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Effect of apple pomace on nutritional quality of gluten-free flour blend based cracker

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Abstract
The different formulations of gluten free flours and apple pomace powder were used for gluten free cracker preparation and crackers prepared were studied. The apple pomace powder was incorporated in the traditional recipe to replace wheat flour with gluten free flour blend (brown rice flour: millet flour) and apple pomace powder at the levels of 0, 80:10:10, 70:20:10, 70:10:20, 60:20:20, 60:25:15 and 60:15:25 percent in the preparation of crackers. Pomace flour blends were prepared by incorporating 10%, 15%, 20% and 25% apple pomace in brown rice flour and millet flour. The results of sensory evaluation revealed that the 10 percent addition of apple pomace powder had higher overall acceptability, taste, texture & flavor. However a declining trend in acceptability was observed with increasing level of apple pomace powder for all the sensory characteristics. The nutritional value of gluten free cracker (as determined through nutrient analysis of moisture, protein, ash and total dietary fibre) with percent of apple pomace powder incorporated cracker was higher than control sample. The apple pomace incorporated gluten-free flour blend cracker T_1 treatment with 80:10:10 (brown rice flour: millet flour: apple pomace powder) ratio had the highest level for overall acceptability and treatment T_6 with 60:15:25 ratio was found acceptable for total dietary fiber.

Keywords: gluten free cracker, apple pomace powder, total dietary fibre

Introduction
Crackers are the popular snack products which have appreciable demand amongst the consumers (Maneerote *et al*., 2009) [4]. Crackers are types of biscuits which are neutral or less sweet in taste. They are thinner and crispy than other types of biscuits. Crackers are typically salted flour products. A gluten-free diet is a diet that excludes the protein gluten. Gluten is found in grains such as wheat, barley, rye, and a cross between wheat and rye called triticale. A gluten-free diet is primarily used to treat celiac disease. Gluten causes inflammation in the small intestines of people with celiac disease. Eating a gluten-free diet helps people with celiac disease control their signs and symptoms and prevent complications. Celiac disease is a serious autoimmune disorder that can occur in genetically predisposed people where the ingestion of gluten leads to damage in the small intestine. Currently, the only treatment for celiac disease is lifelong adherence to a strict gluten-free diet.
Apple pomace being a by-product of apple juice industry has a lot of health benefits as it is a good source of dietary fibre and antioxidants. Phytochemicals present in apple pomace have been associated with many health enhancing benefits e.g. cancer cell proliferation, lipid oxidation decrease and lower cholesterol level (O'Shea *et al.,* 2012) [7]. (Lu and Foo 2000) [3] indicated that the polyphenols, which are mainly responsible for the antioxidant activity, are present in apple pomace and hence could be a cheap and readily available source of dietary antioxidants. Millet flour used for preparation is enriched nutritional source. It is rich in phosphorus, magnesium, manganese, zinc, copper, iron and selenium. (Saini and Yadav 2018) [8] Several authors have reviewed the importance of dietary fibre (O'Shea *et al.,* 2012) [7].
Therefore the present study investigates the possibility of using a by-product such as apple pomace with the aim of improving the nutritional potential of gluten-free flour based cracker by incorporating apple pomace powder in it.

Materials and Methods
This section describes the materials used, the methods applied, calculations used and factors considered in development of apple pomace incorporated gluten free crackers.

Procurement of raw materials
The raw materials (apple, wheat flour, brown rice flour, millet flour, salt, sugar, butter and baking powder) were purchased from the local market of Mahewa, Allahabad.

Preparation of apple pomace powder

Fresh apples obtained washed well with water to remove the dust. The apples were cut into small pieces and crushed into the mixer (Bajaj GX-1 500-Watt Mixer Grinder, India). The juice was squeezed completely from the pulp with the help of muslin cloth and pomace was dried in tray drier at 60 °C for 24 hours and grounded with grinder mill and sieved into fine powder.

Prepration of crackers

Wheat flour cracker (control sample (T_0)) formulation was wheat flour, sugar, salt, fat, baking powder and water. In treatments wheat flour is replaced by brown rice flour, millet flour and apple pomace powder in different formulations i.e. 80:10:10(T_1), 70:20:10(T_2), 70:10:20(T_3), 60:20:20(T_4), 60:25:15(T_5) and 60:15:25(T_6).

