"ENZYMATIC DEGUMMING OF RICE BRAN OIL AND PRODUCTION OF HIGH QUALITY FOOD GRADE RICE BRAN LECITHIN"

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ABSTRACT

A study of enzymatic degumming of rice bran oil and production of high quality food grade rice bran lecithin was carried out. The experiment was done on two different types of crude rice bran oil using Lecitase –ultra enzyme and found that the results were comparatively better with the crude rice bran oil having low acid value (10) and low colour (30 units in ¼ inch).Different experiments based on the variables like pH of buffer solution, time of reaction and temperature of reaction were carried out. The best result observed when we filter the crude rice bran oil and passing it through magnetic separator with pH 5, temperature 55^0C and reaction time 5.5 h. The lecithin obtain was best in quality and nearby to the specification of food grade lecithin. The quality of degummed oil was also much better.

KEYWORDS: Enzymatic degumming, Lecitase-ultra enzyme, rice bran oil, magnetic separator, food grade lecithin, degummed oil.

INTRODUCTION

Rice bran oil is one of the best cooking and salad oil because it has high smoke point and tasty flavor[1] .The rice bran oil is rich in different valuable nutraceuticals like oryzanol, tocopherol, tocotrienol, sterol and squelene. Rice bran oil has high content of phosphatides (up to 1.5%), and this create problem in oil refining. It has two types of phosphatides, hydratable (HP) and non hydratable (NHP).

The rice bran oil has different health benefits[2] .It has balanced fatty acid composition, best oil for improving serum cholesterol level, suitable for stir frying or deep frying, less stick to the food and so less absorbs by the food, rich source of vitamin E and so it is good for human health. Rice bran oil also have antithrombotic and anti cancer properties.

There are different types of degumming process[3] like water degumming, acid degumming, super degumming, total degumming[4], dry degumming, enzymatic degumming[5], membrane filter degumming, impact degumming by Desmet[6] etc.

This paper is based on enzymatic degumming of rice bran oil and production of high quality food grade rice bran lecithin. In enzymatic degumming the phosphorus content of crude rice bran oil can reduced up to less than 5 ppm after bleaching.

In the enzymatic degumming[7] process the non hydratable phosphatide (lecithin) is converted into partially hydratable phosphatide (lysolecithin) by using Lecitase ultra enzyme and this lysolecithin may be much better o/w emulsifier because of its properties.

Due to its emulsifying and drying properties, the lecithin has different applications like in food industry as an emulsifying agent, in baking, in aquaculture, as antioxidant, in cosmetic. Lecithin also used in pharmaceutical industry as a stabilizing, wetting and dispersing agent. The global scenario of lecithin usages[8] in margarine (25-30%), baking/chocolate & ice cream (25-30%), technical products (10-20%), cosmetic (3-5%) and in pharmaceutical (10-12%). The enzymatic degumming is also cost saving process as compare to acid degumming.

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MATERIALS AND METHODS

Materials

Two sample of crude rice bran oil were obtained from Mantora oil Pvt. Ltd.Kanpur. The crude oil was degummed under different experimental conditions of temperature, time and pH value of buffer solution. Lecitase ultra enzyme from Novozymes was used for experiments. Citric acids, caustic soda (NaOH), acetone used in experiments were of analytical grade.

The analysis of crude rice bran oil of low acid value and low colour as below

- Acid value – 10
- Gums – 1.0%
- Colour – 15 Y +3 R=30 Units in 1/4"
- Wax - 2%
- Flashpoint – 120^0C
- MIV- 0.5%
- Bleachability – 40% with 3% tonsil earth at 80 deg temp.
- Fatty acid composition-

  Palmitic - 15.79% ,Stearic - 2.71%

  Oleic - 38.40% , Linoleic - 39.47%

  Linolenic - 0.74%

Methods

Preparation of solutions

Buffer solution - (For 500 g crude oil) Buffer solution is made by dissolving 0.065% of citric acid and 0.025% of NaOH in 7.5 ml water. The pH of buffer solution should be in b/w 4.8-5.5 for Lecitase – ultra enzyme.

Enzyme solution - (For 500 g crude oil) the enzyme solution is made by dissolving 0.027 g of the enzyme in buffer solution.

