

**Formulation and Quality Evaluation of Oyster Mushroom Powder
(PleurotusOstreatus) Incorporated Whole Wheat Flour Bread**

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Abstract

Oyster mushroom being a prime source of protein due to easy bio-availability in human and incorporation of mushroom in bread tends to evolve a product which can be easily substituted in human diet. Oyster mushroom consist of several protein such as lignocellulolytic enzymes, lectins, proteases hydrophobins inhibitor which is beneficial in case of biotechnology and medicinal usage. The formulation of bread consist of flour and mushroom in composition of 95:5, 90:10, 85:15, 80:20 and a control sample without mushroom. The final product showed a trend of increasing protein and fibre content as the mushroom is increased whereas carbohydrate, fat and energy value decreased respectively. Sample consisting 15% of mushroom showed suitable overall acceptability and also the hardness and springiness was also obtained as 11491.071 and 0.413 respectability and was optimum. The chemical composition of product with 15% mushroom was found as 14.63% protein, 15.61% fat, 1.91% crude fibre, 33.01 % of carbohydrate and 331.05 Kcal/100 g.

Introduction

Oyster mushroom (*Pleurotus* spp.), often called “Dhingri” in India, having usually lignocellulose fungus proliferating over living or lifeless tree. They are often identified in

nature because of their eccentric short morphological stipe or stem. Cultivation technology doesn't require expensive infrastructure facilities and is simple in nature. Cultivation in India is principally carried out as seasonal low-price growing rooms with extremely minimised expenditure over infrastructure. Large oyster mushroom cultivator is scarcely found in India which production occurs full year. Absolutely no planned market is available to trade or purchase new or dried out oyster mushroom. Therefore, market of oyster mushroom on an industrial ruler is seen infrequent inside Indian market when compared with button mushroom. Hypothetically each produce requires forty-five days and beneath managed environments and for that reason there may be eight crops every year. (Chitra et al., 2018)

Mushrooms are becoming named a good source of vegan proteins rapidly. Several proteins exclusivity have already been isolated such as lignocellulolytic enzymes, lectins, proteases hydrophobinsinhibitor. They offer answers to many biotechnological and medicinal complications such as for example microbial drug resistance, low dependencies on crop and higher availability of renewable energy. Fungal proteins of industrial software have justified their biotechnological calibre therefore established as higher fungi (very important), even though relatively unknown to get unique proteins (Erjavec et al., 2012).

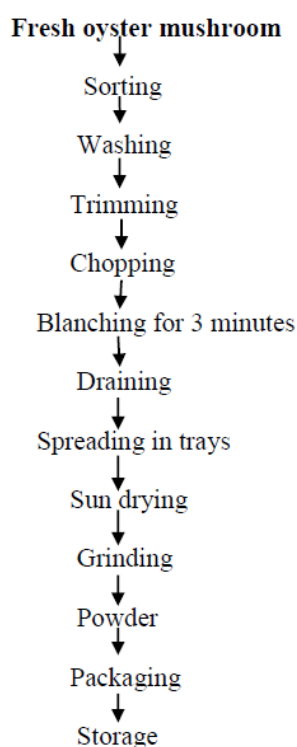
Material and Methods

This present investigation entitled "Formulation and Quality Evaluation of Oyster Mushroom Powder (*PleurotusOstreatus*) Incorporated Whole Wheat Flour Bread" was conducted in the Department of Food Process Engineering at Food Process Engineering Laboratory, VIAT, Sam Higginbottom University of Agriculture, Technology and Sciences, Naini (Allahabad).

Procurement of raw materials and development of products: The dried oyster mushroom (*Pleurotus ostreatus*) was purchased from Kaushambi district and whole wheat flour, sugar, salt, fat, yeast and other raw material were collected from the nearby market.

Formulation of Mushroom Powder

Oyster mushroom leafy petal part was just taken whereas the stem part was removed, the petal was taken (Walde et al., 2006) and then sorted as per quality and then pre-treatment was carried such as blanching for 3 minutes, in 100°C with 0.01% citric acid and 3% salt and blanching water was removed and then petal was spread over perforated tray for drying, and dried at 9-10% moisture content at $33\pm 2^{\circ}\text{C}$ for 48 hours.



