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Optimizing food materials for development of Nutritious pasta

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***Abstract:** Groundnut meal, beetroot juice and refined wheat flour was used for the development of a pasta. The system known as response surface methodology was used to optimize the level of these food materials. Box-benken designs of experiments were used indifferent experimental combinations. Protein content, antioxidant activity and minimum cooking time are the quality attributes that has been used for the study as dependent variables. The food materials were optimized to obtain the best experimental combination for development of 15 g of groundnut meal, 13.3 mL of beetroot juice and 89.2 g of refined wheat flour pasta. Response surface methodology is used for optimization*

***Key words:** Beetroot juice, Groundnut meal, Refined wheat flour, Optimization.*

I.INTRODUCTION

Groundnut meal (Arachis hypogaea) is an important source of protein for livestock feeding in India. Hani pressed, expeller pressed and solvent extracted cake are the three types of oil cakes that are available in India. The content of oil is variable according to the process of extraction of oil. It is 10-12% in Ghana pressed, 6-8% in expeller pressed and 0.5-0.7% in the solvent extracted cake. The Nutritive value is 40-50 %(Desai et al. 1999) protein content and TDN 75-85%. It is deficient in lysine, methionine, cystine, tryptophan, calcium, carotene and vitamin D. The major benefits of beetroot juice are that it contains a colour pigment called betalain. Beetroot juice contains high antioxidant, anti-inflammatory, fungicidal and aid in detoxification substance (Wootton-Beard et al. 2011). There is research that indicates that betalain may exhibit anti-cancer activity (Vidyavati et al., 2004). Beetroot juice is used to heal anaemia, liver, skin, kidneys, lymphatic circulation, tiredness, eye, liver, skin problems, detoxification and cancer. Beetroot juice may kill fungi, and it is a strong antioxidant and it also has anti inflammatory properties (Kanner et al. 2001). Whole wheat flour contains vitamins, minerals, fiber, and photochemical. It is an excellent source of the B vitamins thiamine and niacin, plus large quantities of the minerals copper, iron, and selenium. The American food supply contains a lot of wheat, particularly in processed baked foods and pasta. Many pasta products have been produced with protein-enhancing ingredients in recent decades. This previous study reported the use of Groundnut meal, beetroot juice and refined wheat flour in nutritious pasta formation. The large amounts of uniform pastas were produced from extrusion press. Pasta contains 62% water, 31% carbohydrates, 6% protein, and 1% fat. It is extremely digestible because its carbohydrates suffer some fission processes (Mridula et al. 2009, 2010, 2011) that helps indigestion. The oldest and common operations for the pasta production, is the drying and it is an important step in the industrial manufacture of pasta. The drying process plays an important role in the final quality of product because it indicate the thermal and mechanical damage that affect the final texture of the pasta. To discover the optimum drying conditions much effort has been developed. This process is considerable not only for the final product quality but also for the cost of its manufacture. Pasta is a simple dish, and it has many varieties such as fresh pasta and dried pasta. Pasta is also prepared in light lunches, such as salads or large portion for dinner. Pastas vary in taste, colour and texture. There is a general rule regarding compatibility when choosing the type of pasta (Shenoy et al. 2010) and sauce to serve together. Pasta is mainly rich in carbohydrates (mainly as starch), with moderate amounts of protein and manganese. Pasta is produced from durum wheat flour without adding any other food material or additives and then it is cooked by boiling or baking (Fernandes et al., 2013). Due to its low cost, long shelf life, ease of preparation it is accepted worldwide. The main aim of this study was to optimize the level of groundnut meal, beetroot juice and refined wheat flour. Physical property tests were conducted to determine the appropriate level of each ingredient in the pasta. It is popular amongst many children and adults and it will improve the quality of the diet of the consumers when it is enriched with protein and antioxidant activity.

II.MATERIALS AND METHODSA.EXPERIMENTAL DESIGN

The Response surface methodology (RSM) was used to design the experimental combinations and the nutritious pasta samples were developed. It reduces the number of experiments and it provides sufficient information about statistically acceptable results. The proportion of groundnut meal, beetroot juice and refined wheat flour were the independent variables and Response variables were protein content, antioxidant activity, cooking time.

