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Nutritional Properties of Extruded Prepared by Little Millet (Kutki) and Defatted Soya Flour

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ABSTRACT

This study was conducted on the effect of processing parameters i.e. moisture content of feed (8, 10, 12, 14, and 16 %) and blend ratio of little millet : defatted soy flour (60:40, 70:30, 80:20, 90:10, and 100:00) and operational parameters of extruder i.e. barrel temperature (60, 80, 100, 120, and 140^o C), screw speed (60,80, 100, 120 and 140 rpm) and die head temperature (80, 100, 120, 140 and 160^o C) on nutritional properties of extrudate (protein content, Carbohydrates and fibre). It was found that the second order model has showed the strong association between variable under study with the response variable due to high value of R^2. In this model the blend ratio which is highly significant for changing the pattern of protein, carbohydrates and fibre content of extruded. The extruded product with 60:40 blend ratio prepared at 12% moisture content, recorded highest protein content (21.32%) at barrel temperature 100^{o}C, die head temperature 120^{o}C and screw speed 100 rpm. The carbohydrates and fibre in the extruded was found maximum 67% and 6.76% respectively, which prepared by 100% little millet of 12% moisture content at barrel temperature 100^{o}C, die head temperature 120^{o}C and screw speed 100 rpm.

Key words: *Little Millet, Defatted Soy Flour, Extruded and Nutritional Properties.*

INTRODUCTION

Little millet known as kutki in hindi is grown in limited area as poor men's crop capable of withstanding both drought and water logging. It is generally grown on hills under shifting cultivation. Like other millets it is grown in kharif season. Millets grains rich in fiber, protein and minerals help manage diabetes, blood pressure, constipation and obesity[4]. Controlled gelatinized, extruded & flattened millet flakes, flavored with dark chocolate for taste, low pressure food with long with shelf life of six months. It has high satiety value, easy to carry, ready to eat, crunchy breakfast snack for all age groups. The kutaki millets contains 69% carbohydrates, 8.2% protein, 6.94% fibre, 3.37% fat, 2.89% minerals, at 12.6% moisture and just 335 calories/ 100 [1] and per 100 gm 3.3g ash, 35 mg calcium, 1.7 mg iron, 0.15 mg thiamin, 0-09 g riboflavin and 2 mg niacin at 12% moisture[6].

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Defatted soy flour is high protein, low fat and a simplest form of soy protein. The protein content of the flour is 50-52%, much higher than the flour of other grains. The defatted soy flour is the by-product of oil industry in solvent extraction methods and available in abundance in Madhya Pradesh. Soybean, the first vegetable proteinaceous feed material was used for making protein rich extruded food[5]. In order to utilize, the good quality body building protein of these by-products it was thought of to blend the flour of these by products in different proportions with kutki flour and to identify various operating parameters of food extruded that can yield an acceptable, tasty and nutritious ready to eat extruded snack. Faller *et al.*[2] reported development of a highly acceptable extruded snack products containing soy protein, and evaluated the influence of soy protein type, soy level, and moisture content. To address the problem of malnutrition in tribal area, the enriched protein extruded may fulfill the nutrient requirement of children and women. In this context, the present study is under taken to study the effect of blending little millet with defatted soy flour on Nutritional properties of extruded.

