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Evaluation of Free Fatty Acid Content in Rice Bran Oil Used in Commercial Poultry Feeding in India

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ABSTRACT

An investigation was made to assess the free fatty acid content (FFA) of rice bran oil (RBO) that are regularly used in commercial poultry feeding. A total of 1815 RBO samples were obtained between 2012 and 2021 from various sources like feed manufacturers, farmers from different parts of the country. The samples were analyzed for FFA content at Animal Feed Analytical and Quality Assurance Laboratory, Veterinary College and Research Institute, Namakkal, Tamil Nadu. The extend usage of RBO has increased and hence, the number of samples submitted for FFA analysis increased gradually from 2012 and 2018 (63 in 2013 to 178 in 2018), but it increased thereafter in 2019 (298), 2020 (322) and 2021 (291). The FFA content was found to be in the range of 0.50 to 38.4% with a mean value of 6.99±0.08 %. From this investigation, it is observed that about 11.0 % of RBO samples tested in the last 10 years had more than 10% of FFA

KEY WORDS: Free fatty acid, Poultry feed, Rice bran oil

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INTRODUCTION

Fats and oils are generally used in poultry diets to increase energy concentration. Fat-enhanced feeds increase the efficiency of feed energy and productivity in poultry. An inclusion of 2-5% dietary fats in the form of oil is recommended by poultry nutritionists to support rapid growth and to improve the deposition of fatty acids in the muscles

(Noy et al., 1995). Among the oils, rice bran oil is commonly used in poultry feed in India. India ranks the second in global rice production and is the largest producer of rice bran oil in the world (Pal and Pratap, 2017). Rice bran oil (RBO) is the oil obtained from the hard outer brown layer called rice husk and it is a byproduct of the rice milling industry with a high smoke point of 232°C. Crude RBO is having lower free fatty acids and is used for the production of edible oil. In the total production, half of it is used as edible oil for humans and the remaining unutilized is diverted towards animal feeding as an energy source in poultry feeding. Broilers fed different rations (with similar nutritive value) containing oil showed better performance and higher digestibility of fat than that fed diet without oil inclusion (Rodriguez et al., 2019).

Free fatty acids (FFA) are the hydrolysis products of the triglycerides present in vegetable oils. The level of FFA formation depends on the exposure of the oil to moisture, temperature and time during storage, processing and heating etc. Kusum et al. (2011) reported that the formation of FFA is due to the presence of lipase in the bran which hydrolyses the triglycerides and glycerol upon storage under favorable conditions, especially in tropical countries like India. Further, undesirable odors and flavors will also form due to free fatty acid formation. During the FFA formation, the chemical structures of the fats get changed and the energy value of the fat becomes reduced. Free fatty acid is a key feature linked with the quality and commercial value of the oil. As early as 1961, Youg observed apparent metabolizable energy values were generally higher for soybean oil, corn oil, lard and tallow than their respective hydrolyzed products. Wiseman and

Salvador (1991) and Vinado et al. (2019) stated that the greater the proportion of free fatty acid in a mixture, the less efficient the absorption of the products of digestion due to reduced bile secretion leading to a reduction in the quantity of FFA entering the micellar phase. Leeson and Summers (2005) stated that rancidity can influence the organoleptic qualities of fat as well as colour and texture and can cause the destruction of fat-soluble vitamins in the feed as well as in the body's stores. The reduction in the dietary energy value following hydrolysis is found to be more pronounced with unsaturated fats (Renner and Hill, 1961; Artman, 1964).

Thus, the level of free fatty acid is one of the important quality parameters for any oils used in animal/ livestock and poultry feeding. Keeping these points in mind, a study has been undertaken to evaluate the free fatty acid content of the RBO used in commercial poultry feeding, as RBO has been the major source of energy for broilers amongst many oils and fats available in South India.

MATERIALS AND METHODS

Sample Collection

A total of 1815 samples of rice bran oil that were intended to be used in commercial poultry feeding, were submitted between the years 2012 and 2021 by feed manufacturers from various parts of India to the Animal Feed Analytical and Quality Assurance Laboratory, Veterinary College and Research Institute, Namakkal, for the FFA content, were used for this study.

Estimation of Free Fatty Acid (FFA) Content.