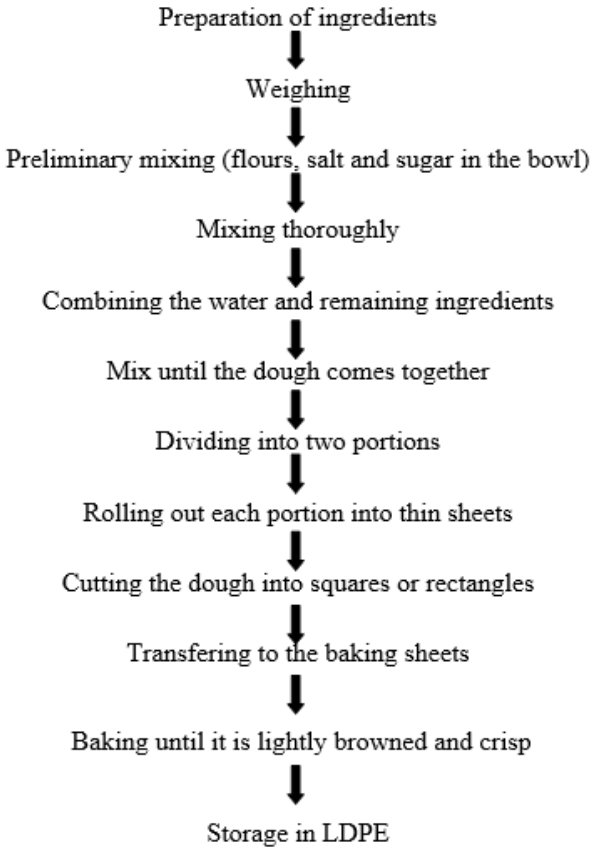

Fig 1: Flow Chart of Cracker Preparation

Physico-chemical analysis

Moisture content, ash content, total dietary fibre and protein content were determined by the AOAC (2000) [2] methods.

Sensory analysis

Sensory analysis was done by 9 point hedonic scale as mentioned by Amerin *et al.* (1965) [1].

Statistical Analysis

Statistical analysis was done with the help of two way ANOVA classification with 5% significance level method given by Gupta (1997).

Results and Discussion

The present investigation was under taken to evaluate the quality as well as acceptability of utilization of apple pomace powder for preparation of gluten free crackers.

Determination of moisture content

The moisture content was found to be varied with different treatments. It was also found that increased level of millet flour also resulted in increased moisture content in the crackers as shown in fig 4.1. The highest moisture content was present in T_6 and lowest moisture content was found in T_0, i.e. 7.36% and 4.75% respectively, this is attributed to high water binding capacity of apple pomace powder. It is evident that the calculated value of F due to treatment is greater than the tabulated value at 5% probability level. During storage the moisture content increases as water vapour present in atmosphere permeated through the packaging material. It was found that moisture content of gluten free cracker increased with increase in levels of apple pomace powder incorporation which is evident from the findings of Moazzezi *et al.*, (2012) [6]

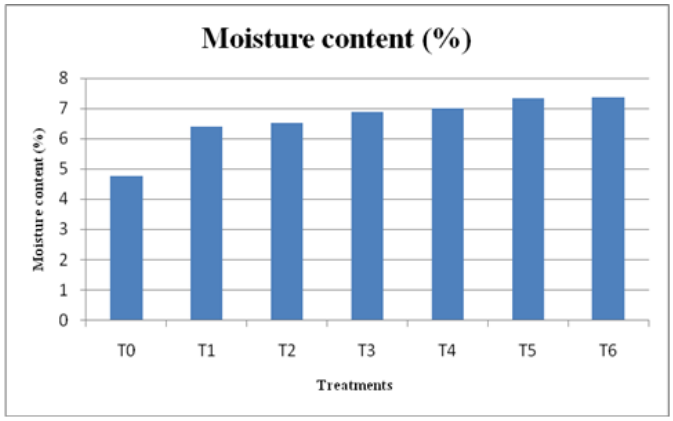

Fig 2: Effect of different treatments on Moisture Content (%) of apple pomace incorporated gluten-free flour blend cracker.

Determination of ash content

It shows that increase in level of apple pomace powder incorporation resulted in increase in ash content of gluten free crackers which is due to the high level of ash content present in apple pomace powder whereas difference in formulation of brown rice flour and millet flour had very slight variation. It is evident that the calculated value of F due to treatment is greater than the tabulated value at 5% probability level. During storage the ash content decreases due to volatilization or interaction between other constituents. The highest ash content percentage was found in T_6 and and lowest ash content percentage on T_0, i.e., 2.41 and 1.67 respectively. Similar results were reported by Lu *et al*., (2017).

