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Effect of storage period on total phenolic content, ascorbic acid and titrable acidity of flour blends made from Himalayan variety of wheat, oat and mushroom flour packed in metalized polyester

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Abstract
Flour blends prepared were made from wheat flour by incorporating mushroom flour at 0%, 3%, 6%, 9%, 12%, 15% and 18% and oat flour at the uniform rate of 15% in each treatment. The flour blends were packed in metalized polyester and stored for 90 days. Total phenolic content, titrable acidity and ascorbic increased with the increase in mushroom flour incorporation. Storage studies of the flour blends revealed that the total phenolic content, titrable acidity and ascorbic acid showed significant decrease with the increase in storage days. Highest total phenolic contentment was found in T_7 (9.87%) at 0 day which decreases to 6.50% with the increase in storage period. Similarly highest value for ascorbic acid and titrable acidity was found at 0.95% and 3.95% in T_7 treatment which then decreased to 0.52% and 1.90% during 90 days of storage.

Keywords: titrable, Himalayan, metalized, metalized

1. Introduction
Cereals make the availability of adequate supplies of flour a major economic and political issue at various times throughout history. Cereal flour is the main ingredient of many foods which is a staple food for many cultures. Common wheat (*Triticumaestivum L.*) is an important component of the human diet, and is used in the production of many food products, including bread, noodles, steamed bread, and cakes, providing energy based on the high contents of protein and carbohydrate. Wheat products contain high levels of antioxidants, which confer protection against cancer and heart diseases mostly coming from phenolics (Adom *et al.*, 2005; Ward *et al.*, 2008) [1, 9]. Wheat flour is one of the most important ingredients in Oceanic, European, South American, North American, Middle Eastern, North Indian and North African cultures, and is the defining ingredient in their styles of breads and pastries. Oats (*Avena sativa L.*) were revaluated in recent years as a promising crop for improving the nutritional quality of foods, due to their richness in many bioactive compounds, including phenols. These plant secondary metabolites are useful as radical scavenging, and also possess positive biochemical effects against cardiovascular diseases, cancer growth and age-related diseases. (Michela & Rita 2015) [6]. Mushrooms are well balanced food that provides definite nutrition and health benefits. Mushrooms are known to produce different kinds of bioactive compounds, generally linked with mycelial cell wall, that help in enhancing the capacity of immune system to fight against carcinogens. The aim of this research was to study total phenolic content (TPC), Titrable acidity and ascorbic acid of wheat, oat, mushroom flour blends and effect of storage on them.

2. Material and methods
2.1 Raw material used in the investigation
The wheat (SKW-355) and Oats (Sabzar) were procured from Seed Research Centre for Field Crops SKUAST-K, Shalimar. Fresh mushrooms (*Pleurotus sajor-caju*), procured from Mushroom Research and Training Centre, Division of plant pathology, Shalimar. Drying of mushroom shall be conducted in cabinet dryer at 33oC to reach 9-11% mc as per the method adopted by Khan (2008) [3]. Part of the wheat flour was replaced by oat flour and mushroom

flour according to the levels provided by (Table 1). Mushroom powder was added in the range of 0-18% and Oat at the uniform rate of 15% shall be added to all treatments except T1 (control). All the flours were packed in metalized polyester bags and stored for further studies under ambient conditions. Metalized polyester was procured from the market and was used as the packaging material to store products.

Table 1: Details of Treatment combination for preparation of flour

Treatment code	Wheat four (%)	Mushroom powder (%)	Total (%)
T_1	100	0	100
T_2	82	3	100
T_3	79	6	100
T_4	76	9	100
T_5	73	12	100
T_6	70	15	100
T_7	67	18	100

Oat flour at the uniform rate of 15% was added to all treatments except T_1 (control)

2.2 Total phenolic content (%)

Total phenolic content (TPC) of samples was performed using the Foline Ciocalteu method as described by Li *et al*., (2015). The samples and gallic acid/ferulic acid standard curve (50-700 mg/ mL-1; y ¼ 0.001x þ 0.036; R2 ¼ 0.97: y ¼ 0.001x þ 0.03; R2 ¼ 0.99) were measured at 760 nm. TPC was expressed as mg gallic acid/ ferulic acid equivalent g-1 of sample (dry weight).

2.3 Ascorbic acid (mg/100g)

Ascorbic acid was estimated by using 2, 6-dichlorophenol indophenol dye. Dye factor was calculated by titrating 5 ml standard ascorbic acid plus 5 ml (3%) metaphosphoric acid against 2, 6-dichlorophenol indophenol till pink colour appeared and volume used was noted.

$$\text{Dye factor} = \frac{0.5}{\text{Titre value}}$$

Ascorbic acid was estimated by taking 5g of sample, volume made upto 100 ml with 3% metaphosphoric acid and filtered. Then aliquot of 10 ml was taken in a titration flask and titrated against 2, 6-dichlorophenol indophenol till light pink color appeared (which persisted for 15 seconds). Vitamin C was calculated using the following formula.

$$\text{Ascorbic acid (mg/100g)} = \frac{\text{Titer value} \times \text{dye factor} \times \text{volume made up}}{\text{Ml of filtrate taken for} \times \text{weight of sample estimation}} \times 100$$

2.4 Titrable acidity (%)

The Titrable acidity was estimated by titrating 5 ml of sample against 0.1N NaOH solution using phenolphthalein as an indicator. The acidity was calculated and expressed as per cent anhydrous citric acid (AOAC, 1995) [2].