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Std	Run	Factor 1 A:groundnut meal g	Factor 2 B:beetroot juice ml	Factor 3 C:refined wheat ... g	Response 1 minimum cookin... minutes	Response 2 protein content %	Response 3 antioxidant activ... %
12	1	15	18	90	9	11.27	16.275
15	2	15	12	85	6	11.37	15.35
1	3	10	6	85	9	11.66	16.777
13	4	15	12	85	8.5	11.66	18.032
9	5	15	6	80	6	12.59	13.087
16	6	15	12	85	7	13.13	20.869
8	7	20	12	90	7.5	13.13	15.517
14	8	15	12	85	7.5	14.12	16.325
2	9	20	6	85	6	14.72	11.418
5	10	10	12	80	6	15.7	14.054
11	11	15	6	90	6	15.77	10.402
4	12	20	18	85	8.5	16.24	19.032
6	13	20	12	80	5.5	17.45	16.598
17	14	15	12	85	7.5	17.65	11.95
10	15	15	18	80	8.5	18.91	22.138
7	16	10	12	90	6.5	14.52	18.032
3	17	10	18	85	7	13.83	15.185

Table 1 *Response surface analysis of nutritious pasta samples*

B.RAW MATERIALS

The materials used for the development of nutritious pasta were refined wheat flour, partially deoiled groundnut meal and beetroot juice. Partially de-oiled groundnut meal was extracted from de-skinned groundnut was tray dried at 50 °C to get 10% moisture content. Fresh Beetroot juice was prepared just before the experiments (Singh et al. 2004).

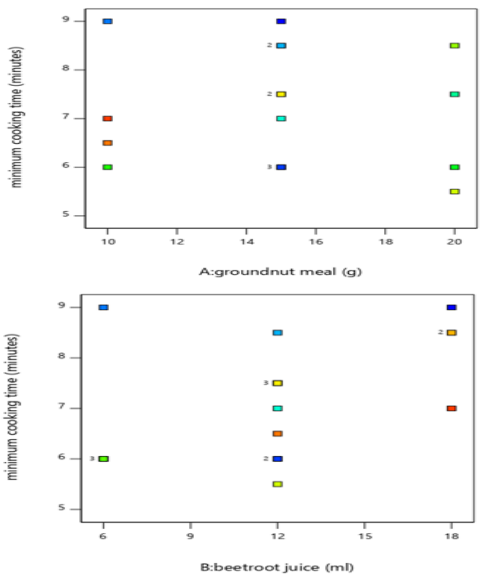
C.PASTA PREPARATION

Food materials i.e., partially de-oiled groundnut meal and refined wheat flour with beetroot juicewere mixed for the preparation of pasta sample as per experimental combinations (Table 1). Pasta extruder was used for uniform mixing. Different samples get varied amount of distilled water for the final moisture content 28 %.The samples were tray dried until they reach a moisture content of approximately 6.5 %. The Low-density polyethylene (LDPE) bags were used for packing and black coloured sheets were used for wrapping to protect from sun light.

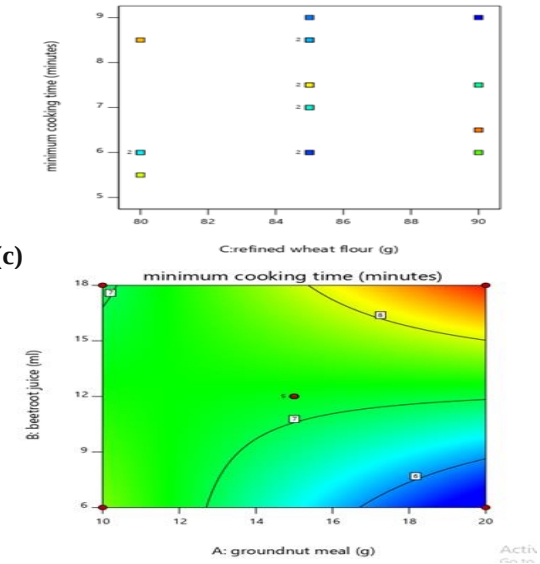
III.RESULTS AND DISCUSSION:

D, PRODUCT QUALITY RESPONSES

A.Cooking time



(a) **(b)**



(c)

(d)

