Effect of Parboiling, Heat treatment and Packaging on Rancidity development in Rice Bran

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Abstract

Rice bran is an important ingredient in animal feeds. The action of lipases results in the release of free fatty acids (FFA) leading to rancidity which commences soon after milling. A study was carried out to assess the effects of two packaging materials, two stabilization treatments (microwave or simple heat treatment) and the parboiling of paddy on the rancidity process of rice bran. The experiment was conducted using a three factor factorial design. All samples were stored at incubator (at 28 °C) and analyzed for FFAs at weekly intervals for a period of 8 weeks. The results were analyzed statistically using a General Linear Model (GLM). The results revealed that three factor interactions were statistically significant ($P<0.05$) for 8 weeks. Therefore combination of tree factors was considered for the interpretation. According to the results, FFA content of both rice bran stored in vacuum pack and polypropylene bags remained below 12% up to 5 weeks with microwave heating and they are statistically significant with other combinations ($P<0.01$). Further, it was found that the simple heat treatment had increased storage time by two weeks keeping FFA amount less than 12% for both raw and parboiled rice bran when compared to untreated bran. The usual practice by Sri Lankan farmers is to store rice bran up to a maximum of four weeks in Polypropylene woven bags before use. The results of this study showed that simple heat treatment would be a cheap and easy option for farmers who use rice bran within first two weeks to keep the rice bran less than 12% of FFA while those who store for longer periods would need to use the microwave treatment to maintain the same condition.

Key words: Rice Bran, Stabilization treatments, Free Fatty Acids, Vacuum packaging, Polypropylene woven bag packaging

Introduction

Rice bran, comprising the outer layer of the rice kernel and a by-product of the rice milling process, is one of the key ingredients in animal feeds. The rapid development of rancidity in rice bran seriously affects its use in animal feeds. The action of lipases results in the release of free fatty acids (FFA) leading to rancidity and this commences soon after milling. The FFA may reduce the palatability due to off-flavours and could affect digestion as well. The packaging materials, stabilization treatments (heat treatment methods) and the parboiling of paddy are some of the factors that influence the development of rancidity. A study was carried out to assess the effects of those factors in order to identify the more effective ways of reducing the rancidity process.

Materials and methods

The experiment was conducted using a three factor factorial design, the factors were being parboiling, stabilization treatments and packaging methods. The stabilization treatments tested were Pan roasting (dry heat) or Microwave heating, whilst the packaging methods were Vacuum packing or the use of Polypropylene woven bag packaging. Suitable controls were included in the experiment. All samples were stored at room temperature (at 28 °C) and analyzed for FFAs at intervals of one week for a period of 8 weeks.

Samples of paddy of the variety BG358 was taken and parboiled rice bran was obtained by parboiling a portion of the paddy using the domestic procedure. Both parboiled and raw paddy was milled in a commercial two-stage, rubber roller mill. Then both types of rice bran were treated with either microwaves or simple heat treatment.

Microwave treatment was carried out in a domestic microwave oven operating at 860 W for 5 minutes

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(Samsung, Model CE 283 GLT).To apply simple heat treatment, raw and parboiled rice bran was dry roasted in an open aluminum pan at around 80 °C for 10 minutes separately. Untreated rice bran samples from raw and parboiled paddy were kept as controls making 6 treatment combinations. All these 6 treatment combinations were packed in both polypropylene woven bag or polyethylene bag (vacuum packed) and placed in an incubator at 28 °C. Samples were taken for FFA analysis at 1 week intervals. Number of replicates was three.

of the fat was calculated using the titre of sodium hydroxide used according to ISO 660;IUPAC 2.201 method (Kirk and Sawyer, 1991)

$$\text{Acid value} = \frac{\text{Titration (ml)} * 5.61}{\text{Weight of sample used}}$$

Results and Discussion

According to Rukmini (2002), If FFA percentage in rice bran exceeds 12; it is not suitable even for cattle feeding.) rice bran stored in polypropylene woven bag in field condition exceeds the 12% of FFA within one week of storage (Weerathilake; Unpublished data). This study

Table 1: Comparison of the effects of different packaging materials, different treatments and different processing methods of rice bran on the release of FFA (g/100g Ether extract) during 8 weeks storage time.