MATERIALS AND METHODS

Little millet were thoroughly cleaned and graded by screen cleaner then it was dehusk by modified inclined energy sheller. After that it was grounded in a khammer mill to reduce the size into final particles to be used for preparing blend ratios. The required quantity of the obtained kutki flour was passed through 40 ASTM mesh size to obtain uniform size of particles. The Defatted Soy Flour was purchased directly from market. Little millet flour prepared by grinding in the hammer mill and defatted soy flour were blended in following ratio 60:40, 70:30, 80:20, 90:10 and 100:00 respectively. The moisture content of the flour of different blend ratio was measured by standard oven drying method. The moisture contain of the blends were brought to the desired moisture content levels by addition/removal were so as to get to the desired level of 8, 10, 12, 14, and 16% (wb) as planned in the experiment. The calculated amount of water plus an addition amount of 10% of calculated water was added to supplement the evaporation losses during mixing and conditioning, tempering of samples was done by keeping the moistened samples for 24 hours at room temperature so as to get uniform distribution of moisture throughout the mass of blend. In the present study, the effect of processing parameters i.e. moisture content of feed (8, 10, 12, 14, and 16 %) and blend ratio of little millet : defatted soy flour (60:40, 70:30, 80:20, 90:10, and 100:00) and operational parameters of extruder i.e. barrel temperature (60, 80, 100, 120, and 140^{o} C), screw speed (60,80, 100, 120 and 140 rpm) and die head temperature (80, 100, 120, 140 and 160^{o} C) on nutritional value of extrudate i.e. protein, carbohydrates and fiber. The responses were analyzed by response surface methodology (RSM) using central composite rotatable design (CCRD). The responses were selected to optimize ready to eat snakes of blends of little millet and defatted soy flour on the basis of their acceptable quality.

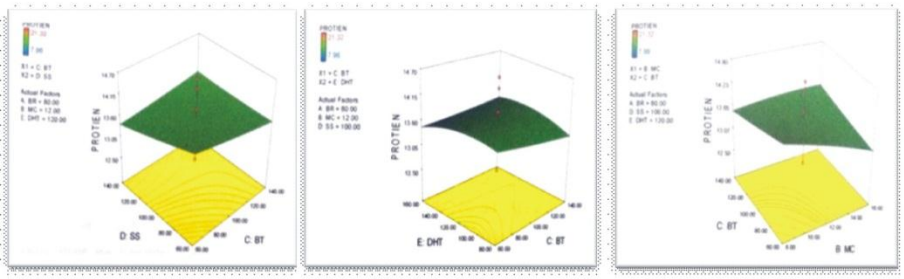
RESULTS AND DISCUSSIONS

The effect of five independent variables like moisture content of feed, blend ratio, barrel temperature, die heat temperature and screw speed on nutritional properties of extrudate (Protein content, Carbohydrates and Fibre), of extruded have been measured using developing the response surface through CCRD of blend of kutki and defatted soy flour. The generated data were analyzed through CCRD having RSM and their interpretations were presented. The adequacy of the model was performed using the coefficient of determination (R^2) and fisher's F-test through ANOVA table. Also various response surface graphs were drown on the basis of generated data to observe the effect of independent variables on dependent variable.

Protein Content (Pro) of Extruded:- The polynomial model generated by multiple regression analysis using CCRD and fitting of second degree polynomial equation for representative response surface of data between protien content of extruded (Pro) versus actual values of feed moisture content (MC), blend ration (BR), barrel temperature (BT), die head temperature (DHT), and screw speed (SS), resulted following model;

Pro= 77.89 - 0.76 x BR – 0.50 x MC - 0.28 x BT -0.12 x SS + 0.08 x DHT - 2.84 E-003x BR x MC + 1.35E-003 x BR x BT + 4.34E-004 x BR x SS – 2.15E-004 x BR x DHT + 6.48E-003 MC x BT + 2.39E-003 x MC x SS + 2.65E-004x MC x DHT + 5.07E-004 x BT x SS + 2.95E-004 x BT x DHT - 2.65E-005 x SS x DHT + 1.98E–004 x BR^2 – 0.01 x MC^2 + 4.40E-005 x BT^2 + 4.71E-005 x SS^2 - 3.93E-004 x DHT^2

The fitted model has showed the strong association between variable under study with the response variable due to high value of R^2 (0.97). This show second order model was adequate in describing the protein content of extruded. It has been noticed that as moisture content of feed increases, protein does not change significantly i.e. protein is independent of moisture content. While blend ratio plays an important role which is tightly significant for governing the protein content of extruded. The extruded product with 60:40 blend ratio prepared at 12% moisture content, recorded highest protein content (21.32%) at barrel temperature 100^{o}C, die head temperature 120^{o}C and screw speed 100 rpm.



