inactivation of enzymes, allowing rice bran to be safely incorporated into the human diet. Rice bran has very short shelf life owing to high fat content and potent enzyme lipase which degrades the oil, making bran rancid and inedible. Stabilization refers to the prevention of hydrolytic degradation. hydrolytic degradation in rice bran is commonly evaluated by measuring lipase activity and the formation of free fatty acids (FFA). Additionally, the activities of enzymes such as lipoxygenase and peroxidase are sometimes used as supplementary indicators of rice bran deterioration (Yılmaz Tuncel., 2023). Stabilization of rice bran by various means is carried out to enhance the stability of rice bran by inactivation of enzyme lipase, for possible applications in food industries (Gul *et al.* 2015). Rice bran is gaining recognition as a valuable functional food ingredient due to its diverse health benefits. With the rising global demand for nutrient-dense and sustainable food sources, rice bran has attracted attention within the food industry (Das *et al.* 2025). Rice bran is rich in protein, crude fiber, lipids, carbohydrates, oryzanols, phenolic compounds, as well as polyunsaturated and monounsaturated fatty acids (Alauddin *et al.* 2019). It was observed that extrusion, microwave (MW) heating, hot air heating, autoclaving, infrared (IR) heating, ohmic heating, radio frequency (RF) heating, ultraviolet (UV) treatment, ultrasound treatment, γ-irradiation, antioxidant addition, enzyme addition, phenolics addition, parboiling, toasting, roasting, and steaming are the RB methods for stabilization studied in the literature (Tunsel, 2023). In the present study the effect of different stabilization methods i.e. Hot Air Oven and Autoclaved stabilization methods on physio-chemical properties such as Moisture content, Bulk density, Water Holding capacity, Free fatty acids, lipase Activity, Peroxide value and Colour of rice bran was evaluated.

MATERIALS AND METHODS

Freshly milled rice bran samples were collected form Kavita mills, Udadavane Tal. Roha, Dist. Raigad. The collected samples were sealed in zip-tight bags and transported to the laboratory for further analysis.

Sample preparation and stabilization of rice bran

The rice bran samples were screened to pass through a 44 μ m aperture sieve to remove the broken grain particles, hull fragments and foreign materials as per the procedure by Aluthge *et al.* 2023. Then the samples were packed in separated Low- density polyethylene (LDPE) air tight bags and prepared for stabilization treatments. LDPE bags were used due to the properties such as good process-ability, high strength and cheap. The stabilization treatments were applied within 24 hours after milling. Unstabilized rice bran was used as the control in this study. Stabilized rice bran samples were cooled down to reach room temperature and they were stored in sealed LDPE zip tide bags. All samples of fresh samples (Un-stabilized rice bran) of Rice bran were stored at Room temperature for further analysis of moisture, Bulk density, Water holding capacity, Free fatty acids, Lipase activity, Peroxide value, Colour.

Stabilization Techniques of Rice Bran

The present study was conducted on three types of rice bran samples; Unstabilized Rice bran, Hot air oven stabilized rice bran and autoclaved stabilized rice bran.

1. Hot Air Stabilization of Rice Bran

Hot air stabilization of rice bran was performed as per the procedure of Bagchi *et al.* 2014; Sangle (2017) and Sharma (2004). 50 grams of rice bran sample was taken and hot air stabilization was done at 130º C for 20 minutes to inactivate the lipase enzyme. For hot air heating, a portion of rice bran (100 g) was transferred into shallow pans and spread uniformly in a layer. The pans were then placed in a preheated oven at 130ºC for 20 min (Bagchi *et al.* 2014). The treated rice bran was immediately cooled to room temperature and packed in polyethylene bags.

2. Autoclave Stabilization of Rice Bran

In Autoclave Stabilization of Rice Bran, the stabilization procedure is based on previous studies (Yu., *et al* 2020; Pranowo., and Savira., 2023; Sangle., 2017). In autoclave stabilization, 50 g of rice bran was weighed and packed in autoclave glass bottles and kept inside the autoclave at 120ºC for 20 minutes and 0.1 MPa. The bottles were removed and cooled at room temperature (Rosniyana *et al.* 2009).

