Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol 2, No.2, 2012

Production of Cellulose from Barley Husks as a Partial Ingredient of Formulated Diet for Tilapia Fingerlings

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Abstract

Cellulose is the most abundant renewable polysaccharide on earth and it is widely used in many aspect and industries such as food industry, pharmaceutical, and many more. Due to the increasing demand in the market, studies and work to produce cellulose are still rapidly developing. In this study, barley husks was pretreated in hot water at 100°C and followed with liquid oxidation process with 30% H_2O_2 at 60°C. Through the hot water treatment, cellulose in the barley husks was successfully recovered as glucuronic acid, saccharides, cellulose and thus leaving fats. Results obtained also show that after treatment, the barley husks is made up 66.00% cellulose. This cellulose can be used as source of the digestible carbohydrate in fish feed which can help in reducing the cost of feed production.

Keywords: Barley husks, hot water treatment, liquid phase oxidation, cellulose

1. Introduction

The current study was focused on the utilization of barley husk as a feedstock to produce a value-added product, namely cellulose .However, barley husk, a by-product of the barley germination. Barley is a valuable agricultural crop, grown in large quantities around the world (Nilan and Ullrich, 1993). The the barley husk amounts to 15–20% of the dry weight of the grain (Bhatty, 1993; Palmer and Bathgate, 1976). More than one third of the husks consist of celluloses (Höije *et al*., 2005). The cellulose can be separated by various extraction and isolation methods, and then utilized in a number of ways, such as pharmaceutical, and formulation of good quality diets .The aims of the present study was focused on the extraction and determination of cellulose from barley husks, (by- product of the barley germination) for the use of fish feed formulation, which can help in reducing the cost of feed production.

2. Material and methods

2.1. Raw material

For this study, samples of barley seeds of varieties De-canter and Chariot. Where were harvested in 2010 were imported from Libya. The barley husks was washed, and then dried in an oven at constant temperature. Oil from barley husks was removed by using conventional Soxhlet extractor. The

extractive-free sample (barley husks) was dried in an oven at 60°C for 18 hours and stored in refrigerator before use.

2.2. Isolation of cellulose

Extraction of cellulose from barley husks was involving a two-step modified liquid phase oxidation method of Kazuhiro Mae *et al* (2000). Hot water treatment is pretreatment step of cellulose extraction. Hot water treatment was performed in cooking pot, which filled with barley husks and of distilled water. The reaction was heated to a temperature of 100°C. After 30 min of hot water treatment, the cooking pot was soaked into cooling water in order to terminate the reaction. The pretreated barely husks was washed with distilled water and ethanol to remove the organic acid and saccharides, then dried and sieved to 600 µm.

Liquid phase oxidation was the performed to remove any residue material like organic compounds and solid residue from barley husks and remain the pure cellulose, by washed with 30% H_2o_2 treatment and Kept for 24 hours at temperature of 60-80 °C in oven. The scheme of extraction stages for cellulose from barley husks is shown in figure.1.

2.3. Analyses of products and yield measurement

2.3.1. Analytical Reagents

The reagents (0.255N sulfuric acid and 0.313N sodium hydroxide) were prepared in Laboratory of analytical chemistry of chemistry department, Faculty of Science and Technology, University Malaysia Terengganu (UMT), Kuala Terengganu, Malaysia

2.3.2. Procedural Schematic

3 g sample +200 ml H_2SO_4 solution, boiling 30 minutes. Filtration. Re dissolve residue in 200 ml NaOH solution. Boiling 30 minutes. Filter. Dry, weight (P1) Calculate. Re weight (P2)

$$Cellulose\ \% = (P1-P2)\ x100\ /\ 3$$

2.4. Statistical analysis

The data were getting from this study subjected to analysis of t-test to determined the percent of cellulose in barley husk by using Gen stat 5 program

3. Results and Discussion

Based on the experiments and modifications, the cellulose concentrations were calculated with the calculated and Weende methods. The results observed that concentration of cellulose was 66% by using calculated and Weende without any significant different at 0.01 between the methods .This result is agreement with Microwave irradiation as a screening method (Roos *et al*; 2009). The results indicate a rapid, easy and low costly in determination of cellulose e in barley husk. Therefore, an experimental design was performed to improve the cellulose determination in barley husk by modifying, the changes

in preparation of extraction method. In this case good agreement was obtained by krawczyk *et al* (2008) and commonly used method based on chemical methods. Good agreement between these procedures was also found in the analysis of cellulose from several barley husk products.

