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Quality Estimation of Brewer's Spent Grains and its Potential: A Product of Beer Industries.

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ABSTRACT

Proximate analysis were carried out on Brewer's spent grain (BSG) and some poultry feed samples used as starter and grower which were sourced from Enugu metropolis, Nigeria. The mineral compositions of the BSG and poultry feeds were determined using Atomic Absorption Spectrophotometer (AAS) and results obtained ranges as follows; Ca 0.03– 0.08%,Mg 0.16-0.34%,K 0.34-1.11%,P 0.41-0.65%,Na 0.01-0.01%,Iron 118.22-215.70mg/kg, Mn 19.80-52.17mg/kg and Zn 41.01-68.54mg/kg; it's proximate composition ranged from 17.50-22.84% protein,7.54-855% moisture,4.39-7.86% crude fibre,5.76-7.25% ash,4.05-5.49% Lipid,51.66-54.35% Carbohydrate,1352.58-1361.945MJ/kg for total Energy,8.23-8.18% for cellulose,8.38-8.57% for Hemicellulose and 45.49-51.03% for Nitrogen Free Extract(NFE). While the mineral composition for Brewer's spent grain were as follows; Ca 0.17%,Mg 0.23%,K 0.05,P 0.61%,Na 0.01%,Iron 110.37mg/kg, Mn 51.52mg/kg, Zn 21.53mg/kg and 14.30.683MJ/kg, Cellulose 18.87%,Hemicellulose 22.26% and 26.18% for Nitrogen Free Extract(NFE); its proximate compositions is as follows: Moisture 12.64%,Protein 25.03%,Crude fibre 10.44%,Ash 4.63%,Lipid 10.64% and Carbohydrate 36.62%. However, when compared these result with NRC (2001) and Westendorf and Wohlt (2002) nutrients data bases for brewer's spent grain, they were found to be within the range. The results were subjected to one way analysis of variance (ANOVA) ($P<0.05$).

Keywords: *Brewer's spent grains, nutritional value, Animal feed.*

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I. INTRODUCTION

Few years ago, beer industries has showed a significant progress by the new technologies introduced in existing technologies which aids in the development of new products: special beer, non alcoholic beer, beer colour products, yields and quality finite product improvement, and complex turning account of by- products. (Banu, 2001). Beer also is the fifth most consumed beverage in the world apart from carbonated, tea coffee and milk with an estimated annual world producing exceeding 1.34 billion hectoliters in 2002 (Fillaudeau et al., 2006). In the cause of beer and malt production as well, different residues and by-products are generated such as cereal wastes, malt rootlets, spent hops; proteic sediment (hot break, cold break) brewer's yeast spent grains and carbon dioxide, e.t.c. Among all these by-products, spent grains hold the most weight out of all obtained from the manufacturing of beer (Mussatto, 2009). Spent grain there is the main by-products generated, and are also the by-products of mashing process; which is one of the initial operations in brewery in order to solubilized the malt and cereal grains to ensure adequate extraction of quality and quantity of the spent grains obtained from the manufacturing of beer, depending on the mash filteration method and the quantity of the raw materials used in the technological process. For example, the spent grains obtained at the mash filteration in lauter tons represents 100÷150kg/100kg matt and have 70÷80% humidity (Banu, 2001; Dabija, 2002; Tang et al., 2009). McDonalds et al (1973), accounts for 30+60% of the biochemical oxygen demand (BOD) and suspended solids (SS) generated by a typical brewery. It was reported that about 3.4 million tons of BSG in the EU are produced from the brewery industries every year (Stojceska et al., 2008), out of which UK alone contributes over 0.5million tones of this waste annually. However, Brazil, the world fourth largest beer producer (8.5 billion litres/year) in 2002, generated -1.7 million tons of BSG (Mussatto et al., 2006). Thus, BSG is a readily available, high in volume and low cost of by-product of brewery and is a potentially valuable resource for industrial exploitation (Robertson et al., 2010). Several attempts have been made in utilizating BSG in animal feeds, production of value-added compounds like Lactic acid, Xylitol, which is a sweetner that can be used to combat dental carriers and treat diabetes, cultivation, or simply as a raw material for extraction of compounds such as acids and antioxidants, proteins and sugars (Mussatto et al., 2007a). BSG, if submitted to a fractionating process under adequate temperature, it may produce liquor rich in xylose, a sugar that can be used as a carbon source for xylitol or effective ethanol production. BSG can serve as an adsorbent for removing organic materials from effluents, removal of organic dyes in waste water which is very important to the textile and dye industries for or during wet processing, and immobilization of different substances (Loancea and Kathrein, 1988; Mussatto S.I. and Roberto I.C., 2008). BSG can as well be utilized for biogas production when digested anaerobically. They produced 58-65% methane and the sludge generated thereafter can provide high quality manure since nitrogen content of the stabilized bio-waste increased at the end of the digestion as revealed by the proximate analysis. Also, they are of high nutritive value (Alam et al., 2007), and contain lignin, hemicelluloses, cellulose and high protein content. However, it is estimated that the annual production of plant biomass in nature, of which over 90% is lignocelluloses, amounts to about 200 x 10^9 tons per year, where about 8 x 10^9 tons of the primary biomass remains potentially accessible. Hemicellulose, which is generally 20 to 35% of lignocelluloses amount to nearly 70 x 10^9 tons per year (Chandel et al., 2010).

