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Germinated cowpea flour in pasta: A comprehensive analysis of sensory and nutritional properties

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Abstract
This research focuses on the development of nutritious pasta by incorporating germinated cowpea flour as a replacement for semolina. The study aimed to evaluate the sensory and nutritional properties of pasta with varying levels of germinated cowpea flour. The pasta formulations were prepared using different combinations of wheat semolina, germinated cowpea flour, guar gum, and physillum husk. Sensory analysis was conducted to assess color, flavor, taste, texture, and overall acceptability, revealing that a formulation with 40% germinated cowpea flour (T_3) received the highest scores. Proximate analysis demonstrated that the T_3 sample exhibited increased protein content (20.12%), lower fat content (0.53%), and comparable carbohydrate and crude fiber levels compared to the control. Mineral analysis revealed higher concentrations of calcium, iron, phosphorus, and zinc in the T_3 sample. Color profile analysis indicated that the addition of cowpea flour affected the color parameters of both dried and cooked pasta. The research concludes that the incorporation of germinated cowpea flour enhances the nutritional profile of pasta, making it a potential value-added and health-promoting product.

Keywords: Germinated cowpea flour, proximate analysis, sensory analysis, nutritional properties

Introduction
Pasta has been characterized as a high-quality, sustainable, and healthful food model by the World Health Organization and the Food and Agriculture Organization of the United Nations. Furthermore, pasta was recognized as an intangible cultural property of humanity by UNESCO (the United Nations Educational, Scientific, and Cultural Organization) in 2010. Pasta's nutritional profile is a major factor in its popularity. Indeed, because pasta has few fats and easily digested carbohydrates, it is generally quite nutritious (Dello *et al*., 2021) [1]. Due to increasing demand for a greater variety of healthy foods, new type of pasta need to be developed. To enhance the protein content the semolina can be replaced by germinated cowpea flour. There is increasing demand for such value-added pasta among consumers due to their health benefits. The entitled research work had been carried out with addition of germinated cowpea flour for development of nutritious pasta. The different levels of germinated cowpea flour were used for this research and their effect on sensory and nutritional property.

Materials and Methods
Materials
The raw materials such as cowpea flour, semolina, salt, etc. were purchased from local market of parbhani. Guar gum and Physillum husk required for research work were available in the Department of Food Chemistry and Nutrition.

Chemical and glassware
The chemicals of analytical grade and glassware required during investigation were used in the department of Food Chemistry and Nutrition.

Methods
The pasta were prepared from 100% semolina as control sample and used for comparative studies. The different combinations of wheat semolina: germinated cowpea flour: guar gum: physillum husk were taken for study. The standardization of the recipe is given in table 1.

Table 1: Standardization of pasta

Ingredients	T_0	T_1	T_2	T_3	T_4
Semolina	100	80	70	60	50
Cowpea flour	00	20	30	40	50
Physillum husk	00	0.5	0.5	0.5	0.5
Guar gum	0.2	0.2	0.2	0.2	0.2
Salt	0.2	0.2	0.2	0.2	0.2

Preparation of pasta

The pasta was prepared according to receipe. The basic ingredients such as wheat semolina, germinated cowpea flour, guar gum and physillum husk used according to standard receipe and with the combinations of different flour given in table 1.

All dry ingredients were mixed in extruder for couple of minute, then add water slowly in order to prepare dough. Then pasta were extruded from lab scale extruder and then dried it at 50-60 °C.

Mixing of dry ingredients (Semolina, Cowpea flour, physillum husk, guar gum, salt)
↓
Mixing water slowly in dry flour to prepare a dough
↓
Extrusion through lab scale pasta extruder with appropriating die
↓
Rotary cutting
↓
Drying (50 °C for 30 min)
↓
Packaging and storage

Sensory analysis

The sensory evaluation was carried out to assess the overall acceptability of the pasta incorporated with cowpea flour. The samples were cooked in boiling water for 6-7 minutes and spices were added. The quality attributes (color, flavor, taste, and texture) of prepared pasta were evaluated against the control sample and prepared sample. Optimally cooked pasta were then analyzed for overall acceptability of samples by 10 members using a nine-point hedonic scale Mean values and SD (standard deviation) were calculated for the determination of the difference among pasta.

Proximate analysis

a. Moisture

The moisture content of pasta was estimated by hot air oven drying method (AOAC 2000) [7].

b. Ash

The as content of pasta was estimated by using standard method of ash estimation muffle furnace combustion method (AOAC 2000) [7].

c. Protein

The crude protein content was determined by using the Micro Kjeldhal Apparatus (AACC 2000) [2].

d. Fat

The crude fat was determined by using Soxhlet apparatus as described in method no. 30-25 (AACC 2000) [2].

e. Crude Fibre

The crude fibre was determined by using following method No. 30-25 (AACC, 2000) [2].

f. Carbohydrate

Carbohydrate were calculated by difference method.