The experimental procedure[9] **- (with Lecitase – ultra enzyme)**

1. Take crude rice bran oil (500 g) in a 1 liter beaker and heated up to 50-55^{0}C for 30 min with continuous stirring.

2. Add the enzyme solution.

3. Perform high shear mixer for about 90 sec.

4. Run the reaction on a magnetic stirrer at 50-55^{0}C temp for about five h.

5. After the reaction is complete increase the temp. to 85^{0}C so that enzyme deactivates.

6. The oil was centrifuged to remove the gums.

7. Evaporate the moisture.

8. Give acetone wash and calculate p content

RESULTS AND DISCUSSIONS

The experiment was focused on crude rice bran oil having low acid value (10) and low colour (30 units in ¼ inch) as second sample of crude rice bran oil which have high acid value (39) and high colour(50 units in ¼ inch) was poor in quality and so the result. The results were also not satisfactory when the experiments carried out without filter and without passing the crude oil through magnetic separator as the HIS of lecithin was high. The experiments were carried out for different temperature, reaction time and Ph value of buffer solution and the efficiency of degumming and the quality of lecithin was evaluated based on hexane insoluble (HIS), acetone insoluble (AIS), colour, moisture, acid value of lecithin and phosphorus (P) content of degummed oil. In my experiment, first I kept pH, time constant and temperature as variable and observed the results,

Table 1- pH, time constant and temperature as variable

S.no.	pH	Time (h)	Temp (^{o}c)	P-content (ppm)	Colour	Moisture (%)	Acid value	HIS (%)	AIS (%)
1	5	5.5	45	80	21	0.8	19.5	0.5	44
2	5	5.5	50	40	21.5	0.7	19.5	0.5	49
3	5	5.5	55	18	17	0.6	20	0.5	57
4	5	5.5	60	42	22	0.8	20	0.5	48

Now I kept pH, temperature constant and time as variable and observed the result,

Table 2- pH, temperature constant and time as variable

S.no.	pH	Time (h)	Temp (^{o}c)	P-content (ppm)	Colour	Moisture (%)	Acid value	HIS (%)	AIS (%)
1	5	3.5	55	120	22	0.9	21	0.5	40
2	5	4.5	55	70	20	0.8	20	0.6	47
3	5	5.5	55	18	17	0.6	20	0.5	57
4	5	6.5	55	30	18	0.8	21	0.5	52

Now I kept temperature, time constant and pH as variable and observed the result,

Table 5.3- temperature, time constant and pH as variable

S.no.	pH	Time (h)	Temp (^{o}c)	P-content (ppm)	Colour	Moisture (%)	Acid value	HIS (%)	AIS (%)
1	4	5.5	55	95	22	0.9	21	0.5	40
2	4.5	5.5	55	65	20	0.8	20	0.6	47
3	5	5.5	55	18	17	0.6	20	0.5	57
4	5.5	5.5	55	30	18	0.8	21	0.5	52

From above experiments and corresponding results it is clear that when the experiments done at time 5.5 h, temperature 55^0C and pH 5 the result of lecithin is much better, which is nearby to the specification of food grade lecithin. We have also observed the quality of degummed oil which is also much better at above parameter of time, temperature and pH.

There are few other factors that also affect the quality of rice lecithin, such as drying of gums at higher temp. 100^0C or above at atmospheric pressure, the moisture goes down but the colour of lecithin increases and when we dried the lecithin at lower temperature (less than 80^0C) and under vacuum the colour of lecithin goes down.

Filtration of crude oil is also very essential to separate fibers and other suspended impurities from the oil, because these are responsible for higher HIS in rice lecithin and which is not good for food grade lecithin.

Metal (iron) impurities also responsible for the deterioration of the quality of lecithin and to arrest these iron particles magnetic separator should use as about 2-3 ppm of iron separated from the magnetic separator.

CONCLUSION

The aim of present research was to get high quality food grade rice bran lecithin by using enzymatic degumming. The variables of the experiment were selected on the basis of the available literature and the best result found at particular temperature, reaction time and pH value of buffer solution. Results shows that the enzymatic degumming not only improve the quality of lecithin but also the quality of final refined oil and this may be because the p content of bleached oil can reduced to less than 5 ppm and as enzyme is an organic compound and no mixing of acid with oil so it can improve the shelf life of refined oil also. The enzymatic degumming is eco friendly process while acid degumming pollutes water as well as soil. It is also analyses that there is no loss of natural anti oxidant of oil which lost in case of acid degumming and these anti oxidant also present in lecithin also which makes rice bran lecithin more valuable.

Thus finally we have seen that by doing proper enzymatic degumming of good quality crude rice bran oil (food grade) followed by a controlled process of lecithin production we can achieve high-quality food-grade rice bran lecithin.

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