II. MATERIALS AND METHOD

2.2.0. MATERIALS AND METHOD

2.2.1 Reagents

All reagents and chemicals were of analytical grade sulphuric acid, copper sulphate, potassium hydroxide, boric acid, methyl blue, Distilled water methyl red ,zinc metal, Atomic Absorption Spectrophotometer(AAS) sodium sulphate, N-Hexane , methanol, hydrochloric acid and were all made up of BDH Chemicals industries poole England and May and Baker company limited Dagenhan, England.

2.2.2 Brewer's Spent Grain (BSG) and Poultry Feed Samples Collection.

For the determination of the nutritive and Mineral Constituent of the samples, the BSG were sourced from beer producing company in Enugu, and poultry feed were as well sourced from Abakpa market, Enugu all in Enugu state, Nigeria. About 500g of each of the samples were collected respectively.

2.2.3 Sample preparation for poultry feed and BSG especially BSG. Why I said especially BSG was that BSG has high moisture content which has to be reduced to some extent before the commencement of the analysis.

Brewer's spent grain were air dried at ambient temperature for 48hrs. However, both samples were ground separately using a Mammonlex super blender mill greater (No 4 AO-0018,Type JW-1001,China), shifted through a stainless steel screen having a mesh size of 1.0mm to obtain a uniform particle size for analysis.(Mahesar et al.,2010).

2.2.4 Analytical methods for proximate and mineral compositions of BSG and poultry feed.

For the determination of minerals constituent, about 0.5g of each of the ground samples were digested with $HClO_4$ and HNO_3 Which lasted for 2hrs and were allowed to cool. Thereafter, the digested sample were transferred into 250ml volumetric flask and were make up with distilled water. The samples were then ready for analysis using Atomic Absorption Spectrophotometer (AAS) with model no 210 VGP.

For the proximate analysis of BSG and poultry feeds, Association of Official Analytical Chemist recommended methods (AOAC, 1990), Official methods and recommended practice of American Oil Chemist Society (AOAC, 2005) and Pearson D. (1976) were used to measure the level of crude protein, ash, moisture, crude fat and crude fibre.

Moisture

An accurately weighed BSG and poultry feed sample (2g) was placed in a petri dish and dried in a previously heated oven at 105^0C to a constant weight.

Protein

The micro Kjeldahl method was used for the Nitrogen (N) determination and crude protein determined by multiplied with a protein factor (N x 6.25).

Ash

Accurately weighed sample 2g each was placed in a platinium crucible and subjected to ashing in a muffle furnace maintained at 550^0C until a constant final weight for ash was achieved.

Fats and Oil

For the fat extraction, approximately 10g each finely ground BSG and poultry feeds were placed in a filter paper, rapped and inserted in the thimble and fat extraction was carried out using N-Hexane in a 250ml Soxhlet extractor for 3hrs.

Crude Fibre

Dietary fibre content of the defatted poultry feed and BSG samples were determined by decomposition starch and protein with dilute acid, while fatty material with dilute base, and then filtration and igniting in the muffle furnace at 550^0C.

Carbohydrate

Total carbohydrate was calculated by difference [100 – (protein + crude fibre + moisture + fats and oil + ash)] as reported by (Akubor et al., 2000).

Nitrogen Free Extract (NFE) was calculated by difference as: NFE= Total Carbohydrate - Crude fibre.

Energy Value

The energy values of the feed and BSG were calculated in mega joules by multiplying the factors of fat, protein and carbohydrate 37.7, 16.7 and 16.7% respectively as reported by (Ekanayake et al., 1999).

2.2.5 Statistical Analysis

Descriptive statistics for all parameters were calculated in triplicate Analysis of variance (ANOVA) to access if they were no significant variations ($P<0.05$) between the feeds and were as well reported as means standard deviation.