After drying the mushroom was cooled to room temperature and then grinded to fine powder using grinder, and then sieved and packed in LDPE for storage purpose.



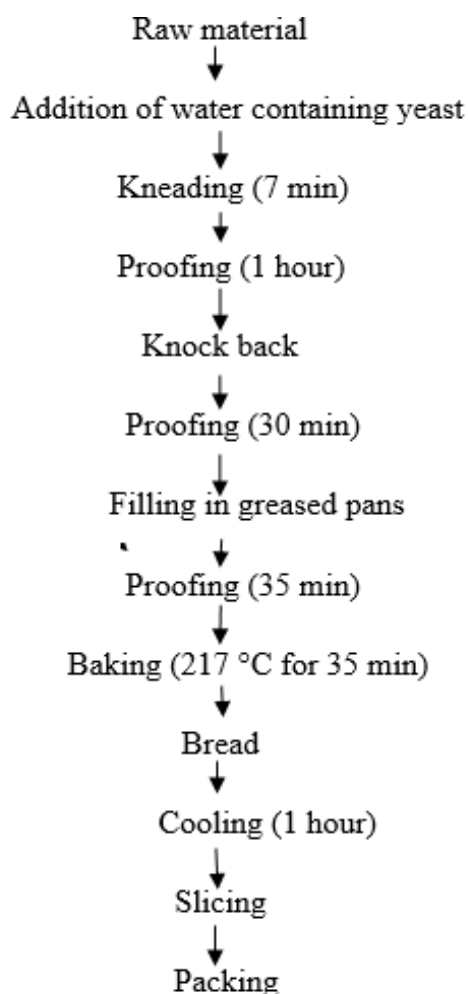
Experimental Plan (Whole wheat flour and oyster mushroom powder bread):

S. No.	Variables/ Parameters	Levels	Description
1.	Product	1	Oyster Mushroom powder Incorporated whole wheat flour bread
2.	Ingredients	7	Oyster Mushrooms powder, Flour (whole wheat), Butter, Baker's yeast, Sugar, Table salt, Drinking Water
3.	Treatments	5	WF - 100% (control) WF - 95%, OM -5% WF - 90%, OM-10% WF – 85%, OM-15% WF- 80%, OM-20%
4.	Analysis		Proximate analysis – Moisture, Protein, Fat, Ash content, Carbohydrate and Energy value. Sensory – Organoleptic analysis

Preparation of flour (whole wheat) and oyster mushroom powder bread:

The formulation involves percentage of mushroom in order of 0%, 5%, 10%, 15% and 20% with respective wheat flour concentration. The control sample was considered with 0% of mushroom powder. Bread was prepared by straight dough Method of Chauhan, et al. (1992). For all baking experiments, Dry yeast 1% (Activated), Salt 2%, Sugar 6%, Fat 1% were weighed according to the levels of flour required per treatment and the formulation. The composite flours and baking ingredients were mixed in a mixer, kneaded in to consistent

dough for 7 minutes and allowed the resulting dough to ferment at 30-32°C for 90 minutes (Eissa et al, 2007). The dough was allowed to prove relative humidity for 60 min and 85% and baked in a baking oven at 217 ° C for 35 min (Okafor et al. 2012). The baked bread loafs were allowed to cool to room temperatures and were packed in polyethylene bags of high density and further analyzed.



Proximate analysis of oyster mushroom powder incorporated whole wheat flour

bread: The chemical composition of flour (whole wheat), mushroom powder, the blends and bread were determined by standard method of AOAC (2000). The crude fibre content was determined by AOAC (2005) with method number 962.09.

Texture Profile Analysis

Compression profile study was completed using texture profile analyser (Model TA-TX plus, Stable Micro System, Godalming, UK) equipped with 75 mm probe, the test was performed at 1mm/s speed and at 80% compression. The sample size was 1.5x1.5 cm, the sample was taken after 3 days of storage period (Monthe et al., 2019).

Statistical analysis: data was reported and analysed for variance. Statistical significance was established using one sample t-test and regression analysis (ANOVA) variance at 5% level of probability and differences test. Statistical analysis was carried out using SPSS for Windows, version IBM 25.