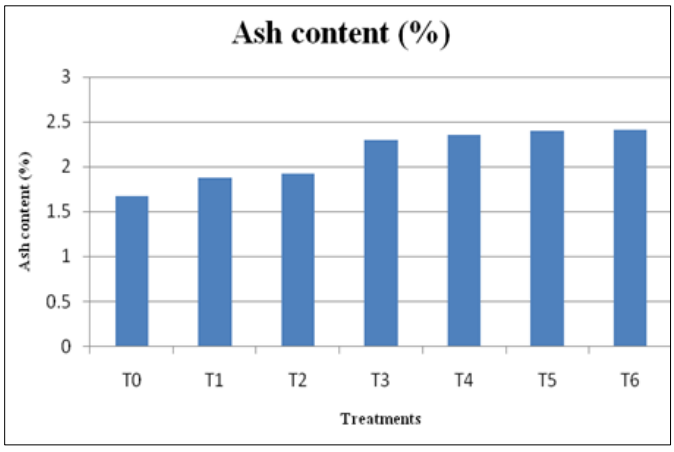

Fig 3: Effect of different treatments on Ash Content (%) of apple pomace incorporated gluten-free flour blend cracker

Determination of total dietary fibre

It shows that increase in level of apple pomace powder incorporation resulted in increase in total dietary fibre in gluten free crackers which is due to the high level of dietary fibre content present in apple pomace powder whereas difference in formulation of brown rice flour and millet flour does not show much variation. It is evident that the calculated value of F due to treatment is greater than the tabulated value at 5% probability level. The highest total dietary fibre was found in T_6 and and lowest total dietary fibre on T_0, i.e., 8.96 and 1.25 respectively. Similar results were reported by Sudha *et al.*, (2007) [10].

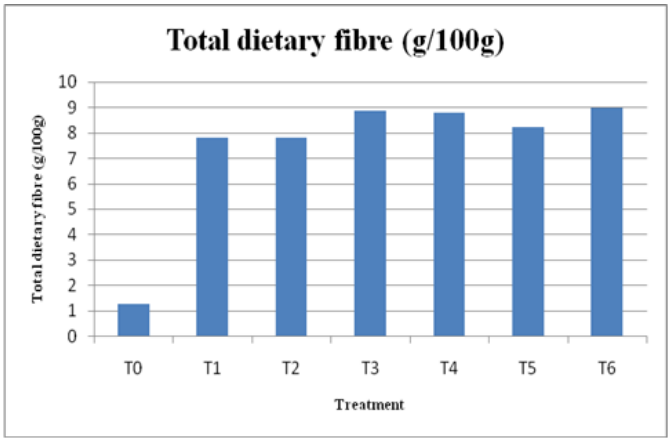

Fig 4: Effect of different treatments on Total dietary fibre (g/100g) of apple pomace incorporated gluten-free flour blend cracker.

Determination of protein content

It shows that increase in level of apple pomace powder incorporation resulted in decrease in protein content in gluten free crackers which is due to the low level of protein content present in apple pomace powder whereas difference in formulation of brown rice flour and millet flour showed slight variation. It is evident that the calculated value of F due to treatment is greater than the tabulated value at 5% probability level. During storage the protein content was decreasing because of denaturation of protein. The highest protein content was found highest in T_0 and and lowest protein content on T_6, i.e., 11.86 and 8.73 respectively. This was because of low protein content present in apple pomace, which was also reported by Mir *et al*., (2017).

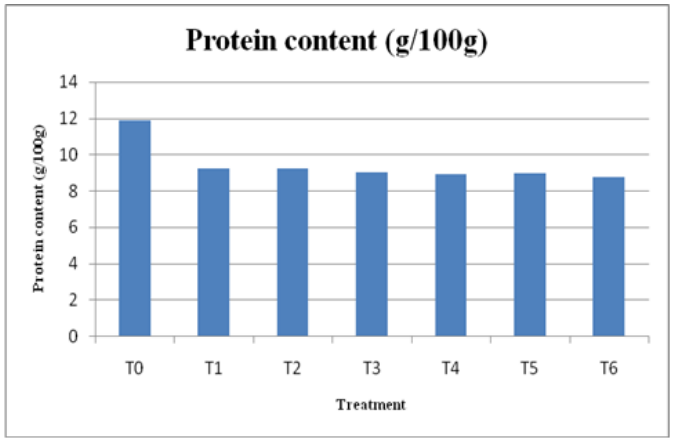

Fig 5: Effect of different treatments on Protein content (g/100g) of apple pomace incorporated gluten-free flour blend cracker.