III. RESULTS AND DISCUSSSION

Result.

Table 1. Poximate Compositions of BSG and Poultry feed Samples.

Parameters (%)	BSG	Starter Poultry Feed	Grower Poultry Feed	NRC (STD)
Moisture	12.64	7.54	8.55	
Protein	25.03	22.84	17.50	
Crude fibre	10.44	4.39	7.86	
Ash	4.63	5.76	7.25	4.60
Lipids	10.64	4.05	5.49	
Carbohydrate	36.62	55.42	53.35	
Cellulose	18.87	9.37	8.23	
Nitrogen Free Extract (NFE)	26.18	51.03	45.49	
Hemicellulose	22.26	8.57	8.38	24.50
Energy (MJ/kg)	1430.683	1352.58	1361.945	

Table 2. Mineral Compositions of BSG and poultry feeds.

Parameters (%)	BSG	Starter Poultry feed	Grower Poultry feed	NRC (STD.).
Ca	0.17	0.08	0.03	0.01-0.32
P	0.61	0.65	0.41	0.01-0.63
Mg	0.23	0.34	0.16	0.01-0.65
K	0.05	1.11	0.34	0.01-0.48
Na	0.01	0.01	0.01	0.001-0.02
Mn (mg/kg)	51.52	52.17	19.80	
Iron (mg/kg)	110.37	215.70	118.22	
Zinc (mg/kg)	42.23	68.54	41.01	

IV. DISCUSSION

The major nutrients value of any substance using in the formulation of poultry feeds diet are protein, fats and oil, crude fibre, energy and moisture (SCAN, 2003). However, looking at most important nutrient which is crude and protein which is used to qualifies any prospective feed due to the fact that it is one of the most costly to supply and a deficiency of protein has drastic effect on growth and production for both man and animal (Tang et al., 2009). Meanwhile, various diets are commonly utilized for poultry feeds depending on the bird production stage, and most important stage in the stages involved are starting and growing stages. Therefore, comparing the protein content of BSG and poultry feeds, the BSG indicates a higher protein content of 25.03% than the poultry feeds whose value ranges from 19.46 – 22.84% for both the starter and grower feeds respectively. There were no significant difference observed as such in the samples (P>0.05). Crude fibre represents the non starch carbohydrate fractions of the feeds. It's considered the cell wall material of the plant which composed primarily of cellulose, hemicelluloses and lignin and they are also considered as a non-digestible polymers (Ozturk et al., 2002). However, comparing the BSG to the poultry feeds, which indicates higher crude fibre content which is necessary in poultry diets, for the growth of the poultry animals. The ash content of a poultry feeds relates to the inorganic mineral content. In comparism of the BSG ash content which is 10.44% to that of poultry feeds who ranges from 4.39 – 7.86%, it was observed to have no significant difference in all(P<0.05). Fats and Oil found in poultry diets are often incorporated to enhance the energy levels (Dhiman et al., 2003). However, comparing between the fats and oil of BSG to poultry feeds, BSG showed a higher value of 10.64% than poultry feeds which ranges from 4.05 – 5.49%. For carbohydrate, poultry feeds showed a higher value of 53.35 -55.42% when compared to BSG which showed a lower value of 36.62%. However, carbohydrate has been known as an essential and good source of energy and the major contributors among the mineral nutrients to the poultry diets which usually occur as starch which easily digested by poultry (Kaur and Saxena, 2004). The energy value in the poultry feeds and BSG were determined and their value ranges from 1352.58 -1361.945MJ/Kg, While BSG gave 1430.683MJ/Kg and there were no significant difference observed in the samples. However, the recommended energy value according to (NRC, 1994) for poultry depends upon the age, nature, stages of production and environmental temperature.

V. CONCLUSION

Following the results obtained in the analysis, there were no much variation between the BSG and poultry feeds. However, recent advances in biotechnology ensure that brewer's spent grain (BSG) can no longer be regarded as a waste but rather a feedstock primarily for birds, cattle, pigs, goat, fish and just about any other livestock and as well for production of several products(Loancea and Kathrein, 1988). Meanwhile, a diet of up to 25percent BSG is ideal for livestock (NRC, 2001). Thus, base on these fact, and the undeniable evidences which BSG has shown, proof its potential importance for sustainable through biotechnological processes. Finally, more insight is required for large scale utilization, and farmers especially those on poultry could as well take advantage of

BSG because of its composition and nutritive value as a choice of feed and its ration for the better growth and health of the poultry basis of cost, palatability and energy.

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