Sensory Evaluation

Sensory evaluation was performed using hedonic scale for consumer preference in regards with different proportions of bread. For selection of optimum composition of bread keeping in view of general consumer behaviour. The sensory was performed for 50 people on whose average was taken so as to pool out best suitable composition.

RESULTS AND DISCUSSION

Data on physico-chemical characteristics of raw material viz. flour (whole wheat) and oyster mushroom powder is being given in Table1.

Table 1 : Chemical analysis of Wheat and Mushroom

S. No.	Parameters	Whole wheat flour	Oyster mushroom powder
1	Moisture (%)	11.4	7.80
2	Crude protein (%)	7.50	14.35
3	Crude fat (%)	0.68	1.10
4	Ash (%)	1.20	7.60
5	Crude fiber (%)	1.50	2.12
6	Carbohydrate (%)	77.72	67.03
7	Energy (Kcal/100g)	347	335.42

Whole wheat flour

The data available in table 1 showed the physico-chemical characteristics of whole wheat flour i.e. moisture content (11.4%) and crude protein, crude fat, ash and crude fibre content were 7.5, 0.68, 1.20 and 1.50 percent respectively. Carbohydrate and energy value were found 77.72 percent and 347 (Kcal) on calculated basis. The composition of whole wheat flour observer was more or less similar to those reported by **(Okafor et al., 2012)**. Okafor et al., (2012) delineated that the nutrient content of whole wheat flour as follows: Moisture 12.30%, crude protein 9.70%, carbohydrate 75.94%, fat 1.30%, ash 0.76%, crude fibre 0.30% and energy 341.66 (kcal/100g).

Oyster mushroom powder

The ready powder of mushroom obtained was slightly brown and, it was analysed for its chemical composition. It was demonstrated by the evaluation of powder (Table 1) as moisture 7.80%, protein 14.35%, fat 1.10%, ash 7.60%, Crude fibre 2.12%, total carbohydrate 67.03% and energy value (kcal/100g) 335.42. The value for all parameters was comparable such as ash, protein, fat, and moisture but carbohydrates percentile was greater than asstated by **Julita and Marek (2007)**. They have shown that dried mushroom (*Pleurotusostreatus*) have energy as much as 345 Kcal, fat 2.66%, ash 0.04%. water content 10.6%, proteins 15.7%, carbohydrate 64.1%.

Nutritional value of Formulated bread

Table 2 : Chemical composition of formulated bread

WWF: OMP	Moisture (%)	Ash (%)	Protein (%)	Fat (%)	Crude fiber (%)	Carbohydrate (%)	Energy (kcal/100gms)
100:00	30.20	0.86	8.93	17.21	1.80	41.00	354.61
95:5	31.40	1.86	13.57	16.25	1.60	35.32	341.81
90:10	32.20	1.92	14.33	16.31	1.89	33.35	337.51
85:15	32.80	2.04	14.63	15.61	1.91	33.01	331.05
80:20	33.20	2.46	14.19	15.55	2.05	32.55	326.91

Table 2 shows the range of moisture content in prepared oyster mushroom powder and whole wheat flour bread samples as 30.2-33.2 % and it is clear from Table 2 there was increase in moisture content with increased concentration of OM powder. The lowest moisture content material (30.2%) was seen in the complete wheat flour breads samples prepared using 100% whole wheat flour. The significant difference was observed between control and oyster mushroom powder incorporated bread samples. In contrast, as the mushroom powder

concentration amplified the moisture concentration of the whole wheat flour bread samples increased. The highest moisture content of 33.2 % was detected in the whole wheat flour bread formulation with the highest concentration of oyster mushroom powder (20%). The high moisture contents of samples may be attributed to the water added during the baking process. The moisture content of the bread in reported study of **Adeoye et al., (2019)**.