4. Conclusions

Liquid phase oxidation using H_2O_2 was presented for separating and recovering cellulose from barley husks. The method consists of hot water treatment and oxidation with H_2O_2 in liquid phase. As an option, water soluble organic compounds obtained in oxidation stage. Cellulose from barley husks was converted as saccharides through the hot water treatment, leaving cellulose for oxidation stage. The residue materials like organic compounds and solid residue from barley husks was dissolved as soluble organic compound after the oxidation with H_2O_2 and remain the pure cellulose. This method has been shown to be a possible method for extraction of cellulose from barley husks. The result shows, the average of cellulose yield about 66%. The Barley husk is good source of cellulose .This material would provide a useful addition at feed formulation already using barley husks for cellulose production.

5. Recommendation

This study has provided valuable baseline data on the extraction of cellulose from barley as a partial ingredient of formulated diet for tilapia fingerlings (*Oreochromis niloticus*) a freshwater fish species and has also been able to help in reducing the cost of feed production. The proximate composition of experimental diets (g/100/DM) prepared for Nile tilapia (*Oreochromis niloticus)* by Ighwela *et al* (2011) in Table. 1.

6. Acknowledgements

Financial support for this study was provided by scheme scholarship Higher Education of Libya and these are acknowledged with gratitude.

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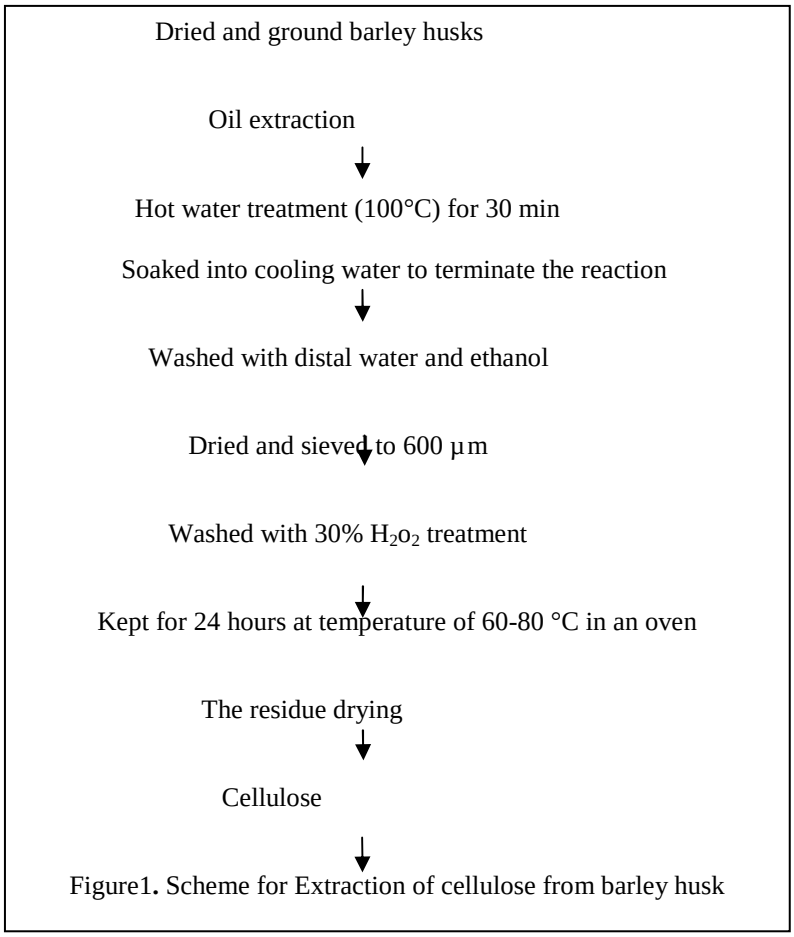

Figure1. Scheme for Extraction of cellulose from barley husk

Table1. Proximate composition of experimental diets (g/100DM) prepared for Nile tilapia (*Oreochromis niloticus*) by Ighwela *et al* (2011).

Ingredient	**Feed A**	**Feed B**	**Feed C**	**Feed D**	**Feed E**
Fish meal	12	12	12	12	12
Soya bean	38	38	38	38	38
Wheat flour	10	10	10	10	10
Maltose	0	20	25	30	35
Cellulose	**35**	**15**	**10**	**5**	**0**
Palm oil	3	3	3	3	3
Mineral premix	0.5	0.5	0.5	0.5	0.5
Vitamin premix	0.5	0.5	0.5	0.5	0.5
Vitamin C	0.4	0.4	0.4	0.4	0.4
Binder (CMC)	0.5	0.5	0.5	0.5	0.5
Chromic oxide	0.1	0.1	0.1	0.1	0.1
Total (%)	**100**	**100**	**100**	**100**	**100**