Determination of physico-chemical properties

1. Moisture content

The moisture content of the rice bran (Un-stabilized, stabilized using hot air stabilization and Autoclave Stabilization of Rice Bran**)** was determined was by AOAC (2010). 5g of the rice bran samples was taken for in to each three different moisture boxes. The initial weight of moisture box was recorded. The samples were exposed to 105˚C ± 1˚C in a hot air oven. The final weight was recorded. The moisture content of the samples were determined by,

$$\text{Moisture content (\% db)} = \frac{W_2 - W_1}{W_3 - W_1} \times 100 \qquad \ldots(1)$$

Where,

W_1 = Weight of moisture box (g); W_2 = Weight of moisture box + sample (g); W_3 = Weight of moisture box + oven dried sample (g)

2. Bulk Density

The bulk density of rice bran (Un-stabilized, stabilized using hot air stabilization and Autoclave Stabilization of Rice Bran**)** was determined according to the method described by (Vengaiah *et al.* 2013). Weigh 2 gm of rice bran and filled into a 10 ml graduated cylinder. Rice bran was continuously tapped into it until the volume remained constant. The experiment was replicated for 4 times the average value of bulk density was reported. The bulk density was calculated by using following equation;

$$\text{Bulk Density} = \frac{\text{Weight of Sample}}{\text{Volume of Sample}} \times 100 \qquad \ldots(2)$$

3. Free fatty acids

Rice bran samples (Un-stabilized, stabilized using hot air stabilization and Autoclave Stabilization of Rice Bran**)** was analyzed for free fatty acid (FFA) content using a titration method (AOCS, 1989). About 1 g of the rice bran was accurately weighed in a conical flask. About 50 mL of ethanol (99%) was taken separately and a few drops of phenolphthalein indicator was added. The ethanol was neutralized by titrating with standardized 0.1 N sodium hydroxide (NaOH) solution until a faint pink color persists. The neutralized ethanol was then be added to the sample and the mixture was shaken thoroughly. The contents was gently heated at 45–50°C for about 10 minutes with intermittent shaking to ensure complete dissolution of the oil. The resulting solution will be titrated against standardized 0.1 N NaOH with continuous shaking until a stable light pink endpoint is obtained. The volume of NaOH consumed was recorded. The FFA content was calculated and expressed as oleic acid equivalent using the standard formula,

$$\text{FFA (\%)} = \frac{V \times N \times 28.2}{W_S} \qquad \ldots(3)$$

Where,

V = Vol. of NaOH sol^n

N =Normality of NaOH

W_S =Weight of Sample

4. Lipase Activity

The lipase activity of rice bran (Un-stabilized, stabilized using hot air stabilization and Autoclave Stabilization of Rice Bran) was determined with slight modifications based on the method reported by Yu *et al.* (2023). About 1 g of rice bran oil and 1 mL of distilled water were added to a conical flask and allowed to react at 35 °C for 2 minutes. After reaction, 50 ml 95 % ethanol and 0.5 ml 1% phenolphthalein were added to the mixture, then KOH solution (0.1 mol/L) was used to titrate the mixture until it became red and lasted for 30 sec. The lipase activity was calculated by using following equation (4);

$$\text{Lipase Activity} = \frac{V \times C \times 1000}{t \times m} \qquad \ldots(4)$$

Where,

V = amount of potassium hydroxide (ml)

C = concentration of KOH solution (mol/L)

t = reaction time (min)

m = mass of rice bran oil, g

5. Water Holding capacity

The water-holding capacity (WHC) for rice bran (Un-stabilized, stabilized using hot air stabilization and Autoclave Stabilization of Rice Bran) was measured based on the method of Quinn and Paton (1979). A sample of 5g rice bran was mixed with 20 ml distilled water and placed in pre-weighed centrifuge tube. The mixture was mixed vigorously for 2 min with a spatula and placed it for 30 min. It was centrifuged for 10 min at 2000 rpm. After the supernatant was removed, the weight gain in sample was recorded. Water Holding Capacity was determined by equation (5),

