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OPTIMIZATION AND NUTRITIONAL EVALUATION OF TRADITIONAL INSTANT PANCAKE FLOUR FOR LACTATING MOTHERS

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ABSTRACT

In this study, we develop a calcium-rich Instant Pancake flour for lactating mothers optimized by Response Surface Methodology-Box Behnken method (RSM). The flour intends to supplement one-third calcium needs of lactating mothers as per RDA. Calcium deficiency is commonly observed in lactating mothers and is a rising trend in India leading to a serious threat to lactating mother and infant health. Nutrimix flour, mixed with cumin seeds and green gram used to prepare the Pancake flour. Box-Behnken, fifteen sets of experiments were conducted to arrive at the optimized value. The functional properties and proximate analysis of the flour were conducted using the lab food testing methodologies for result validation. The mixing ratio was formulated from a variety of ingredients as Nutrimix flour (72.5 g), Green Gram (19.0 g), and Cumin Seeds (8.5 g) for Pancake flour. We prepared a Nutrimix flour which consists of Finger Millet (37.5 g), Semolina (11.25 g), Green Gram (27.5 g), Amaranth Seeds (8.75 g), and Gingley Seeds (15 g). Based on experimental results, we were able to meet the one-third calcium recommended daily allowances of the lactating mother (0-6 months) in the instant Pancake flour. The nutrient content of the optimized flour was calcium (404±1.36 mg), Iron (4.4±0.86 mg), Moisture (7.8±0.99), Protein (18.4±0.56%), Carbohydrates (60.27±2.32 g), Energy Value (375.3±0.006 Kcal) and Crude fat (6.7±0.82%). The functional properties of the optimized flour were swelling capacity 17.2±0.21%, Water absorption capacity (48.4±0.44%), Oil absorption capacity (36.4±0.9%), Emulsion Activity (42.6±0.3%), Emulsion stability (46.6±0.4%) and Bulk density (416±1.5 Kg/m³).

Keywords **:** RSM, Calcium, Lactating Mothers,Traditonal Instant Pancake

Introduction

Traditional food practises are followed by pregnant and lactating mothers across countries. They influence and guide the lactating mothers about the nutritious food and its effect on the baby. Even with the changing time, traditional food demand is continuous and high in many countries including developed nations of west (Trichopoulou, Soukara and Vasilopoulou, 2007). Similarly, For many decades in India, culturally accepted foods are produced and managing malnutrition successfully (prasad, holla and gupta, 2009). The home-cooked food has higher acceptability in mothers (Dube *et al.*, 2009). Based on this background of increased calcium demand and acceptability issues; we aimed to prepare an optimized Calcium-rich Instant Pancake flour.

Pancakes are traditional Indian recipes, widely consumed by Lactating mothers. Based on the traditions, Cumin seeds and Green gram, known for increasing breast milk secretion and calcium-related properties are widely accepted among the lactating mothers across pan India.

The traditional pancake, even though made from the calcium-rich ingredients, does not meet the recommended lactating mother's calcium daily allowance (RDA) of 1200 mg/day (WHO, 2013a). The study target to raise the usage of traditional pancake; by increasing its nutritional values, using fortified Nutrimix flour.

We prepared a calcium-rich instant pancake flour with ingredients as Nutrimix flour, cumin seeds, and green gram grown locally. Finger millet (*Eleusine coracana*), Green gram (*Vigna radiate*), Semolina (*Durum wheat*), Amaranth seeds (*Amaranthus*), and Gingley seeds (*Sesamum indicum*) are the basic ingredients of Nutrimix flour.

While working on the flour mixtures, the human behaviour and ingredient's ease of availability was considered. It helped in achieving the traditional acceptability and additional nutritional value of the pancake.

About 200 mg/day Calcium transfers between the mother and infant during full breast-feeding. The amount of calcium secreted into breast milk varies widely and can be as high as 400 mg/day in some individuals (Prentice, 2000). Various studies have demonstrated that lactation is accompanied by significant reductions in maternal bone mineral content during the first 3–6 months (Laskey and Prentice, 1999) especially at the spine and hip. The World Health Organization (WHO) recommends a daily intake of calcium i.e. 1200 mg/day during pregnancy and lactation(WHO, 2013b). The balanced key nutrients like

protein, calcium, and vitamins are a must in diets (Black *et al.*, 2008) of lactating mothers. With an effort to reduce the gap of calcium deficiencies in lactating and pregnant women, the focus is on the readily available food items which are closely following the traditional food patterns.

