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Yeast Enrichment of Soybean Cake

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Abstract: The proximate composition, amino acids, pH, temperature and titratable acidity of yeast (*Saccharomyces cerevisiae*) fermented soybean cake were determined within 72 hours of fermentation. Crude Protein increased from 29.1 mg.16g^{-1}N to 68.7 mg.16g^{-1}N. There were slight decreases in crude fat (10.46 to 9.80 mg.16g^{-1}N), ash (5.60 to 3.74 mg.16g^{-1}N) and carbohydrate (47.70 to 10.66 mg.16g^{-1}N). methionine and cystine had their values increased (1.24 to 5.67 and 1.05 to 4.92 mg.16g^{-1} N respectively). The pH fell downward (5.6-4.1), titratable acidity increased (6.1 to 8.6 %) and also temperature (26.3 to 27.0°C). There was also an increase in the viable count of yeast (4 x 10^3 to 1.04 x 10^{25} cfu/g). The raising of the limiting amino acids (methionine and cystine) in the soybean cake is an important milestone to the production of animal feed.

Key words: Enrichment · Fermentation · Methionine · Cystine and Yeast

INTRODUCTION

Improvement of agricultural products by solid substrate fermentation is an established and accepted practice. For example the method is used to improve soy beans, reducing the antitryptic factor and in cassava, removing the residual toxicity and enriching the protein content [1].

The first suggestion of an industrial process for the cultivation of microorganisms as a source of protein [2].Since then there have been several reports on Single Cell Protein (SCP) in the literature in the past years. However, not much has been reported on the use of legumes in the production of SCP. This has been due to the fact that legumes have high quality of proteins. The methionine and cystine are the essential sulphur amino acids that ere limiting in soybeans [3].

Soybeans are used as a source of protein in animal feeds but this has always been supplemented with methionine and cystine. The reasons why sulphur amino acids are important in poultry production is that they reduce cannibalism, fat deposition feed consumption and they increase egg size and improved performance of growth rate. Reduced performance in pigs fed with raw soybean protein has been associated with reduced digestibility which may be caused by a hypersensitivity to soybean proteins, glycinine and conglycinin [4].In recent studies, Dietz *et.al* [5] and Guerin *et.al* [6] found out that some source of refined soybean protein could serve as suitable replacement for dried skim milk in diets of early-weaned pigs.

Eka [7] found out that yeast fermentation of rice and sweet potatoes gave higher protein content than the unfermented material. In the case of sweet potatoes the protein content was more than double that in the unfermented foodstuff. Other microorganisms such as bacteria, filamentous fungi and algae [8,9 and10] have been used to increase the production of protein. The production involves fermentation procedure with the exception of algae, which are produced photosynthetically.

Since soy bean cake is intended for use as protein and energy source for animals, knowledge of its nutritive quality is desirable.

MATERIALS AND METHODS

Two kilograms of Sam soy II was purchased from Emir's Market, Ilorin. The beans were hand picked so as to be free of dirt and stones. These were then roasted in a Giant Roaster at 160° C for five minutes with continuous stirring and then passed into an expeller where the beans were crushed and the oil expelled.

The soybean cake was sterilized at 58°C for 15 minutes. This was allowed to cool down, two liters of sterile distilled water was added and a two day old culture

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of *Saccharomyces cerevisiae* (4 x 10^3 cfu/g) was inoculated into the fermentor. Readings were noted every eight hours for three days. The pH was taken using a pH meter, titratable acidity was taken with phenolphthalein as indicator and viability count was by serial dilution. The amino acids were determined using automatic amino acid analyzer using the principle of Moore [11]. Proximate composition of the soybean cake was determined by the standard methods of A.O.A.C. as described by Horwizt [12].

RESULTS

The results of the amino acid analysis (Table 1) showed that there was a general increase in the amino acid content after fermentation. Lysine had an increase of 4.55 mg.16gN, histidine (0.45 mg.16g^{-1}N), Asparagine (0.22 mg.16g^{-1}N) Threomine (1.22 mg.16g^{-1}N). Serine (1.47 mg.16g^{-1}N), this was the trend in cystine, alanine, valine, methionine, isoleucine, leucine and tyrosine whose differences were very high. However, there were some losses of amino acid quality in arginine (-1.81 mg.16g^{-1}N), proline (-0.43 mg.16g^{-1}N) and phenylalanine (-5.96 mg.16g^{-1}N).

There was a decrease in the dry matter (92.86 to 92.10%); moisture (7.14 to7.10 %); fat (10.46 to 9.80 %); ash (5.60 to 3.74 %) and carbohydrate (47.70 to 10.66 %) while crude protein increased from 29.10 to 68.70 % (Table 2). Yeast population increased (Table 3) with increase in the time of fermentation. Thee was rapid growth rate of the yeast from 4.0 X 10^3 cfu/g on inoculation to 1.04 10^{25} cfu/g on the third day of incubation. This rapid growth led to the rise on temperature from 26.3°C to 27.0°C. With the increase in the utilization of nutrients in the medium, there was a gradual decline in the pH from 5.6 to 4.1 and increase in titratable acidity from 6.1 to 8.6 % on the third day of fermentation.