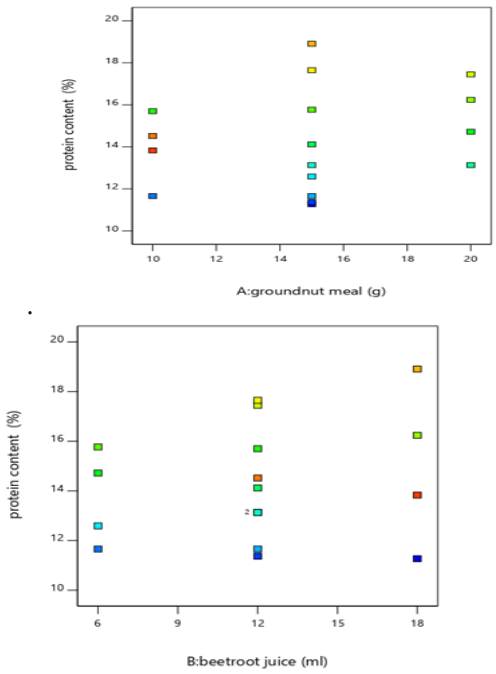
Fig 2 *Graphical representation of groundnut meal, beetroot juice and Refined wheat flour on cooking time of nutritious pasta*

The cooking time of all pasta samples varied from 5.5 to 9.0 min. The sample containing 20g of groundnut meal and 12 ml of beetroot juice has lesser cooking time i.e., 5.5 mins. The samples containing minimum amount of beetroot juice and groundnut meal has higher cooking time i.e., 9 mins.

Minimum cooking time (Y_1) = 29.801- 1.750 X_1 – 0.792 X_2 – 0.2 X_3 + 0.0375 X_1 X_2 + 0.0150 X_1 X_3 + 0.0042 X_2 X_3

B.Protein content

The standard (AOAC 2000) Kjehdahl method using nitrogen estimation system was used for the determination of protein content of pasta.



(a) (b)

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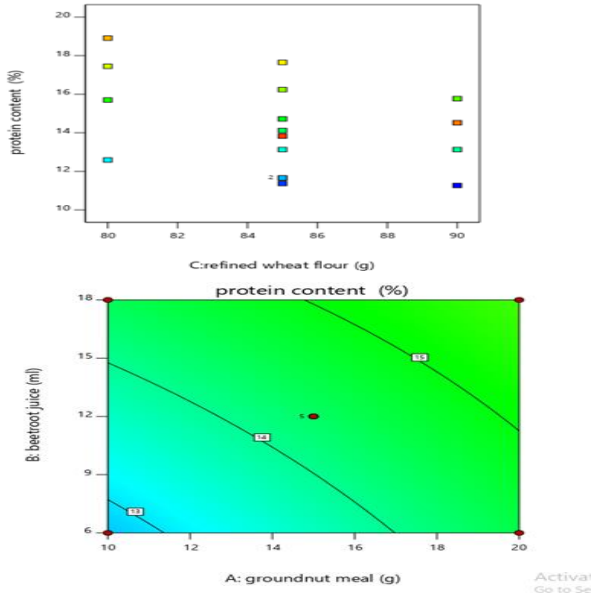


(c) **(d)**

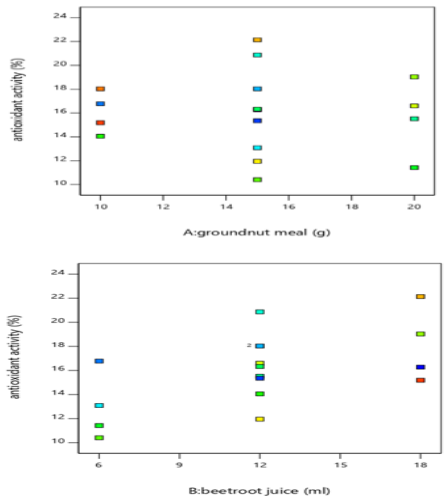
Fig. 3 *Graphical representation of groundnut meal, beetroot juice and refined wheat flour on protein of nutritious pasta*

The variations in protein content were observed from 11.27 to 18.91 % for different pasta combinations with an average value of 12.98 %.protein content indicated an increase from 11.6% at 10 g of groundnut meal to 12.59% at 15 g, and further it is increased to 14.72% at 20 g with the concentration of beetroot juice (6ml).The maximum protein content observed in the pasta sample is 18.91% prepared from 18 ml of beetroot juice, 15 g of groundnut meal and 80 g of refined wheat flour while minimum protein content was found to be 11.27% prepared from 18mlof beetroot juice, 15 g of groundnut meal and 90 g of refined wheat flour. The coefficient of regression (R^2) is 0.2054 and non significant lack of fit.