The proximate composition of the formulated oyster mushroom powder and whole wheat flour bread is available in Table 2 The results showed that the values of ash content were increased by increasing oyster mushroom powder substitution. The range of ash composition in the different samples of oyster mushroom powder and whole wheat flour bread ranges from 0.86% to 2.46%. Ash contents directly represents the mineral contents of certain foods, 0.86% was the ash content of the whole bread samples prepared from that of 100% whole wheat flour. The oyster mushroom powder concentration increases, the ash content of the bread was increased. The results of ash of present study are followed similar trend of the study reported by **Okafor et al., (2012)**. It was found that the ash content of control sample (100% whole wheat flour bread) is differed significantly at ($P < 0.05$) from the rest of the samples but there was significant difference at ($P < 0.05$) in each other. MahedyMahamud et al. (2012) revealed that 15% powder form of oyster mushroom supplemented whole wheat flour bread was showed 2.20% ash, this is slightly lesser then the present study this may be because of the agro geological variations of the raw materials, but the similar trend was reported in the increase of ash concentration.

Proteins are very important food molecules, providing the essential amino acids for living cell metabolism. Table 2 The results showed that the values of protein range in the preparation of oyster mushroom powder and whole wheat flour bread was 8.93-14.19%. The lowest protein

content (8.93%) was seen in 100% whole wheat flour prepared in the bread samples. The control of whole wheat flour bread sample with the other samples (oyster mushroom powder incorporated) is statistically significant ($P < 0.05$). It is a known fact that whole wheat flour is a poor source of the protein and good source of carbohydrate. In contrast, as the oyster mushroom powder concentration increased the protein concentration was also increased in formulated bread. The highest protein content of 14.63% was observed in the whole wheat flour bread formulation with the highest concentration of oyster mushroom powder (15%). This is attributed to that of rich source of the quality protein in oyster mushroom powder **Okafor et al. (2012); Sheikh et al. (2010).**

Nutrient composition of formulated bread samples from oyster mushroom powder and flour (whole wheat) is as presented in Table 2. The range of fat content determined as 17.21%-15.55% in formulated bread samples by using different compositional mixtures of both flours and it is clear from table 2 that the fat content also decreased with increased concentration of OM powder. The significantly ($p < 0.05$) difference in total fat content was observed between the 100% whole wheat flour bread and 5-20% oyster mushroom powder supplemented samples. The fat content of the bread from 100% whole wheat flour is about 17.21%. The high fat contents of the bread samples may be attributed to the refined oil added during the baking process. The fat content of the bread in reported study of (Okafor et al.,2012). The value of fat content for prepared samples followed similar trend of the study reported by (Adeoye et al., 2019).

The proximate composition of formulated oyster mushroom powder and whole wheat flour bread was presented in Table 2 the results indicated that the values of crude fiber were increased by increasing oyster mushroom powder substitution. The ranges of crude fiber were

determined as 1.80 to 2.05% in the prepared bread samples. In the prepared whole wheat flour bread samples, the crude fiber content of the bread samples also increased as oyster mushroom powder substitution was increased. Bread prepared with 100% whole wheat flour had showed the least crude fiber content (1.80%) while sample with 80% of whole wheat flour and 20% oyster mushroom powder had the highest crude fiber content of 2.05%. There was no significant difference also existed at ($P < 0.05$) in the crude fiber contents of samples prepared with (T_0) 100% of whole wheat flour and sample prepared from (T_1) 95% whole wheat flour, 5% oyster mushroom powder. The raise in the fiber content of the whole wheat flour bread with the raise in the oyster mushroom powder attributed to the high content of the crude fiber in the mushroom powder compared with the whole wheat flour (table 1). **Okafor et al. (2012)** reported the similar trend in the increase of fibre content as the oyster mushroom powder increase, and the fibre value of the prepared bread sample is similar with that of reported study.

The proximate composition of formulated oyster mushroom powder and whole wheat flour bread has been presented in Table 2 Carbohydrates are the major composition of the many plant-based foods and are the immediate sources of energy in the metabolism. The carbohydrate contents of the breads decreased significantly ($P < 0.05$) as oyster mushroom powder concentration was increased. The bread formulated only from whole wheat flour showed highest amount of carbohydrates (41.0%) whereas the lowest (32.55 %) observed in the whole wheat flour breads prepared from highest concentration (20%) of the oyster mushroom powder. This trend is because of the wheat is a good source of carbohydrate then oyster mushroom powder (Table 1). The carbohydrate content of the bread in the present study is lower with that of Mepba et al. (2007); Okafor et al. (2012), but found to be in the

range of as reported by Malomo et al. (2011), who observed the bread properties with different wheat based composite flours.