Mineral Content

Mineral content was determined by (AOAC 2000) [7].

Color Analysis

Results and Discussion

Table 2: Sensory properties of pasta

Sample	Sensory				
	Color	Flavour	Taste	Texture	Overall acceptability
Control	8.1	8.2	8.2	8.0	8.1
T_1	8.1	8.4	8.4	8.2	8.2
T_2	8..3	8.6	8.1	8.3	8.2
T_3	8.6	8.8	8.6	8.7	8.6
T_4	7.7	7.7	8.0	7.6	7.7
SE	0.068	0.067	0.075	0.077	0.087
CD at 5%	0.207	0.205	0.228	0.234	0.266

Organoleptic evaluation is one of the important quality characteristic of food products. It is important in preference of product in market place. The prepared pasta were subjected for sensory evaluation based on 9-point hedonic scale to color, flavour, taste, texture and overall acceptability which was compared with control sample and prepared sample results obtained are tabulated in Table 2.

The data presented in (Table 2) revealed that sample T_3 got highest score for color among all samples. All Sample T_1, T_2, T_3 and control found good score flavor and taste. The overall acceptability of pasta showed that the sample T_3 was highly acceptable among all samples.

Table 3: Chemical properties of pasta

Parameter (%)	Control (T_0)	Selected Sample (T_3)
Moisture	8.54±0.05	10.68±0.03
Protein	12.87±0.04	20.12±0.03
Fat	1.3±0.2	0.53±0.25
Ash	1.10±0.02	5.26±0.05
Carbohydrate	73.73±0.04	60.8±0.04
Crude fibre	2.4±0.2	1.61±0.02

The chemical composition of the sample T_3, which was chosen based on a sensory evaluation, as well as the control sample, was examined and is displayed in Table 3. T_3 has a higher moisture content than control, according to the results shown in Table 3. The T_3 sample had a protein content of 20.12±0.03. The control sample had a fat percentage of 1.3±0.2 percent, while the T_3 sample had a fat content of 0.53±0.25 percent. Carbohydrate content in the T_3 sample is 60.8±0.04 percent lower than in the control sample, which has 73.73±0.04%.

The T_3 sample's crude fiber content was determined to be lower than that of the control, at 1.61±0.02 percent and 2.4±0.2 percent, respectively. It was discovered that the chosen pasta sample had a higher ash level (5.26±0.05%) than the control (1.10±0.2%). Similar outcomes are close finding with (Bashir *et al*., 2012) [3].

Table 4: Mineral content of pasta

Parameter (mg/100 g)	Control (T_0)	Selected Sample (T_3)
Calcium	23.65±0.04	34.30±0.02
Iron	8.81±0.03	11.82±0.03
Phosphorous	123.13±0.01	266.48±0.01
Zinc	2.97±0.02	3.45±0.04

The mineral composition of the control and selected samples (T_3) is displayed in Table 4, where it is indicated that the selected sample has a higher calcium concentration than the control sample. The calcium contents of the sample that was chosen and the control are 34.30±0.02 mg/100 g and 23.65±0.04 mg/100 g, respectively. It has been discovered that the iron, phosphorus, and zinc concentrations of sample T_3, which was chosen, are higher than those of the control sample. Iron, zinc, and phosphorus contents were determined to be 8.81±0.03 mg/100 g and 11.82±0.03 mg/100 g, 123.13±0.01 mg/100 g and 26.48±0.01 mg/100 g, 2.97±0.02 mg/100 g and 3.45±0.04 mg/100 g, respectively, for the control and chosen sample. The findings align with those of Yadav *et al*. (2014) [4].

Table 5: Color profile analysis of pasta

Sample	Dried pasta			Cooked pasta		
	L	a	b	L	a	b
Control	83.79	1.47	13.79	64.27	1.54	17.21
T_3	80.42	1.07	14.71	59.53	2.26	18.76

The color profile of the control and chosen pasta sample T_3 is shown in the data from table 16 above. When comparing the dried pasta selected sample to the control, the value of L* increased dramatically. The T3 sample had the highest L* value (80.42) whereas the sample control had the lowest value (83.79). L* value dropped in cooked pasta. The control group had the highest L* value (64.27) whereas the T3 group had the lowest value (59.53). The proportion of cowpea flour in dry pasta significantly darkened as the percentage of cowpea flour in semolina grew from 0% to 40%, as evidenced by lowering L values. For dried pasta, the value of "a" dropped from 1.47 to 1.07. Likewise, the value of "a" rose from 1.54 to 2.26 in cooked pasta. As the amount of cowpea flour increased, so did the value of 'b'. T_3 had the highest value of "b" compared to control. Comparable outcomes were discovered that closely matched those of Gull *et al*. (2016) [6].

Conclusion

From present investigation, it was concluded that pasta incorporated with cowpea flour had good nutritional and sensory quality attributes. It was also concluded that sample T_3 got highest score for overall acceptability and it was taken for further analysis.

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