The innovation required to develop such products is reflected in the continuous efforts and steps taken by the food industry (Stewart-Knox and Mitchell, 2003). Food processing industries and government departments continuously study the behaviour of lactating mothers and assess their respective needs. In the ever-growing market of the food industry, Response Surface Methodology (RSM), plays a pivotal role in optimizing the ingredients and processes used in industry(Nazni P and Gracia J, 2014). In our study, we focus on the ingredient optimization and the variables which affect the product. RSM reduces the number of experiments and helps in achieving the desired results using the simulation(Gunst, Myers and Montgomery, 1996).

The flour prepared based on the scientific approach will be ready to use and will find in its acceptability and usability among the group of pregnant and lactating mothers to meet the one-third need of daily calcium as recommended by RDA.

Materials and Methods

Materials

The ingredients used for the Pancake flour formulation were as listed below were procured from the market of New Delhi, India.

1. Nutrimix flour
2. Cumin seeds *(Cuminum cyminum)*
3. Green gram (*Vigna radiate*)

We optimized Pancake flour with the following combination of ingredients by the Response Surface Methodology – Box Behnken.

Table 1: Ingredients of the Pancake flour optimized by RSM

Ingredient	Optimized Values (gm)
Nutrimix Flour	72.5
Green Gram	19
Cumin Seeds	8.5

Methods

Preparation and Pre Processing of Ingredients

A digital scale weighed all the ingredients. Measure the Nutrimix flour and keep in a clean bowl. Wash the Green Gram (100 gm) 5 times in tap water. Dry (1:10 w/v) the seeds at 45±5 °Cfor 5 h and cool at room temperature for 2 hours. Wash the seeds and dry in a hot air oven at 110°C and ground in powder. Grind the seeds to achieve the sieve size of 0.8 mm. Roast the Cumin seeds at 50°C for 2-minute and cool the seeds at room temperature and grind. Grind the seeds to achieve the sieve size of 0.8 mm

Proximate Analysis Procedure

Proximate analysis of the optimized samples was determined according to AOAC, (2005).Iron, Calcium, Moisture, crude fat, total protein, crude fiber, and ash contents were estimated using standard methods of FSSAI, lab manual 10 (AOAC, 2000), (Safety *et al.*, 2016), (Additives, 2005). Carbohydrates were determined using the difference method. Energy values were calculated by the standard method of summing up the values of Total carbohydrates, crude protein and crude fat obtained and multiplying the quantity of carbohydrate and protein per 100 gm by 4 kcal and that of fat per 100 gm by 9 kcal respectively (Atwater and Benedict, 1993)

Functional Properties Analysis Procedure

The functional properties of the Pancake flour were analyzed for Swelling capacity (Okaka and Potter, 1979) (ml), water absorption (Sosulski and McCurdy, 1987) (WAC %), Oil absorption capacity (Sosulski and McCurdy, 1987) (OAC %), Emulsion activity (Sosulski and McCurdy, 1987) (EA %), Emulsion stability (ES %) and Bulk density (kg/m³)

Sensory Evaluation Procedure

The Sensory evaluation was conducted by using the nine points hedonic test for the overall acceptability, appearance, colour, texture, odour and palatability of the fifteen (15) formulations of instant traditional Indian pancake.

A scale of 1 to 9 was used in hedonic test with 1 being Dislike Extremely and 9 being Like extremely.

The 30 lactating mothers of age between 20-40 years were panellists from Delhi region to carry out the sensory evaluation for the product. The panellists were told how to evaluate the samples using the parameters of hedonic test (Chu and Resurreccion, 2004) (Błońska, Marzec and Błaszczyk, 2014)

Results and Discussion

Optimization and Fitment Result of Response Surface Methodology

Design-Expert version 11 software helped in the numerical optimization of independent variables of pancake flour. Outcomes of evaluation variance (ANOVA) was showed that the F-value of 1779328.48 in the model is significant in the case of calcium. There is only a 0.01% chance that an F-value this large could occur due to noise. P-values (1.01459E-15) less than 0.0500 indicate model terms are significant.

Since the present study involved three variables, the value of one variable was fixed to see the effect of other variables on the response.

Similarly, the Model F-value of 129.37 strongly suggested the model is significant in case of overall acceptability with P-values (2.20315E-05) less than 0.0500 indicate model terms are significant.