Table 2 shows a significant decrease in the bread energy value ($P < 0.05$) with the increased concentration of mushroom powder. The highest amount of energy (354.61 kcal/100 g) was detected in the bread samples formulated from 100% WF whereas the lowest (326.91 kcal/100 g) breads prepared from the highest concentration (20%) of the oyster mushroom powder were observed. This trend is because of the whole wheat flour is a good source of energy then oyster mushroom powder (Table 4.1) The energy value of the bread in the present study is lower with that of **Okafor et al. (2012)**, who reported the bread properties with different whole wheat flour based composite oyster mushroom powder.

Texture profile analysis was observed onto the selected bread sample for which 3 sample was chosen for minimum and maximum value as well as for the optimum bread as preferred by the consumers. It was observed that sample A T33 as shown in table 3 and figure 2 showed the highest springiness as well as maximum hardness was observed in A T2, the A T33 was taken bread with ratio of 85:15 and A T1 was 95:5 and A T2 was 80:20 as shown in figure 1 and 2 it can be observed that there is minute difference in the overall texture analysis carried with respect to A T33.

Table 3 : Textural Parameter of bread

Test ID	Hardness	Fracturability	Adhesiveness	Springiness	Cohesiveness	Gumminess	Chewiness	Resilience
	g	g	g.sec					
	Force 2	Force 3	Variable					
A T1	7283.103		-700.113	0.337	0.205	1494.996	503.838	0.087
A T2	8927.449		-610.896	0.320	0.206	1837.579	588.838	0.085
A T33	11691.071		-2.033	0.413	0.263	3077.729	1271.051	0.118

