Effect of Solid-State Fermentation on Proximate Composition of Rice Bran Meal

ABSTRACT

Fish farming is often faced with high feed cost comprising approximately 60 to75% of total production costs; these causes decrease in profit margin for the fish farmers. An attempt to upsurge the profit is to minimize the cost of feed as minimal as possible. One way to do this is to explore local feed ingredients that could be used as an alternatives for fish feed. Consequently, farmers use locally available fish feed ingredients including agricultural by-products. These feed ingredients have led to increased pond productivity due to their nutrients constituent andbio-availability. This study evaluate the effect of solid state fermentation on proximate compositions of fermented rice bran meal. Rice bran was collected in three different containers, ground into powder, then sieved and fermented using solid state fermentation procedure. Each sample was solidly fermented at 10% moisture and keep in fermenter at ambient temperature for 24 hours (1 day), 96 hours (4 days), and 168 hours (7 days). Afterward, the fermented samples were oven dried for one hour at 100^{o}C. The fermented samples were taken to the laboratory for proximate analysis. The results obtained from the study shows that, fermenting rice bran for seven days (168hrs) increases the crude protein from 10.53±1.27 to 15.07±1.43 and reduction in crude fibre from 10.74±062 to 7.87±1.71. This study revealed that, solid state fermentation of rice bran meal for one to seven days improved the crude protein and reduces crude fibre and the fermented bran meal can be incorporated as an essential part of the fish feed.

Keywords: Solid-State Fermentation, Proximate Composition, Rice Bran Meal,

1. INTRODUCTION

Rice is the staple food for over half the world's population and the most important among all the cereal crops [1; 3]. Approximately 480 million metric tons of milled rice is produced annually. China and India alone account for 50% of the rice grown and consumed.

In Nigeria rice has consumption per capita of 32kg indicating 4.7% increase in the past decade making the total consumption to be 6.4 million tonnes in 2017 as against 3.7 million tonnes produced per year [4; 12,27,28,29,30].

Rice is the world's major cereal and is the main food grain that is eaten in India and other parts of Asia. Paddy milling to produce edible rice grain yields two major economic and nutritionally important items, namely paddy husk and rice bran [8; 10]. Paddy husk does not have any value

for food, but it has many industrial applications. However, rice bran can serve as a food supplement for humans, as a valuable source of edible oil and as animal feed [5; 6].

Rice bran is the brown coating accomplished by dehusking paddy and polishing the rice in the white starchy rice kernels. Though white rice has no nutritional value, the bran that is extracted contains 65% of the nutrients of the rice kernel and has a multitude of health benefits. Rice bran contains 11-17% of protein, 12-22% of oil, 10-15% of moisture, 6-14% of fiber and 8-17% of ash. It is rich in minerals and vitamins such as aluminum, calcium, chlorine, iron, magnesium, manganese, phosphorus, potassium, sodium and zinc and vitamin E, thiamine and niacin. Rice bran often contains a decent amount of nutraceutical compounds and approximately 4% unsaponifiables, most of which are natural antioxidants (approximately 100) such as oryzanol, tocotrienols and tocopherols [6; 7]. There is a number of bioactive phytochemicals present in both bran and rice bran oil with the ability to minimize the risk of chronic degenerative diseases [11; 14; 19]. The nutritional value of the protein concentrated in the rice bran is exceptional and somewhat similar to that of any other cereal and legume endosperm protein. Rice bran proteins are highly digestible and rich in essential amino acids, especially lysine, so they can be used to enrich food recipes as ingredients. This study investigate the effect of solid state fermentation on proximate composition of rice bran meal.

2.0 MATERIALS AND METHODS

2.1 Experimental Location

This research was conducted at the Nutrition lab of the Department of Fisheries Technology, School of Agriculture, Yobe State College of Agriculture, Science and Technology Gujba, Yobe State, Nigeria.

2.2 Source of Experimental Ingredients

Rice bran was procured from feedstuffs market Damaturu, Yobe State.

2.3 Processing and Fermentation of Rice Bran

Rice bran was collected in three different containers, ground into powder, then sieved and fermented using solid fermented procedure as described by [124]. Each sample was solidly fermented (wet at 10% moisture and keep in fermenter at ambient temperature) for 24 hours (1 day), 96 hours (4 days), and 168 hours (7 days). Afterward, the fermented samples were oven dried for one hour at 100^{o}C as described. The fermented samples were taken to the laboratory for proximate analysis.

2.4 Proximate Composition of the Fermented Rice Bran

The fermented rice bran at various fermentation periods were analysed for crude protein, crude fibre, crude lipid, ash and a nitrogen free extracts according to Association of Official Analytical Chemist Methods [3]

Determination of Moisture

The moisture content of the samples was determined by weighing the samples and oven dried at 80^{o}C for 24 hours. The loss in weight gave the moisture content of the original sample.

Moisture (%) = =

W_1 = Weight of crucible

W_2 = Weight of crucible + sample

W_3 = Weight of crucible + sample after drying

Determination of Ash

The ash content of the samples were determined by the method described by [3].

Determination of Crude Lipid

The crude lipid was determined by the continuous solvent extraction method in a Soxhlet apparatus as described [15].

Determination of Crude Fibre

The crude fiber was determined by the Weende method described [3].

Determination of Crude Protein

The protein content of the samples were determined by the Kjeldhal method reported by [3]. The total nitrogen was determined and multiplied by the factor, 6.25, to obtain the protein concentration or content.