$$\text{WAC (g/ml)} = \frac{W_2 - W_1}{W_0} \times 100 \qquad \ldots(5)$$

Where,

W_0 = Wt. of sample, g

W_1 = Wt. of Centrifuge tube + Sample, g

W_2 = Wt. of Centrifuge Tube + Sediment, g

6. Rancidity (Peroxide Value)

About 1 g of rice bran oil sample (Un-stabilized, stabilized using hot air stabilization and Autoclave Stabilization of Rice Bran) was weighed into conical flask. 30 mL of an acetic acid–chloroform mixture was added and swirled to dissolved. Subsequently, 1 mL of saturated potassium iodide solution was added, and the mixture was shaken for about 1 minute. Then, 30 mL of distilled water was added, followed by further shaking to ensure proper mixing. The liberated iodine was titrated with standardized 0.01 N sodium thiosulfate solution, added from a burette. A few drops (approximately 0.5 mL) of 1% starch solution added as an indicator during the titration. The titration will be continued with constant shaking until the blue-black color disappears and the solution becomes colorless (or faint white), indicating the endpoint (AOAC, 1990). The initial and final burette readings will be recorded.

$$\text{Peroxide Value} = \frac{V \times N \times 1000}{W_S} \qquad \ldots(6)$$

Where,

V = Vol. of Sodium thiosulphate ($Na_2S_2O_3$)

N = Normality of Sodium thiosulphate ($Na_2S_2O_3$)

W_S =Weight of Sample

7. Colour

Colour of rice bran samples (Un-stabilized, stabilized using hot air stabilization and Autoclave Stabilization of Rice Bran) was measured by using Konica Minolta colour Reader. (Make: Minolta Camera Co. Ltd. Japan Model: (R-10). The colour of the samples was measured in dark room. The rice bran samples was placed on white surface and placing colour reader on the rice bran samples in a Petri dish and the colour was measured in *L, a, b* were reported. Where L value indicates degree of lightness or darkness, '*a*' value indicates redness or greenness and '*b*' value indicates the yellowness or blueness. (Velasquez, *et al.* 2020).

RESULTS AND DISCUSSION

The present study was conducted on three types of rice bran samples; Unstabilized Rice bran, Hot air oven stabilized rice bran and autoclaved stabilized rice bran. The stabilized rice bran samples obtained by Hot Air Oven and Autoclaved stabilization methods were analyzed for physio-chemical properties. Table 1 shows the Physico-chemical and functional properties of Rice Bran such as Moisture content, Bulk density, Water Holding capacity, Free fatty acids, lipase Activity, Peroxide value And Colour. The results obtained are presented and discussed below.

Table 1: Physico-chemical and functional properties of Rice Bran

Sl. No.	Parameter	Unstabilized Rice Bran	Hot Air Oven Stabilized Rice Bran	Autoclave Stabilized rice Bran	SE (m)	CD
(a)	Moisture (%)	10.390±3.609	5.263±0.618	8.720±0.558	1.069	3.469
(b)	Bulk Density (g/ml)	0.373±0.011	0.378±0.008	0.369±0.019	0.007	N/A
(c)	Water Holding Capacity (ml/g)	1.458±0.055	1.63±0.069	2.175±0.131	0.046	0.149
(d)	Free Fatty Acids (%)	8.394±0.390	4.349±0.192	5.558±0.320	0.156	0.505
(e)	Lipase Activity (μmol/g.min)	43.648±2.840	5.012±0.699	11.460±1.564	0.957	3.106
(f)	Peroxide Value (meq/kg)	11.3536±1.366	6.6807±0.431	9.4137±1.188	0.537	1.743

Moisture Content

The effect of stabilization method on the moisture content of rice bran stored at room temperature is shown in Table 1 (a). The moisture content of Unstabilized rice bran was 10.390±3.609, Moisture content of Hot air oven stabilized rice bran was 5.263±0.618 and the Autoclave Stabilized rice Bran was 8.720±0.558 **.** The moisture content of untreated rice bran was found to be higher compared to stabilized rice bran samples. Among the stabilization methods, the moisture content was lowest in hot air oven rice bran sample. Moisture content is an important parameter that influences the shelf life and storage stability of rice bran. The moisture content of rice bran samples varied depending on the stabilization method used. The moisture content was significantly different w.r.t. stabilization methods used at $p \leq 0.01$. Moisture content of unstabilized rice bran, hot air oven stabilized rice bran, autoclave stabilized rice bran was reported in literature are 8.2, 6.3, 6.7 respectively by Sangle *et al.* (2017), Krishnegowda, (2016), Abd El-Hady and S.R. (2013), Siswanti, *et al.* (2019).