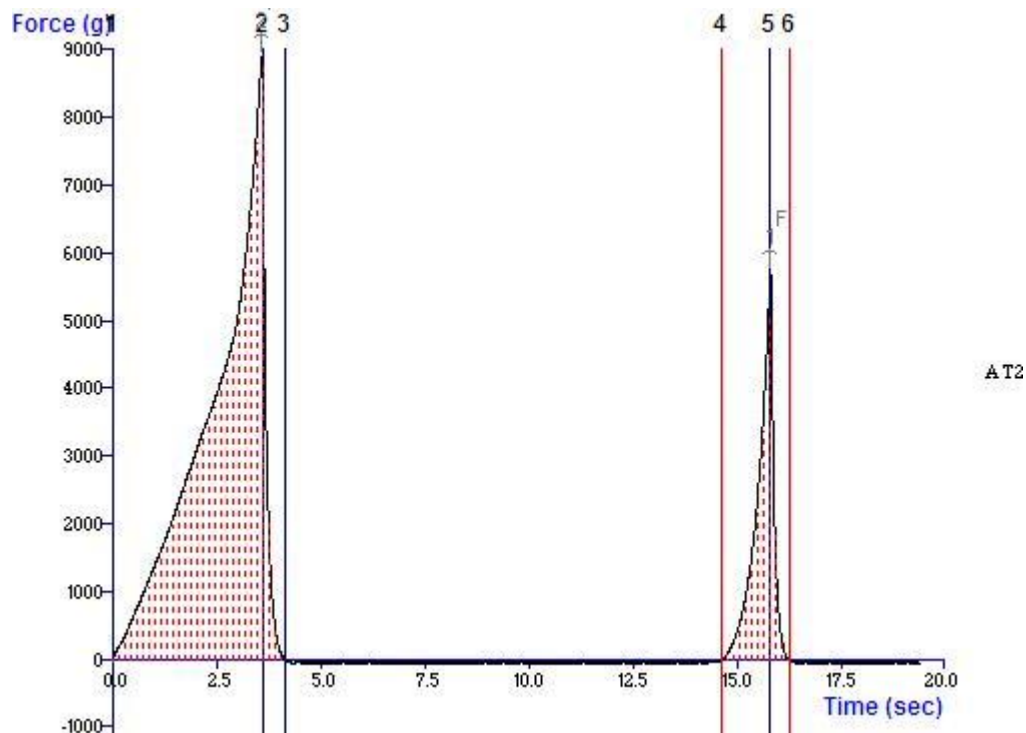


Figure 1 : A T2 Sample Curve

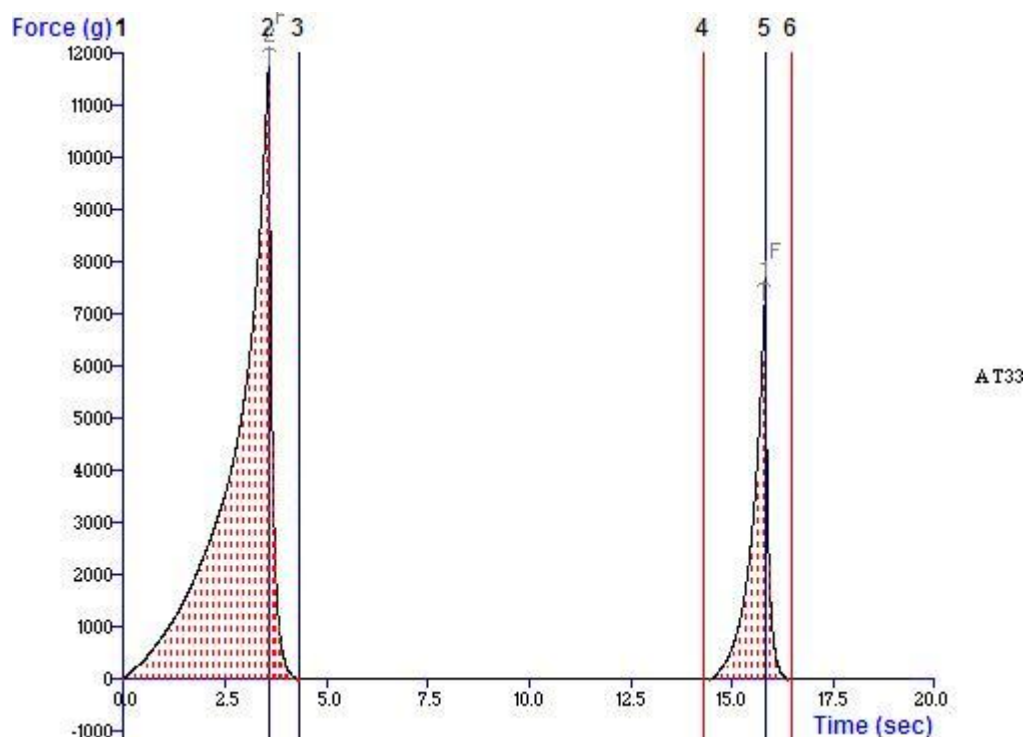


Figure 2 : A T33 sample curve

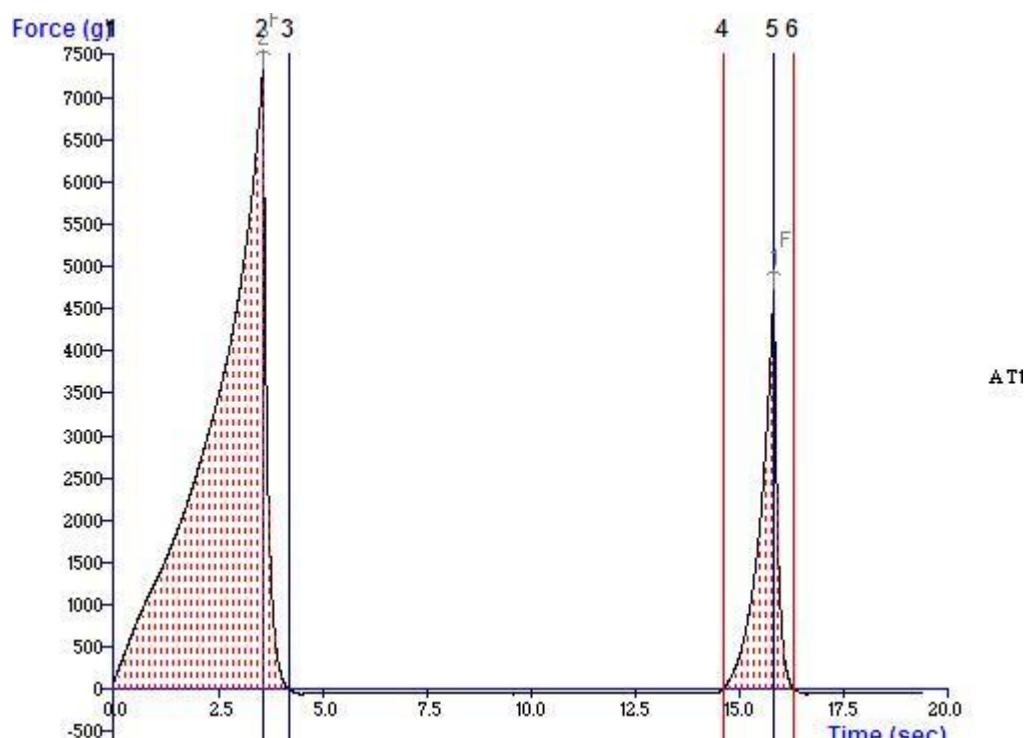


Figure 3 : A T1 Sample curve

Sensory evaluation of Formulated bread

Color: It is shown in Table 3 that the mean score of control sample was 8.60 whereas value obtained by F_0 to F_4 i.e. ranging from 5-20% with a gap of 5%OM powder incorporated whole wheat flour bread were 7.80, 7.80, 8.40 and 7.40 respectively. The result shows that samples with 5% and 15% incorporation of OM powder had better color.

Test: Table 3 shows the mean score of control sample was 7.00 whereas value obtained by F_0 to F_4 oyster mushroom powder incorporated whole wheat flour bread were 6.80, 7.20, 7.40 and 6.20 respectively. The result shows that F_2 and F_3 incorporated samples had better test than control and other incorporated bread products.

Table 3 Sensory evaluation of oyster mushroom powder whole wheat flour bread

WWF: OMP	Color	Taste	Texture	Appearance	Overall

					acceptability
100:00	8.60	7.00	7.60	7.20	8.00
95:5	7.80	6.80	7.20	7.00	7.60
90:10	7.80	7.20	8.00	6.60	7.40
85:15	8.40	7.40	7.80	7.80	7.80
80:20	7.40	6.20	6.80	7.40	7.00

Texture: Table 3 shows that the mean score of texture of control sample was 7.60, while the mean value of F₁ (5%), F₂ (10%), F₃ (15%) and F₄ (20%) oyster mushroom powder incorporated whole wheat flour bread were 7.20, 8.00, 6.80 and 6.80 respectively. The result shows that texture of F₂ (10%) incorporated samples had higher than control and other incorporated products.