Free fatty acid content analysis was carried out as per the method of AOAC (2012). The free fatty acid present in the oil sample was estimated by extracting it with alcoholic ether (neutralized) and titrating it with 0.1 N sodium hydroxide. For this, 5 g oil was taken in a conical flask containing 50 ml of neutralized alcoholic ether. After thorough mixing, it was titrated against 0.1 N sodium hydroxide till the formation of permanent pink colour as the endpoint. The free fatty acid content is calculated by using the following formula.

$$\text{Free fatty acids (\%)} = \frac{(\text{Titre value} \times 0.02825)}{\text{Sample weight (g)}}$$

RESULTS AND DISCUSSION

The number of RBO samples submitted for quality testing by FFA analysis was initially low between 2012 and 2018 (63 in 2013 to 178 in 2018) but it increased thereafter in 2019 (298), 2020 (322) and 2021 (291) which showed the importance to assess the quality of RBO especially for its free fatty content. The oils of vegetable origin as a source of energy for broiler chicken are steadily growing in India. The percentage of free fatty acid content in RBO tested during the period from 2012 -2021 is represented in Table 1 and Figure 1. Among the total number (1815) of samples analyzed during this period (2012 to 2021), the FFA was found to be in the range between 0.50 and 38.44 per cent with a mean value of 6.99 ± 0.08 %.

Table 1. Free fatty acid (per cent) content of rice bran oil (2012-2021)

S. No	Year	Number of samples	Distribution of free fatty acid content (%)					Mean ± SE	Range
			0.1 to 5	5.1 to 10	10.1 to 20	20.1 to 30	>30.0		
1	2012	130	15 (11.5)	47 (36.1)	52 (40)	15 (11.5)	1 (0.77)	11.3 ± 0.55	0.5 - 35.7
2	2013	63	16 (25.4)	36 (57.1)	10 (15.9)	1 (1.60)		7.17 ± 0.34	3.35 - 28.5
3	2014	81	35 (43.2)	38 (46.9)	8 (9.9)	-	-	6.32 ± 0.28	0.22 - 16.5
4	2015	158	45 (28.5)	85 (53.8)	23 (14.5)	5 (3.16)	-	7.35 ± 0.35	0.80 - 25.3
5	2016	164	60 (36.6)	91 (55.5)	11 (6.7)	-	2 (1.23)	6.43 ± 0.37	0.53 - 38.4
6	2017	130	43 (33.1)	76 (58.4)	10 (23.3)	1 (0.77)	-	6.58 ± 0.26	2.48 - 25.1
7	2018	178	74 (41.6)	94 (52.8)	10 (5.62)	-	-	6.00 ± 0.21	1.15 - 19.5
8	2019	298	122 (40.9)	162 (54.3)	14 (4.7)	-	-	6.00 ± 0.19	1.31 - 17.3
9	2020	322	94 (29.2)	214 (66.4)	14 (4.34)	-	-	6.59 ± 0.21	2.49 - 20.3
10	2021	291	46 (15.8)	200 (68.7)	43 (14.8)	1 (0.34)	1 (0.34)	7.59 ± 0.29	1.59 - 33.5
Total		1815	550 (30.3)	1043 (57.5)	195 (10.7)	23 (1.27)	4 (0.22)	6.99 ± 0.30	0.5 - 39.0

The value within the parenthesis indicates the per cent values for respective number of samples under each distribution levels of FFA