Error! Reference source not found. and Fig. 2 **:** are the optimized values of Pancake flour.

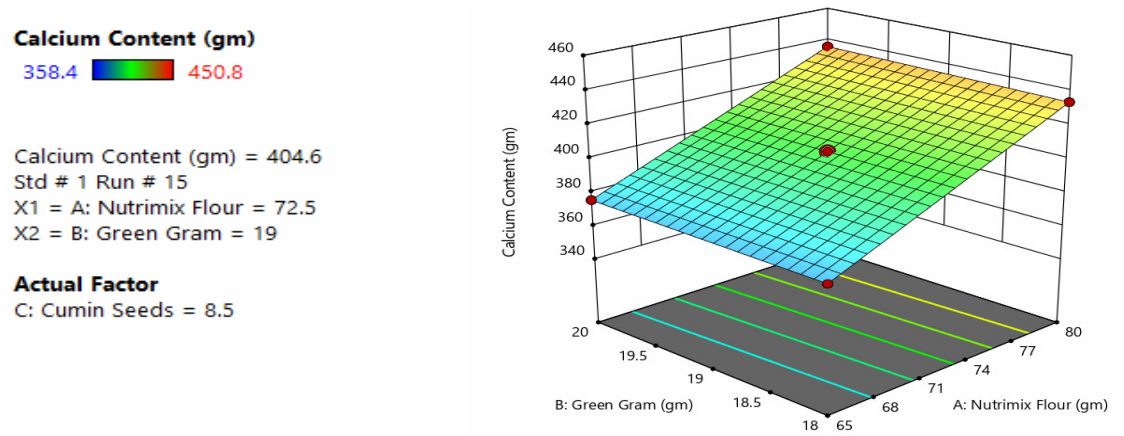

Fig. 1 : 3-D response surface plots representing interaction effects X1: X2 with Calcium in Pancake Flour

Error! Reference source not found. represents a relationship between X1: X2 parameters and their effect on the response (Y1), keeping all other parameters as constant. The X-axis shows A (Nutrimix flour), Y-axis shows B (Green gram) and Z-axis shows Response (Calcium). The red dot in the middle of the 3D image represents the optimum value obtained from RSM

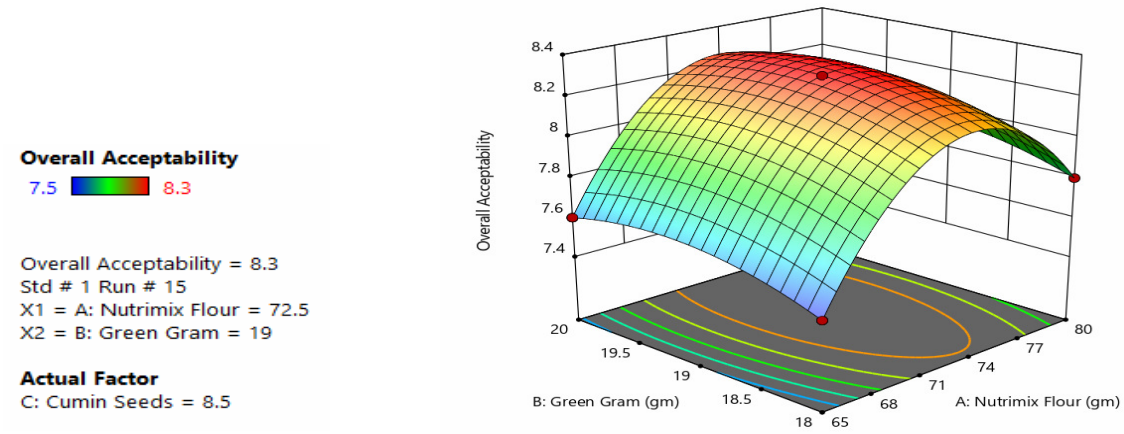

Fig. 2 : 3 D surface response graphs representing interaction effects of X1: X2 on Overall Acceptability

Fig. 2 : represents a relationship between X1: X2 parameters and their effect on the response (Y1), keeping all other parameters as constant. The X-axis shows A (Pancakeflour), Y-axis shows B (Green Gram) and Z-axis shows Response (Overall acceptability). The red dot in the middle of the 3D image represents the optimum value obtained from RSM. The optimized value for the Pancake flouris Nutrimix Flour (72.5 gm), Green Gram (19 gm), and Cumin Seeds (8.5 gm).