Bulk Density

The bulk density of un-stabilized rice bran, hot air oven stabilized rice bran, autoclave stabilized rice bran were 0.373 g/ml, 0.378 g/ml, 0.369 g/ml respectively as per shown in Table 1(b). In case of Bulk density heat treated rice bran was more or less similar to control sample from un-stabilized rice bran. There was no significant change (at $p \leq 0.01$) observed in bulk density when rice bran was thermally treated because the physical structure of the bran particles remained largely unaffected by heating process. Heat treatment primarily impacts the chemical composition and nutritional quality of rice bran without altering its bulk density significantly (Priyadarsani, 2025). Bulk density of rice bran reported in literature was 0.33 to 0.36 g/mL, 0.45 g/ml and 0.34 g/ml by Sangle, (2017), Irakli *et al.* (2020), Miftahurrahmi *et al.* (2025) respectively.

Water Holding Capacity

The effect of stabilization method on the Water holding capacity of rice bran stored at room temperature is shown in Table 1 (c). The water holding capacity of untreated rice bran was found to be lowest about 1.458 ml/g compared to stabilized rice bran samples hot air oven rice bran 1.63 ml/g and Autoclave stabilized rice 2.175 ml/g . Among the stabilization methods, Autoclave stabilized rice bran showed slightly higher (at $p \leq 0.01$) water holding about 2.175 ml/g compared to hot air oven rice bran samples which showed about 1.63 ml/g. Water holding capacity of rice bran reported in literature was 2-3 ml/g, and 1.74 ml/g by Bhosle *et al.* (2015) and Rafe *et al.* (2017) respectively.

Free Fatty acids

The effect of stabilization method on the Free Fatty Acids of rice bran stored at room temperature is shown in Table 1 (d). Rice bran contains lipases, primarily responsible for the hydrolysis of triglycerides into glycerol and free fatty acids. In present study, the values of unstabilized rice bran, hot air oven stabilized rice bran, autoclave stabilized rice bran was found as 8.394%, 4.349% and 5.558% respectively. The highest free fatty acid content is found in the unstabilized rice bran. The lowest free fatty acids was reported in hot air oven stabilized rice bran. There is significant difference of (at $p \leq 0.01$) Free Fatty Acids of rice bran in hot air oven stabilized rice bran, autoclave stabilized rice bran. The stabilization process using an oven and autoclave can inhibit enzymatic activity (Siswanti *et al.* 2019). According to literature Dry-heating gave the lowest FFA content about 3.91% by (Irakli *et al.* 2020). The recommended FFA% in rice bran is less than 10%. The FFA% in raw rice bran at 0 hour is 3.76% and leads to 13% after 36 hours (Akhter *et al.* 2016).

Lipase Activity

The effect of stabilization method on the Lipase Activity of rice bran stored at room temperature is shown in Table 1 (e). The lipase activity of unstabilized rice bran was found to be highest about 43.648 μmol/g.min. whereas, lipase activity of autoclave stabilized rice bran was found to be 11.460 μmol/g. min compared to hot air oven stabilized rice bran has lowest lipase activity about 5.012 μmol/g.min. There is significant difference of (at $p \leq 0.01$) Lipase Activity of rice bran in hot air oven stabilized rice bran, autoclave stabilized rice bran. Increase in FFA (%) was taken as function of lipase activity in rice bran (Akhter *et al.* 2016). The lipase activity of unstabilized rice bran was found to be highest about 13.553 U/kg whereas, lipase activity of autoclave stabilized rice bran was found to be 1.418 U/kg compared to hot air oven stabilized rice bran has lowest lipase activity about 5.282 U/kg. Yılmaz (2023) reported that, Residual lipase activity was 13.21 U/kg for untreated control and only 1.25 U/kg for MW-treated RB at 5 kW for 13 min. The Lipase Activity was significantly reduced after dry heat treatment (Rashid *et al.* 2022).

According to Yu *et al.* 2020; autoclaving had stabilization effect for 10.73% lipase activity. The Lipase Activity was significantly reduced after dry heat treatment (Rashid *et al.* 2022).