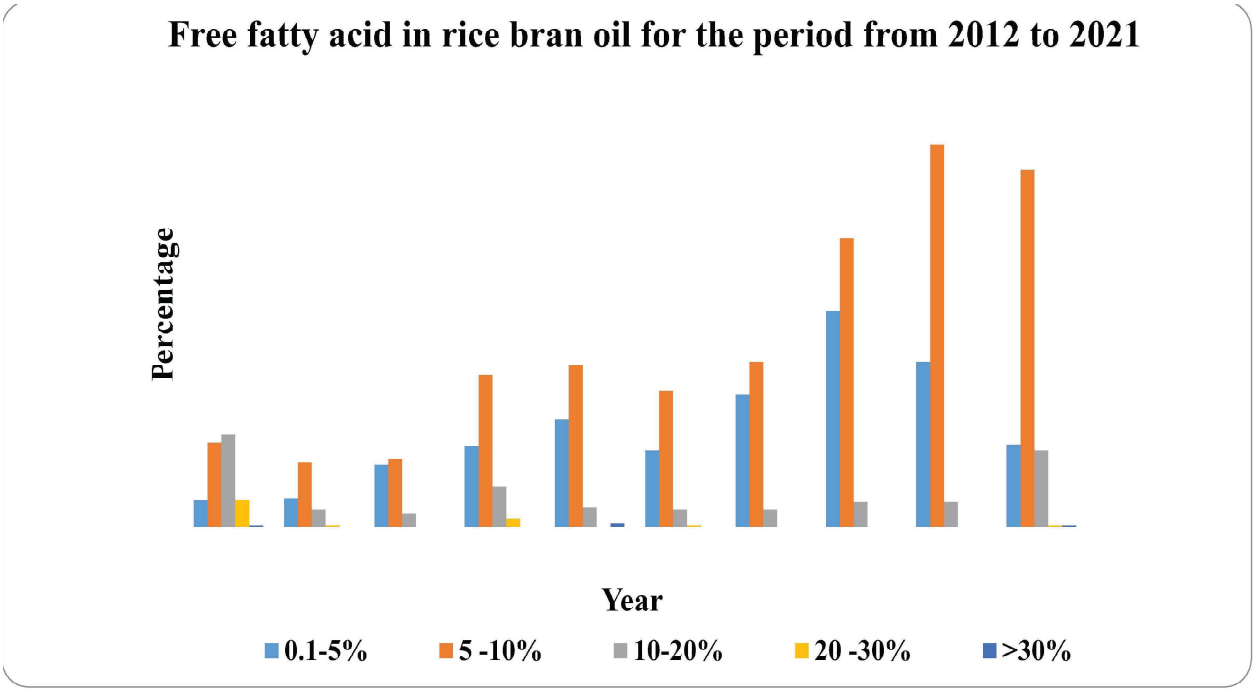

Figure 1. Distribution of FFA content in RBO at different years of sampling

From the table, it is clearly observed that the majority of crude RBO samples fell in the category of < 5 % to 5 - 10 % FFA level which is considered as low FFA or very safe for the use of these oils in the feed for the poultry. However, only the initial year of FFA analysis in 2012 showed 52.3% (68) of 130 samples had > 10% FFA level but the samples received after 2012 did not. From 2013 to 2020, the category of higher FFA (> 10%) showed a declining trend but 2021 witnessed fairly higher FFA content (43, 10.01 to 20.0 and 15.46 %).

The present study revealed that the majority numbers of RBO samples were found to have 5-10% of free fatty acids. The presence of this level may not cause deterioration of feeds meant for fast-growing modern poultry for meat and eggs. However, when FFA values are higher than > 10 %, it would increasingly cause problems by enhanced quality deterioration. Pesti et al. (2002); Wu et al. (2011) reported lower weight gain in broilers when the FFA content in the diet increased. The reduction in weight gain was due to lower feed intake and this may be due to altered physical, chemical or physiological characteristics of the feed reducing the palatability (Rossell, 1994). Kusum et al. (2011) stated that the FFA content of refined oil varies from 2 to 5%, whereas crude oil with high FFA content ranged from 15 to 40 % depending upon the quality of the rice bran from which the oil has been extracted. The type of RBO used in poultry or other animal feed, the type of RBO could be crude rather than refined, as refined oil goes for edible purposes. No doubt, when oils are not refined and are crude, the FFA levels would naturally be showing higher values and in our study also, higher FFA values beyond 10 % were commonly observed. These higher FFA values of rice bran oil would definitely cause absorption efficiency to be disturbed as observed by Sklan (1979) who reported that the absorption efficiency of fat was inversely related to FFA content. In biological experiments Chae et al. (2002) reported that feeding rancid rice bran had a negative effect on the growth performance and lipid stability of meat in broilers. It has been suggested that for each 1% increase in acidity, 10 kcal of metabolizable energy is lost per kg of diet/ ingredient (Barbi and Lucio, 2003). Recently Rodriguez et al. (2019) concluded moderate levels of acid oil (not more than 15%) can be a substitute for crude soybean oil without affecting the body weight gain and fatty acid absorption in the broiler starter diet. Further, he reported higher FFA content leads to low nutritional

value and other factors such as dietary fat saturation degree and age of the chicken also determine the utilization of fat rich in FFA.

Considering the negative effect of higher FFA values on the absorption efficiency of energy and other nutrients affecting the body weight of modern broilers and egg-producing stock, it is imperative to have a quality check on the FFA content of crude rice bran oils used in animal feeding since, at least 11.0 % of rice bran oil samples tested in the last 10 years showed more than 10% FFA which, when only known, could facilitate decision making on the level of use in poultry feed manufacturing.

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