Proximate Analysis Result

Proximate analysis of optimized pancake flour was evaluated.

Table 2 : Proximate analysis of the Pancake flour

Parameter	Pancake Flour(per 100 g)
Moisture (%)	7.8±0.99*
Crude Fat (%)	6.7±0.82*
Total Ash (%)	2.7±0.02*
Crude Fibre (%)	2.8±0.12*
Protein (%)	18.4±0.56*
Energy Value (Kcal)	375.3±0.006*
Iron (mg)	4.4±0.86*
Calcium(mg)	404.0±1.36*

The above table represents the various proximate analytical Mean ±SD values of different parameters in the Nutrimix flour, analysed individually in triplicate. Here, * indicates a non-significant difference.

The pancake flour had a moderate moisture content of 7.8±0.99%, was rich in calcium 404.0±1.36 g, iron content was 4.4±0.86 mg and had an energy of 375.3±0.006 kcal. The crude fibre was moderate with 2.8±0.12% and protein content of 18.4±0.56%. The crude fat was a moderate value of 6.7±0.82 with Total ash content as 2.7±0.02%. The values represent the various proximate analytical Mean ±SD values of different parameters in the Pancake flour, analyzed individually in triplicate.

Results showed that optimized Pancake flour is calcium and protein-rich and it is fulfilling approximately one-third of the RDA for lactating mothers (0-6 months).

Functional Properties Result

The functional properties of the pancake flour show the swelling capacity of 17.2±0.21 ml was determined in the Pancake flour. WAC is a critical function of proteins in food products like dough and baked products (Adeyeye, 2012). A Water absorption capacity 48.4±0.44% and Oil absorption capacity 36.4±0.9% was observed in the samples.

The water and oil binding capacity (OAC) of the food protein depends upon the intrinsic factors and leads to a flavor enhancement and mouth feel in various food dishes.

Table 3 : Functional parameters of Pancake flour

Functional Parameter	Pancake Flour (per 100 g)
Swelling Capacity (ml)	17.2±0.21*
Water absorption capacity (%)	48.4±0.44*
Oil absorption capacity (%)	36.4±0.9*
Emulsion activity and capacity (%)	42.6±0.3*
Emulsion stability (%)	46.6±0.4*
Bulk density(kg/m³)	416±1.5*

The above table represents the various proximate analytical Mean ±SD values of different parameters in the Nutrimix flour, analyzed individually in triplicate. Here, * indicates a non-significant difference.

Emulsion Activity 42.6±0.3% and Emulsion stability 46.6±0.4 % was observed in the Pancake flour. Increasing emulsion activity (EA), emulsion stability (ES), and fat binding during food processing are primary functional properties of the protein.

The difference between the lowest emulsifying activity and the highest emulsion stability would determine the EA. Hydrophobicity of protein has been attributed to influence their emulsifying properties (Kaushal, Kumar and Sharma, 2012). In bakery and desserts, varying emulsifying and stabilizing capacity is required because of their various compositions and processes(Adebowale, Adeyemi and Oshodi, 2005).

The Bulk density 416±1.5Kg/m³ depends upon the particle size and initial moisture content of flours. The high bulk density of flour suggests their suitability for use in food preparations. low bulk density would be an advantage in the formulation of complementary foods(Akpata and Akubor, 1999).

Overall Acceptability Result

9 Hedonic test was conducted on 15trials of Pancake by a group of 30 panelists.

Table 4 : Mean and SD Score of Sensory attributes for Pancake

Sensory Attributes	Mean ± SD
Appearance	7.74±0.32
Colour	7.7±0.28
Taste	8.13±0.34
Texture	7.56±0.59
Odour/Aroma	7.67±0.52
Palatbility	8.08±0.27
Over All Acceptability	7.92±0.27

The results were studied and collated after the test to arrive at the overall acceptability of the sample. The Mean values shows that the sample pancake was Like very much by the panellists.

Conclusion

In this study, the Box-Behnken Design of Response Surface Method was used to optimize and develop the Pancake flour using Nutrimix flour. It led to improved consumers' acceptability of Pancake. The hedonic test shows that flour has higher overall acceptability by using the Nutrimix flour formula. The Pancake meets the one third recommended daily allowance of approx. 400 mg (per 100 gm of serving) calcium needs of the lactating mothers.

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Conflict of Interest

The authors have no conflict of interest to report.

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