Effect of SS & BT of feed on Protein of extruded

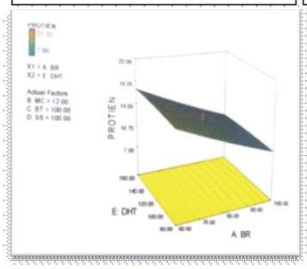
Effect of DHT & BT of feed on Protein of extruded

Effect of MC & BT of feed on Protein of extruded

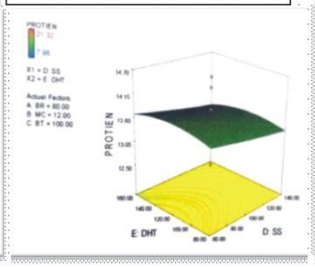
Effect of SS & MC of feed on Protein of extruded

Effect of DHT & MC of feed on Protein of extruded

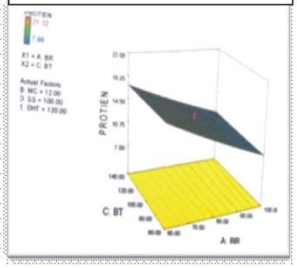
Effect of MC & BR of feed on Protein of extruded



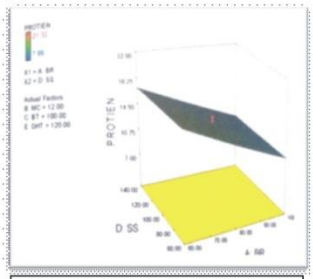
Effect of DHT & BR of feed on Protein of extruded



Effect of SS & DHT of feed on Protein of extruded



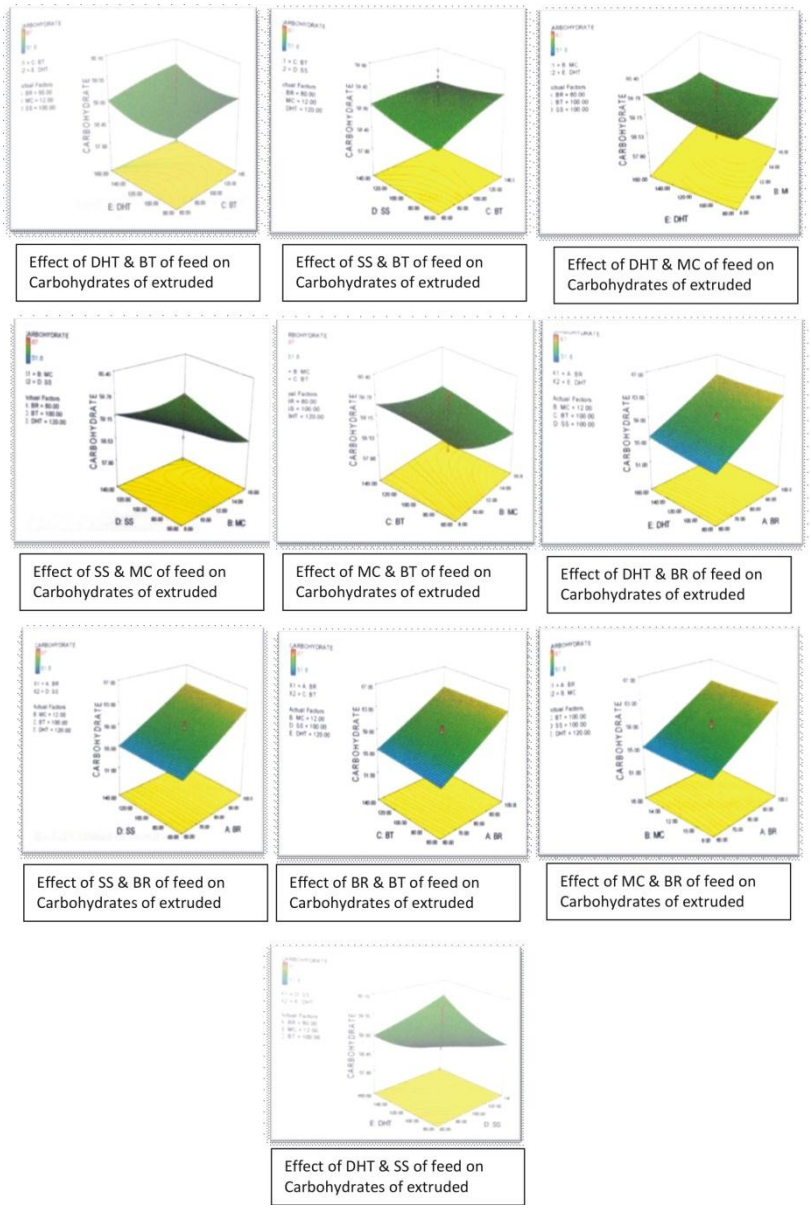
Effect of BR & BT of feed on Protein of extruded