Appearance: Table 3 shows that the mean score of appearance of control sample was 7.20, while the mean value of F₀ to F₄ oyster mushroom powder incorporated whole wheat flour bread were 7.00, 6.60, 7.60 and 7.40 respectively. The result shows that appearance of F₄ (20%) incorporated samples had higher than control and other incorporated product.

Overall acceptability: Table 3 shows that mean score of control sample was 8.00 while the mean value of F₀ to F₄ oyster mushroom powder incorporated whole wheat flour bread were 7.60, 7.40, 7.40 and 7.00 respectively in overall acceptability. The result shows that the mean score value of control sample was higher than incorporated products at different level. But the 5% incorporated whole wheat flour bread shows better overall acceptability than other incorporated whole wheat flour breads.

Conclusion

The experiment showed various result in regards of mushroom effect over the fulfilment of protein requirement of the body. As shown in above result it was clear as addition of mushroom powder increased protein content of overall product whereas decreasing the fat, carbohydrate and energy, it also helped to replenish the fibre content within the sample. It was observed that highest overall acceptability other than control bread was observed in bread with mushroom ratio of 85:15 in proportion, also the texture profile analysis showed the corresponding result in term of hardness and springiness termed as A T33 sample. Thus it can be used as a regular substitute to various protein requirement.

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