Determination of Carbohydrate

The carbohydrate content of the test samples were determined by estimation using the arithmetical difference method described by [3]. The carbohydrate content was calculated and expressed as the nitrogen free extract.

2.5 Statistical Analysis

All data generated are subjected to descriptive statistics to determine the mean values and then subjected to analysis of variance (ANOVA) at 95% probability level where the significant differences were detected. Means values were separated using Least Significant Difference

(LSD). All data were analyzed using SPSS (Statistical Package for Social Sciences) version 20.0 Statistical Package.

3.0 RESULTS

3.1 Proximate Composition of the Fermented Rice Bran

The proximate analysis of the fermented rice bran revealed that, the highest percentage moisture content was recorded in the 168 hours (7 days) fermentation with 17.20±1.11 and the lowest was recorded in the zero hour (control) fermentation with 10.25±0.64. There is a significance difference ($P<0.05$) between the treatments. The percentage dry matter content recorded was highest in zero hour (control) fermentation with 89.75±1.52 and the lowest was recorded in 168 hours (7 days) fermentation with 82.80±1.65. The highest percentage ash was recorded in zero hour (control) fermentation with 8.31±0.63 and the lowest was recorded in 168 hours (7 days) with 5.46±1.82. The highest percentage crude lipid recorded was found in 168 hours (7 days) fermentation with 8.08±0.52 and the lowest was recorded in zero hour (control) fermentation with 6.46±1.38 while the highest percentage crude fibre was recorded in zero hour (control) fermentation with 10.74±0.62 and the lowest was recorded in 168 hours (7 days) fermentation with 7.87±1.71. The highest percentage crude protein was recorded in 168 hours (7 days) fermentation with 15.07±1.43 and the lowest was recorded in 0 hour (0 day) fermentation with 10.53±1.27. There is a significance differences ($P<0.05$) between day seven and other treatments. The highest nitrogen free extract was recorded in zero hour (control) fermentation with 53.71±1.82 and the lowest was recorded in 168 hours (7 days) fermentation with 46.32±0.79. There is a significance difference ($P<0.05$) between the treatments as shown in table 1.

Table 1: Proximate Composition of Fermented Rice Bran Meal (g/100g)

Parameters	0hr (0day) Fermentation	24hrs (1day) Fermentation	96hrs (4day) Fermentation	168hrs (7day)Fermentation
Moisture	10.25 ± 0.64^{d}	11.65 ± 1.25^{c}	15.60 ± 1.56^{b}	17.20 ± 1.11^{a}
Dry Matter	89.75 ± 1.52^{a}	88.35 ± 1.09^{b}	84.40 ± 1.54^{c}	82.80 ± 1.65^{d}
Ash	8.31 ± 0.63^{a}	7.58 ± 1.85^{b}	5.94 ± 1.24^{c}	5.46 ± 1.82^{d}
Crude Lipid	6.46 ± 1.38^{c}	7.43 ± 0.76^{b}	7.78 ± 0.25^{b}	8.08 ± 0.52^{a}
Crude Fibre	10.74 ± 0.62^{a}	9.10 ± 1.87^{b}	8.18 ± 1.47^{c}	7.87 ± 1.71^{c}
Crude Protein	10.53 ± 1.27^{c}	10.94 ± 1.68^{c}	12.24 ± 1.79^{b}	15.07 ± 1.43^{a}
NFE	53.71 ± 1.82^{a}	53.30 ± 0.54^{a}	50.26 ± 0.12^{b}	46.32 ± 0.79^{c}

Means in the Same Row with Different Superscripts are Significantly Different ($P<0.05$)

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4.0 DISCUSSION

The result obtained from the proximate analysis of the fermented rice bran meal revealed that, one hundred and sixty eight (168) hours (7 days) fermentationhad the best percentage crude lipid and crude protein level and the lowest crude fibre compared to others. The variation observed from the values often exists during the process of chemical analysis of the fermented rice bran meal was due to the variation in the fermentation period as reported by [2;12]. This occurred as a result of fermentation level which improve the protein composition, reduce anti-nutrients substances and crude fibre content of the fermented rice bran meals. This result is in line with findings by [21, 22] who reported that fermentation increase crude protein and decrease fibre content of un-sieved yellow maize. The results also agreed with the findings by [26] who reported that fermentation of wheat bran with a mixed fungal strains reduce crude fibre level of the ingredient and improves protein content. [5; 13] who reported that fermentation of wheat bran improves protein content and reduces crude fibre content and anti-nutrients of the wheat bran. Nitrogen free extract (NFE) values recorded from this study was lowest in one hundred and sixty eight hours (168) fermentation and the highest was in zero hour (control) fermentation. This result is comparable with the values reported by [17; 18] who reported that fermentation improve the protein content and decrease nitrogen free extract of wheat bran as a functional ingredient in baking. This result is in agreement with the findings of [20; 23] who reported a reduction in the NFE values of fish diet with growth promoters.

CONCLUSION

The results obtained from this study revealed that, solid state fermentation method improve the proximate composition of the fermented rice bran. The study also revealed that, fermenting rice bran for one to seven days improve crude protein and reduce crude fibre with the best results obtained in seven days compared to others. This study also revealed that fermented rice bran for seven days using solid statefermentation method can be incorporated in to the fish feed for optimum utilization and cost efficiency.

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