Effect of SS & BR of feed on Protein of extruded

Carbohydrates:- The following polynomial model generated by multiple regression analysis using CCRD and fitting of second degree polynomial equation for representative response surface of data between carbohydrates of extruded (CARBO) versus actual values of feed moisture content (MC), blend ration (BR), barrel temperature (BT), die head temperature (DHT), and screw speed (SS); CARBO= 45.67 + 0.39 x BR – 1.65 x MC + 0.10 x BT -0.19 x SS - 0.05 x DHT - 2.40 E-003x BR x MC - 8.65E-004 x BR x BT + 2.34E-004 x BR x SS – 1.29063E-003 x BR x DHT + 2.45E-003 MC x BT + 7.64E-003 x MC x SS - 2.54E-003x MC x DHT - 3.60E-004 x BT x SS + 7.65E-005 x BT x DHT + 8.51E-004 x SS x DHT + 1.56E–003 x BR^2 + 0.04 x MC^2 - 1.26E-004 x BT^2 + 1.07E-004 x SS^2 + 4.35E-004 x DHT^2.

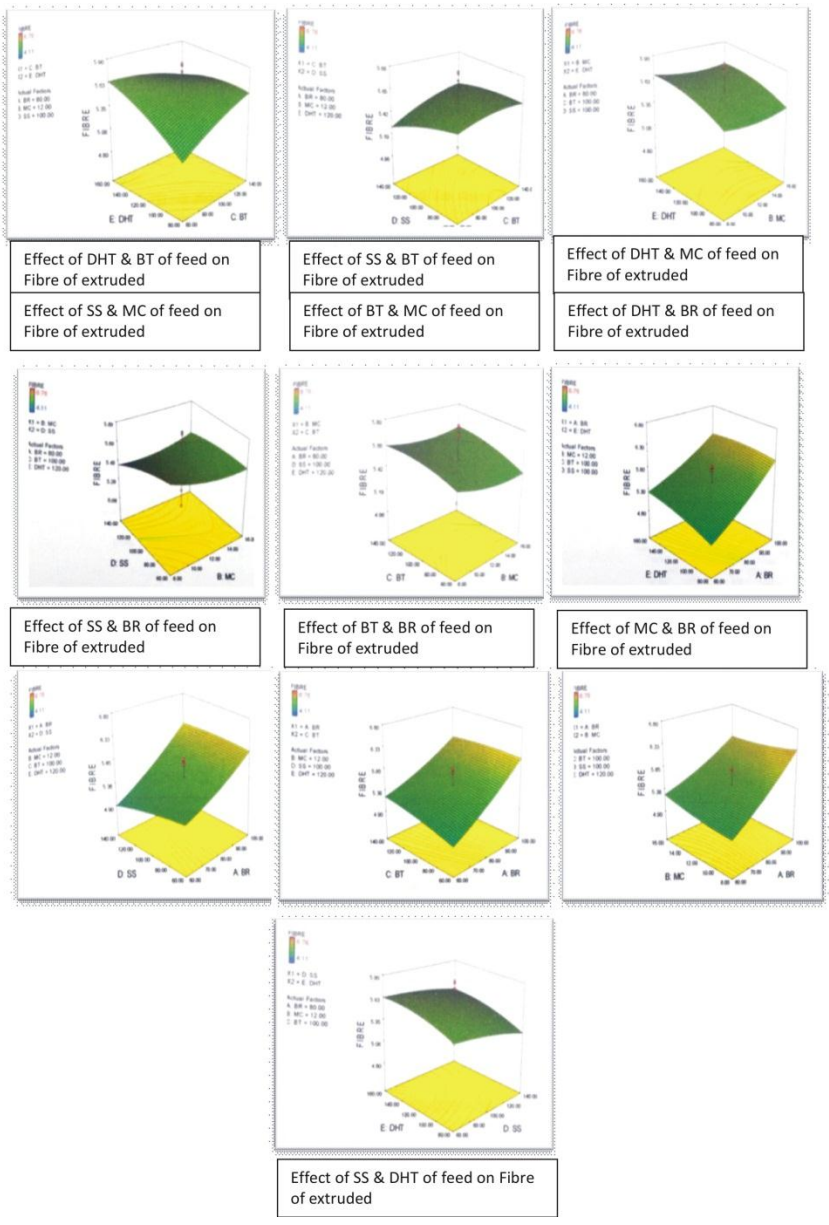
The fitted model has showed the strong association between variable under study with the response variable due to high value of R^2 (0.98). The standard error, mean, coefficient of variation and predicted residual error of sum squares (PRESS) were found 0.81, 59.37, 1.36 and 126.31 respectively. This show second order model was adequate in describing the carbohydrates of extruded. In this model the blend ratio which is highly significant for changing the pattern of carbohydrates content of extruded. The carbohydrates in the extruded was found maximum 67%, which prepared by 100% little millet at 12% moisture content at barrel temperature 100^{o}C, die head temperature 120^{o}C and screw speed 100 rpm.