Sensory properties

The different treatment of gluten free cracker samples showed varied degree of acceptability. As shown in Figure 5, it was revealed that the mean sensory score for color, flavor, texture, taste and overall acceptability of treatment T_1 containing 80% brown rice flour, 10% millet flour and 10% apple pomace powder was higher among all other treatments including the control sample. It is evident that the calculated value of F due to treatment is greater than the tabulated value at 5% probability level. T_1 was observed to have higher level of acceptance. Similar results were reported by Sudha *et al.* (2007) [10].

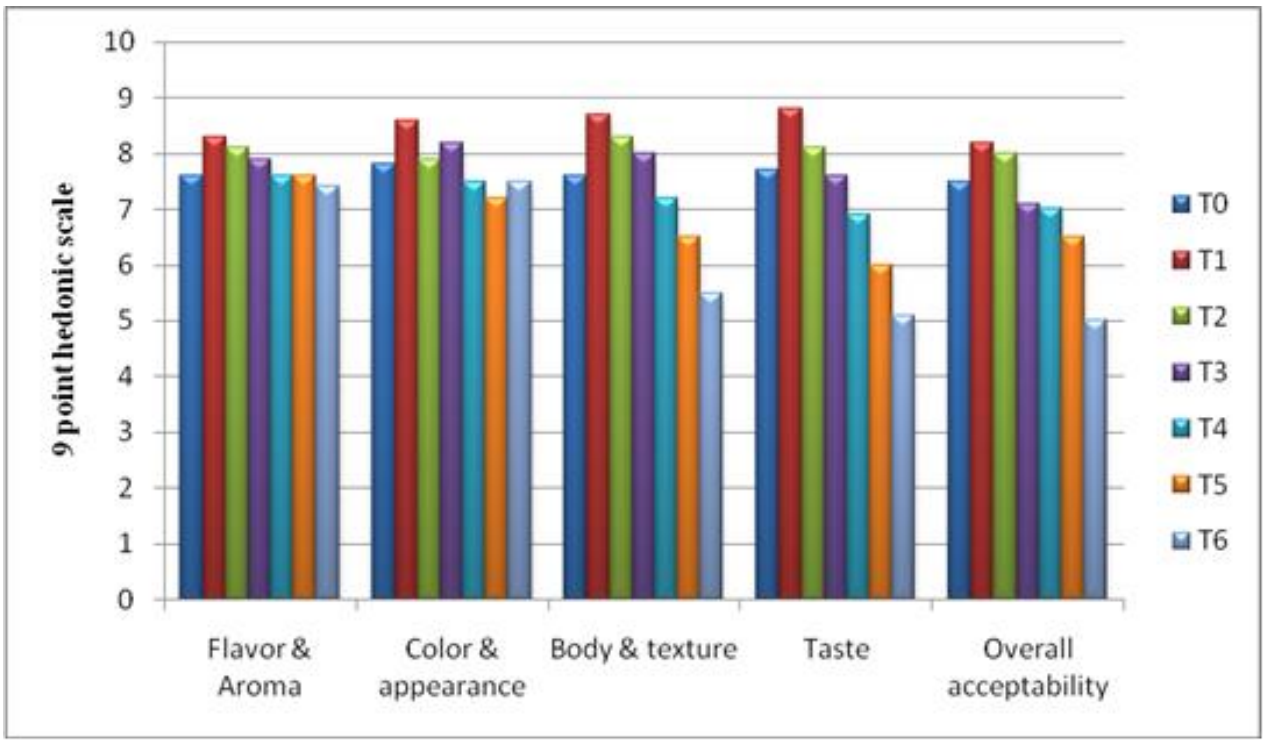

Fig 6: Effect of different treatments on sensory properties of apple pomace incorporated gluten-free flour blend cracker.

Conclusion

The present investigation was carried with the development of apple pomace powder in the preparation of gluten free cracker incorporated with apple pomace powder which is good source of dietary fibre. From the results, cracker containing 80% brown rice four, 10% millet flour and 10% apple pomace powder (T_1) was found sensory acceptable after sensory analysis and found satisfactory after testing of physio-chemical analysis like ash, moisture, protein, dietary fibre. During study in comparison of 0%, 10%, 15%, 20% and 25% apple pomace powder incorporated gluten free cracker, they were found different in their physio-chemical and organoleptic characteristics. There was significant variation in these treatments but 25% sample was found to be more satisfactory as compared to sample 0%, 10%, 15% and 20% in case of total dietary fibre content. Hence, it can be concluded that small amount of apple pomace can be used in bakery products as functional ingredient as it has proven to be a good source of dietary fibre.

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