Peroxide value

The effect of stabilization method on the Peroxide value of rice bran stored at room temperature is shown in Table 1 (f). The peroxide of unstabilized rice bran, hot air oven stabilized rice bran, autoclave stabilized rice bran were 11.3536 meq/kg, 6.6807 meq/kg and 9.4137 meq/kg respectively as per shown in Table 1(f). There is significant difference of (at $p \leq 0.01$) Peroxide value of rice bran in hot air oven stabilized rice bran, autoclave stabilized rice bran. Peroxide value of unstabilized rice bran and autoclave stabilized rice bran was reported in literature are 13.96 and 16.69 respectively (Yu, C.W. *et al.*2020). The peroxide value of hot air oven stabilized rice bran was reported in literature is 14.73 (Velasquez *et al.* 2020). The lowest Free Fatty Acids and Peroxide value is considered as the best quality because it indicates a low level of fat damage during storage. If the content of free fatty acids is high, then the peroxide value will also increase (Ling *et al.* 2018).

Colour

The rice bran had a characteristically uniform light brown colour. The colour values (L^*, a^* and b^*) of the heat-treated rice bran samples are shown in Table 2.

The highest *L* value was observed 69.98 in unstabilized rice bran followed by hot air oven stabilized rice bran was 63.5 and autoclave stabilized rice bran was 66.14. The highest a value was observed 3.79 in hot air oven stabilized rice bran followed by unstabilized rice bran was 3.25 and autoclave stabilized rice bran was 3.55. The highest b value was observed 23.96 in hot air oven stabilized rice bran followed by unstabilized rice bran was 21.32 and autoclave stabilized rice bran was 22.29. There is significant difference of (at $p \leq 0.01$) all the colour values *L, a* and *b* of rice bran in hot air oven stabilized rice bran, autoclave stabilized rice bran. All colour values were affected by heating temperature and time. The brightness (L^*) of rice bran after hot air heating treatment decreased but redness (a^*) and yellowness (b^*) increased as temperature increased. Unstabilized bran had the

Table 2: Effect of Stabilization Methods on Colour Values of Stabilized Rice Bran

Methods	L value	a Value	b value
Unstabilized Rice Bran	69.98±0.962	3.25±0.158	21.32±0.603
Hot Air Oven Method	63.5±1.047	3.79±0.179	23.96±0.384
Autoclave Method	66.14±0.741	3.55±0.217	22.29±0.438
SE(m)	0.293	0.059	0.153
CD	0.854	0.172	0.447

lightest colour compared with stabilized rice bran. This was reflected by the higher *L** values obtained (Table 2). Stabilized rice bran was also more red and more yellow and this was reflected by the higher *a** and *b** values. The rice bran had a characteristically uniform light brown colour. It was suggested that the colour of bran depends on the degree of milling which involved gradual removal of bran layer and germs from the rice endosperm (Rosniyana, 2007).

Colour of rice bran was reported in literature by Sangle, (2017) are as follows *L* values was 69.13, 63.12, 66.53 for unstabilized rice bran, hot air oven stabilized rice brand and autoclave stabilized rice bran respectively. *a* value was 3.29, 3.72, 3.51 for unstabilized rice bran, hot air oven stabilized rice brand and autoclave stabilized rice bran respectively. *b* value was 21.38, 23.94, 22.36 for unstabilized rice bran, hot air oven stabilized rice brand and autoclave stabilized rice bran respectively.

CONCLUSION

Stabilization of rice bran was carried out using hot air oven method and autoclave method. The rice bran was stabilized using hot air oven method at 130ºC for 20 min and autoclaved with commercial retort at 120°C for 20 min. Stabilization of Rice Bran is important to reduce lipase activity and prevent rancidity during storage. Study showed that both hot air oven and autoclave treatments were effective in improving the stability of Rice Bran by reducing free fatty acids and lipase activity. Among the stabilization methods, hot air oven method appears to be a practical and rapid tool for heat stabilization of rice bran and had best stabilization effect. The study concluded that, stabilization is an effective technique for improving the quality and utilization potential of rice bran.

GENERATIVE AI DECLARATION

The author(s) confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript, and no images were manipulated using AI. The authors developed and verified all scientific content, data analysis, interpretation of results, and conclusions. The authors take full responsibility for the accuracy, integrity, and originality of the work presented, and no AI tool was listed as an author.

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