Table: 1 Amino acid analysis of Soybean cake fermented with *Saccharomyces cerevisiae* and unfermented Soybean cake (mg.16g^{-1} N)

Amino Acid	Fermented Soybean Cake	Unfermented Soybean Cake
Alanine	4.83	4.38
Arginine	7.63	9.44
Asparagine	2.86	2.64
Cystine	4.92	1.05
Glutamine	8.27	8.15
Glycine	4.93	4.38
Histidine	4.89	4.44
Isoleucine	9.39	4.65
Leucine	8.97	6.03
Lysine	6.57	2.02
Methionine	5.67	1.24
Phenylalanine	8.65	14.61
Proline	2.60	3.03
Serine	7.60	6.13
Threonine	10.67	9.45
Tyrosine	11.50	2.34
Valine	4.89	3.05

Table: 2 Proximate analysis of Soybean cake fermented with *Saccharomyces cerevisiae* (%)

Time (Hr)	DM	Moisture	Fat	Ash	CP	NFE
0	92.86	7.14	10.46	5.60	29.10	47.700
8	92.99	7.01	10.25	5.38	33.10	43.86
16	92.88	7.12	10.04	5.16	37.90	39.86
24	92.77	7.23	9.83	4.94	42.30	35.70
32	92.40	7.10	9.62	4.72	42.70	31.86
40	92.66	7.34	9.41	4.50	51.10	27.65
48	92.90	9.22	9.20	4.25	53.50	23.90
56	92.78	7.22	9.40	4.10	59.90	19.38
64	92.70	7.30	9.60	3.92	64.30	14.88
72	92.10	7.10	9.80	3.74	68.70	10.66

Table 3: Total yeast counts, pH, titratable acidity and temperature during the fermentation period

Time (hr)	Tempt (°C)	Viable Count (cfu/g)	pH	Ta
0	26.3	4×10^{3}	5.6	6.1
8	26.4	16×10^{6}	5.4	6.4
16	26.6	6×10^{10}	5.2	6.8
24	26.7	2.09×10^{14}	5.1	7.2
32	26.8	1.63×10^{18}	4.8	7.4
40	26.9	4.5×10^{21}	4.7	7.8
48	27.1	1.63×10^{25}	4.5	7.9
56	27.4	6.5×10^{27}	4.3	8.1
64	27.2	2.62×10^{26}	4.2	8.4
72	27.0	1.04×10^{25}	4.1	8.6

DISCUSSION

The increase in the amino acid content is attributable to the high production of the cell mass of yeast and consequently the production of protein within the yeast population. This result is comparable to that of Dubey [13], where protein content of yeast is 53%/100g of dry weight.

The relative decrease in the carbohydrate content and the residual product of fermentation in comparison to the unfermented sample gives an insight into the extent of fermentation of soybean cake. The relative increase in amino acid in the residual product can be attributed to the yeast protein content after fermentation. The rise in growth of the microorganism could be due to the prevalence of favourable conditions of the fermentation such as suitable temperature, moisture content, pH and availability of high concentrations of organic nutrients. Chiao and Peterson [14] made similar quantitative determinations of methionine and cystine in 20 yeast selected from ten genera. The methionine content ranged from 0.17 percent in *Endomycosis fibuligar* to 1.0 percent *Rhodotorula gracillis* and cystine content from 0.19% in *Debaryomyces sp* to 0.58% in *Hansenula saturnus.*

The higher values for both these critical amino acid could render the microorganisms more than usual as food adjunct. The conventional relationship of pH to titratable acidity is that of an inverse proportionality. The pH of the fermenting soybean cake decreased while the titratable acidity increased. This could be due to the introduction of acids into the medium as a result of uptake of carbohydrates by the fermenting yeast. The increase in protein content of the fermented soybean cake over that of the unfermented cake calls for thorough investigation to the possible use of the products as animal feed.

REFERENCES

1. Kokke, R., 2008. Improvement of Carob Pods as feed by Solid-substrate Fermentation. J. Appl. Bacteriol. 43: 303-307.
2. Champagnat, A., C. Vernet, B.M. Lame and J. Filose, 1963. Microbiology, Growth on refinery effluents. Nature, 187: 13.
3. Karl, E.W., 1987. Processing, Nutrition and Utilization of soybean cake, in: *Soybean for the Tropics.* (Sign S.R., K.O. Rachie and K.E. Dashiell, (Editors) John Willey and Sons Ltd, New York, USA.
4. Sohn, K.S., C.W. Maxwell, D.S. Buhaman and L.L. Southern, 1994. Improved Soybean protein sources for early weaned pigs. Effects on Performance and total tract amino acid digestibility. J. Anim. Sci., 72(3): 620-630.
5. Dietz, G.N., C.V. Maxwell and D.S. Buchanan, 1988. Effect of protein source on performance of early-weaned pigs. J. Anim. Sci. 66(suppl. 1) 314. (Abstr.).
6. Guerin, H.B., G.A. Kasel, W.T. Black, T.B. Halfied and C.N. Daniel, 1988. Effect of isolated soy protein in wheat on replacing dried skim milk in a prestart for weaned baby pigs. J. Anim. Sci., 66(suppl): 230(Abstr.).
7. Eka, O.U., 1979. Effect of yeast fermentation of rice and sweet potatoes on their nutritive status. Nigeria J. Sci., 13(1 and 2): 243-250.
8. Ratledge, C., 1968. Growth of moulds on a fraction of n-alkenes. J. Appl. Bacteriol., 13: 233-240.
9. Calloway, D.H. and A.M. Kumar, 1969. Protein quality of the bacterium *Hydrogenomonas entroha.* Appl. Microbiol., 17: 176-178.
10. Clement, G., 1972. Recent advances in food algae 'Spirulina'. Presented at the Chem. Biol. Prot. Evaluation, Reading, England.

11. Moore, S., 1963. The determination cysteic acid. J. Chem., 238: 238-237.
12. Horwizt, W., 1980. Official Methods of Analysis (13th edition). Association of Official Analytical Chemist, Washington DC, USA.
13. Dubey, R.C., 1993. Single Cell Protein and Mycoprotein. A text book of Biotechnology. Chand and Coy Ltd New Delhi, pp: 412-441.
14. Chiao, J.S. and W.H. Peterson, 1953. Amino acid analyses of yeasts. J. food Chem., 1: 1005-1008.