3. Results and discussion

The TPC, Ascorbic acid and Titrable acidity increased significantly as the proportion of mushroom flour in the blends increased (fig.1, 2, 3.). It has been reported that wheat has less phenolic content than mushroom. (Yaoguang *et al.*, 2015) [10]. The total phenolic content has positive correlation with the free radical scavenging ability in fruits and cereal (Stratil *et al*., 2007) [8]. It depends on type of cereal, cultivar, composition and technical assay (Maisuthisakul *et al*., 2008) [5]. This could be due to the fact that major phenolic compounds may have both hydrophilic and hydrophobic properties in nature that are able to solubilize both in germ and endosperm i.e. coniferyl alcohol, syringic acid, and ferculic acid. (Kuo *et al*., 2002) [4]. On storage TPC, ascorbic acid and Titrable acidity decreases this might be due to the oxidation of monohydric or dihydric phenols that occurs, and with this, the reduction of active phenols (Reyes *et al*., 2005) [7]. Also due to acidity of enzymes like PPO antioxidant activity decrease on storage.

Table 2: Total phenolic content, Ascorbic acid and Titrable acidity of individual flours

Parameters (%)	Wheat flour	Oat flour	Mushroom flour
Total phenolic content	4.30±0.2	3.90±0.03	6.90±0.05
Ascorbic acid	0.00	0.00	5.23±0.01
Titrable acidity	4.02±0.01	4.05±0.03	6.90±0.05

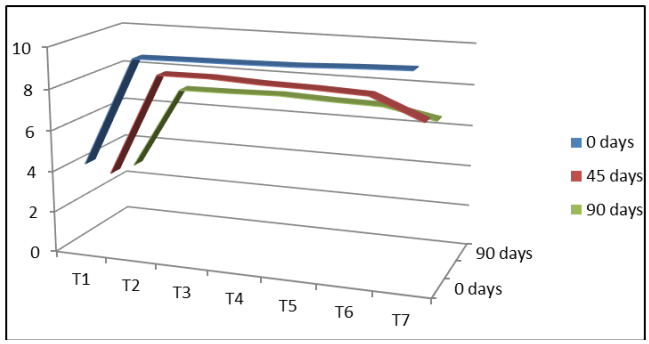

Fig 1: Effect of storage period on Total phenolic content (%) of flour blends packed in metalized polyester packaging. ($T_{1=}$, T_2, T_3, T_4, T_5, T_6, T_7)

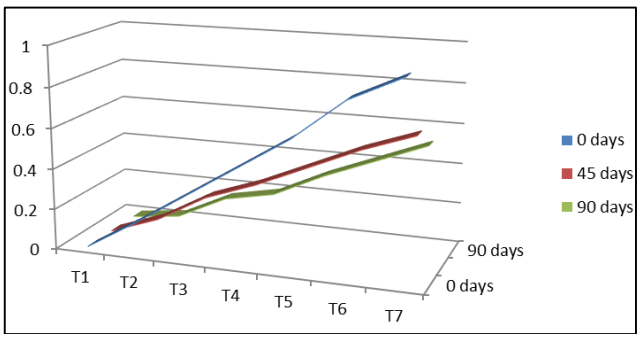

Fig 2: Effect of storage period on ascorbic acid (%) of flour blends packed in metalized polyester packaging. ($T_{1=}$, T_2, T_3, T_4, T_5, T_6, T_7)

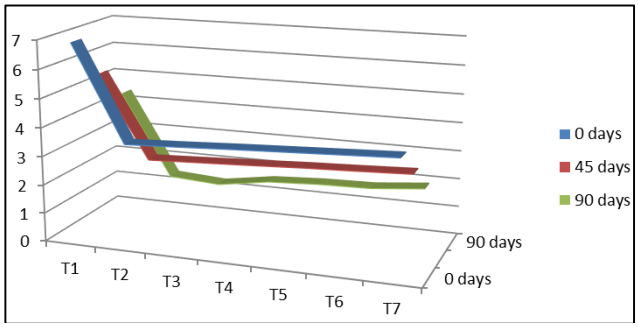

Fig 3: Effect of storage period on Titrable acidity (%) of flour blends packed in metalized polyester packaging. ($T_{1=}$, T_2, T_3, T_4, T_5, T_6, T_7)

4. Conclusion

Incorporation of mushroom flour in wheat flour significantly affected the TPC ascorbic acid and Titrable acidity. The TPC

of blends were significantly influenced by incorporation of mushroom flour. Storage studies of the flour blends revealed that the total phenolic content, titrable acidity and ascorbic acid showed significant decrease with the increase in storage days. This shows the overall potential of flour increased. This flour can be used for many products like biscuits, cake etc.

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