Treatment	Week								
	0	1	2	3	4	5	6	7	8
CVPR	9.^{a}	10.3^{a}	12.3^{a}	12.2^{a}	12.8^{a}	14.1^{a}	15.5^{a}	16.1^{a}	16.9^{a}
CPBR	9.^{a}	12.3^{b}	13.3^{b}	13.8^{b}	14.2^{b}	16.1^{b}	17.1^{b}	17.7^{b}	18.9^{b}
CVPP	4.4^{b}	9.6^{c}	12.0^{c}	13.4^{b}	14.7^{b}	16.1^{b}	17.3^{b}	19.3^{c}	21.1^{c}
CPBP	4.4^{b}	10.5^{d}	13.0^{d}	14.4^{c}	15.9^{c}	17.2^{c}	18.5^{c}	20.2^{d}	22.0^{d}
MWVPR	2.7^{c}	3.4^{e}	5.0^{e}	6.4^{d}	7.2^{d}	9.1^{d}	10.5^{d}	11.1^{e}	11.7^{e}
MWPBR	2.7^{c}	3.5^{e}	6.4^{f}	7.8^{e}	10.3^{e}	11.2^{e}	12.3^{e}	13.2^{f}	14.0^{f}
MWVPP	1.8^{d}	2.2^{f}	3.1^{g}	4.7^{f}	5.4^{f}	6.5^{f}	6.8^{f}	7.4^{g}	8.8^{g}
MWPBP	1.8^{d}	2.8^{f}	3.6^{g}	4.9^{f}	6.0^{f}	6.9^{f}	7.1^{f}	8.8^{h}	10.0^{h}
SHVPR	5.5^{e}	5.9^{g}	7.6^{h}	10.5^{g}	12.1^{g}	13.8^{g}	15.2^{g}	16.2^{i}	16.9^{i}
SHPBR	5.5^{e}	9.6^{h}	11.3^{i}	12.8^{h}	13.8^{h}	14.5^{g}	15.8^{g}	16.8^{i}	17.4^{i}
SHVPP	3.1^{f}	7.1^{i}	8.5^{j}	9.8^{i}	11.6^{i}	12.5^{h}	13.6^{h}	16.1^{i}	16.9^{i}
SHPBP	3.1^{f}	7.9^{j}	9.8^{k}	10.5^{j}	12.8^{j}	13.0^{h}	14.5^{h}	17.4^{j}	18.2^{j}

values are given as mean ± Standard deviation, Values bearing similar superscripts in same columns are not significantly different at P > 0.05

Abbreviations used in Table 1

CVPR = Control vacuum packed raw rice bran
CPBR = Control poly propylene woven bag packed raw rice bran
CVPP = Control vacuum packed parboiled rice bran
CPBP = Control poly propylene woven bag packed parboiled rice bran
MWVPR = Microwave treated vacuum packed rice bran
MWPBR = Microwave treated poly propylene woven bag packed raw rice bran
MWVPP = Microwave treated vacuum packed parboiled rice bran
MWPBP = Microwave treated poly propylene woven bag packed parboiled rice bran
SHVPR = Simple heat treated vacuum packed raw rice bran
SHPBR = Simple heat treated poly propylene woven bag packed raw rice bran
SHVPP = Simple heat treated vacuum packed parboiled rice bran
SHPBP = Simple heat treated poly propylene woven bag packed parboiled rice bran

Extraction of fat from rice bran was carried out in a semi-automatic fat analyzer (VELP SER 148, Extractor unit, Model No: F30300242) using petroleum ether (boiling range 40- 60 °C) as the non-polar solvent. The acid value

clearly showed that the FFA content of rice bran stored in vacuum pack or polypropylene bags (Currently use packing method in Sri Lanka) remained below 12% up to 2 weeks even after simple heating. The condition can be extended up to 5 weeks for both rice brans with microwave heating and, for parboiled rice bran it can be

extended up to 8 weeks. This study further discovered, vacuum pack is the most effective packing method to reduce the development of

Conclusion

The usual practice by Sri Lankan farmers is to store rice bran up to a maximum of four weeks in Polypropylene woven bags. The results of this study show that for farmers who use rice bran within first two weeks, simple heat treatment would be a cheap and easy option while those who store for longer periods microwave heating would be helpful.

Finally, it would concluded that heat treatment is one of the cheap and best methods to maintain the keeping quality with respect to FFA of rice bran before using it as an animal feed.

References

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