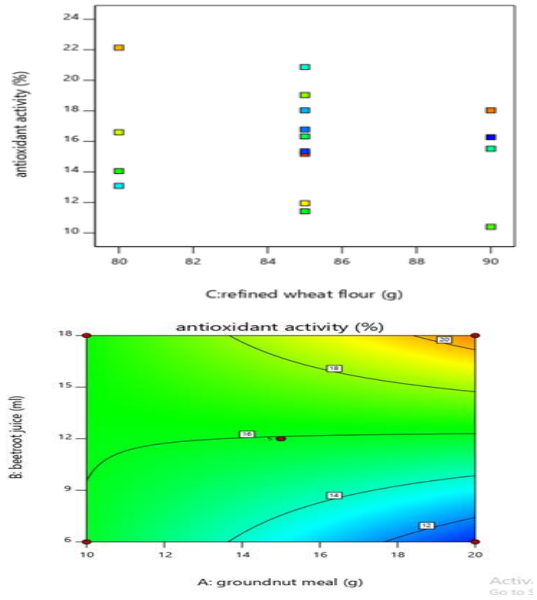
Protein content (%) $Y_2 = - 101.04 + 2.879\ X_1 + 7.86\ X_2 + 1.304\ X_3 - 0.0054\ X_1\ X_2 - 0.0314\ X_1\ X_3 - 0.090\ X_2\ X_3$

C.Antioxidant activity

The radical scavenging activity using 2,2-diphenyl-1-picrylhydrazyl radical (DPPH) (Scherer and Godoy 2009, 2014) was used for the determination of pasta sample antioxidant activity.



(a) **(b)**



(c) **(d)**

fig. 4 *Graphical representation of beetroot juice, groundnut meal and refined wheat flour on antioxidant activity of nutritious pasta*

A wide range of variations were observed from 10.402 to 22.138 % with an average value of 15.6419 % for pasta products on antioxidant activity. The maximum beetroot juice concentration of 18 ml along with 15 g of groundnut meal and 80 g of refined wheat flour. Results shows that the increasing beetroot juice significantly increases the antioxidant activity level in the pasta. This shows that beetroot has high antioxidant activity (Wootton-Beard and Ryan 2011). For a given value of groundnut meal viz.15 g, the antioxidant activity increased from 13.087% at 6 mL beetroot juice concentration to 16.325 % at 12 mL and further 22.138 % at 18 mL beetroot juice concentrations. The coefficient of regression (R^2) is negative.

Antioxidant activity (%) $Y_3 = -54.434 + 3.34\ X_1 + 1.536\ X_2 + 0.935\ X_3 + 0.076\ X_1\ X_2 - 0.506\ X_1\ X_3 - 0.026\ X_2\ X_3$

Target		Experimental range Min	Max	Optimum
Beetroot juice (mL)	range	10	20	18.00
Groundnut meal (g)	range	6	18	20.00
Refined wheat flour (g)	range	80	90	83.49
	Quality responses			**Predicted**
Antioxidant activity (%)	maximum	10.40	22.13	15.641
Protein content (%)	maximum	11.27	18.91	12.983
Cooking time (min)	minimum	5.5	9.0	7.736

Table 2 *Optimum values of nutritious formulation and quality of pasta*

IV.CONCLUSION

The optimization of ingredients was evaluated using Response surface methodology with independent variables (Groundnut meal, Beetroot juice, Refined wheat flour) against responses (minimum cooking time, protein content and antioxidant activity).

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The obtained optimized pasta contains 15.8275 g of groundnut meal, 13.2559 mL of beetroot juice, 89.1534 g of refined wheat flour.This pasta sample contains 12.98% of protein content, 15.641 % of anti oxidant activity and minimum cooking time of 7.736 mins.

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