FIBRE of Extruded:- The following polynomial model generated by multiple regression analysis using CCRD and fitting of second degree polynomial equation for representative response surface of data between fibre of extruded (FIBRE) versus actual values of feed moisture content (MC), blend ration (BR), barrel temperature (BT), die head temperature (DHT), and screw speed (SS);

FIBRE= -6.60 + 0.047 x BR – 0.03 x MC + 0.09 x BT -0.06 x SS + 0.11 x DHT - 5.87 E-003x BR x MC - 4.50E-004 x BR x BT + 4.81E-004 x BR x SS – 4.18E-004 x BR x DHT + 5.93E-004 MC x BT + 1.62E-003 x MC x SS - 3.12E-004x MC x DHT + 1.31E-004 x BT x SS - 4.06E-004 x BT x DHT + 5.31E-005 x SS x DHT + 7.60E–004 x BR^2 + 0.012 x MC^2 - 1.09E-004 x BT^2 - 8.18E-005 x SS^2 - 1.59E-004 x DHT^2

The fitted model has showed the strong association between variable under study with the response variable due to high value of R^2 (0.87). The standard error, mean, coefficient of variation and predicted residual error of sum squares (PRESS) were found 0.34, 5.55, 6.08 and 19.06 respectively. This show second order model was adequate in describing the carbohydrates of extruded. In this model the blend ratio which is highly significant for changing the pattern of fibre content of extruded. Samples containing 100% little millet at 12% moisture content, barrel temperature 100^{o}C, die head temperature 120^{o}C and screw speed 100 rpm recorded maximum fibre content (6.76%) among all samples.



CONCLUSIONS

It was found that the second order model has showed the strong association between variable under study with the response variable due to high value of R^2. In this model the blend ratio which is highly significant for changing the pattern of protein, carbohydrates and fibre content of extruded.

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