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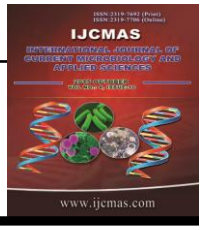

Original Research Article

Physicochemical Properties of Gluten-Free Banana Bread from Corn and Rice Flours

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Keywords

Gluten-Free Banana Bread, Corn and Rice Flours, Physico-chemical Properties

A B S T R A C T

Gluten-free Banana bread were prepared using corn flour and rice flour with different variations, i.e., 25% corn flour & 75% rice flour,50% corn flour & 50% rice flour and 75% corn flour & 25% rice flour. The Sensory parameters were evaluated for consumer acceptability by using a 9- point hedonic scale and Sensory results found to be Significant (5% level of confidence). On the other hand, chemical properties of the gluten free banana bread, such as protein content, fat, total carbohydrate, ash and moisture were generally comparable with those of their rice counterpart. The only non-significant difference was in the Microbial analysis i.e. S.P.C., Yeast & mould and coli form count. Moisture content in bread were decreased from 52.45, 52.30 to 52.20 and 51.74 respectively. So the ratio 25:75(T3) of Gluten free flour incorporation was highly acceptable while the other samples were also acceptable.

Introduction

Celiac disease is an autoimmune disease acquired through genetics and the environment. People with Celiac Disease cannot eat foods with wheat, rye, or barley because of their gluten content. These symptoms include diarrhea, weight loss, malnutrition, and abdominal distension (Tenório *et al.*, 2011). Unfortunately, the only treatment of Celiac Disease this far is through a strict diet that includes refraining from all foods that contain gluten (Tenório *et al.*, 2011). Approximately 6% of children and approximately 4% of adults in the western countries including the US have food allergies (Gonipeta *et al.*, 2009). This condition results because of an immune reaction to the gliadin contained in the protein of wheat and similar grains (Alvarez-Jubete *et al.*, 2010 and Fasano *et al.*, 2003). The most frequently used are corn, potatoes, rice, and tapioca (derived from cassava).

Banana bread is a type of bread that is made with mashed fully ripe bananas. It is often a moist, sweet, cake-like quick bread. Banana bread first became a standard feature of American cook books with the popularization of baking soda and baking powder in the 1930s, appeared in Pillsbury's 1933 *Balanced Recipes* cook book, and later gained more acceptances with the release of

the original *Chiquita Banana's Recipe Book* in 1950.

In a 2005 survey (Thompson *et al.*, 2005) found that less than 46% of female respondents consumed the daily-recommended amount of dietary fiber and only 44% of female respondent`s consumed the daily-recommended amount of iron during the 3-days recording period.

Rice (*Oryza sativa* L.) flour is made from ground and polished rice, is mainly starch and is completely gluten free. The appearance of rice flour is white to creamy white, which is relatively free from specks. The flavour is blend and is of typical rice flavour with no rancid or off flavours (Anonymous, 2003). Rice flour is a particularly good substitute for wheat flour, which causes irritation in the digestive systems of those who are gluten -intolerant. Rice flour is very commonly used in gluten free baked goods to give them structure and substance. **Corn** (***Zea mays***) flour is very popular. Maize flour is derived from grounded and desiccated seed of the maize plant. It is the second most produced and consumed flour after wheat flour, competing with rice flour. The flour is naturally rich in dietary fibre, antioxidants, vitamin B, omega 6 unsaturated fat and vegetable proteins. It recommends consuming whole-grain foods reduce heart disease risk and provide vital nutrients. Whole -grain corn flour is high in fiber, containing about 7.3 grams per 100-gram serving, according to the U.S. Department of Agriculture. This fiber travels through your digestive tract and absorbs water to help your stool move more easily through your body.

In this study, our objective was to develop gluten-free banana bread to meet the need of people with celiac disease. We prepared banana bread using different ratios of corn and rice flours. Chemical, Microbial and Sensory properties of this gluten free bread are also presented.

Material and Methods

The experiment "**Effect of gluten free flour on quality of Banana Bread**" was carried out in lab of Food Technology Warner school of Food and Dairy technology Sam Higginbottom Institute of Agriculture Technology & Sciences Deemed to be University, Allahabad (U.P.). The control and experimental gluten free banana bread samples was tested and statistically analyzed. The details of experimental techniques employed during the course of present investigation are summarized under the following headings:

1. Procurement and collection of ingredients.
2. Treatments and procedure adopted for manufacturing control & experimental Gluten free banana bread
3. Testing of control and experimental product.

    - Chemical analysis
    - Microbial analysis
    - Sensory analysis
    - Statistical analysis

Procurement and collection of ingredients

Rice flour – Rice flour under the brand name of "Sehat" was obtained from local market of Allahabad

Corn flour – Corn flour under the brand name of "Sehat" was obtained from local market of Allahabad.

Banana - Banana was obtained from local market of Allahabad.

Sugar - was procured from local market of Allahabad.

Butter – butter sold under the name of "Delicious" was obtained from local Market of Allahabad.

Egg - was procured from local market of Allahabad.

Baker's yeast- was procured from bakery shop of Allahabad market.

Salt- sold under the brand name of "Tata salt" was obtained from local market of Allahabad

Analyses

Moisture percent was determined by hot air oven method in this method a clean empty porcelain dish was weighed. 2–4 gm of the mixed sample of banana bread was weighed in the dish. It was heated on water bath until it dries. It was heated in a steam for 2 hrs. Then it was cooled in the desiccator and weighed.

Determination of ash content was done by muffle furnace (Ranganna, 1986). Total ash was determined according to A. O. A. C. (1975). Five gm sample was weighed into crucible and ignited at law flame till ant the material was completely charred. That was kept in muffle furnace for 6 hrs at 600C and further cooled in desiccators and weighted. This was repeated till two consecutive weights were constant and per cent ash was calculated.

Estimation of protein was done by Kjeldahl method: Sample was digested with boiling sulphuric acid; the nitrogen of sample was transformed to ammonium sulphate. The acid digest was strongly alkaline using sodium hydroxide (NaOH). The ammonia released was distilled into boric acid solution; it was then titrated with standard sulphuric acid. The results were transformed by calculation into a percentage of protein in original sample. Reagents used in this method were Standard sulphuric acid (0.1 N), Standard sodium hydroxide solution (0.1 N), Mixed indicator (a part of 0.2% methyl red and 2 parts of 0.2% bromocresol green), Digestion mixture (prepared by mixing 10 parts potassium sulphate, 0.3 parts copper sulphate and 0.02 parts selenium powder), 4% boric acid solution, 40% sodium hydroxide solution.

Determination of fat involves a partial drying of a weighed sample prior to a Soxhlet extraction. The extracted fat is weighed and the fat content calculated. It is important that sand be incorporated with the sample before drying. The purpose of the sand is to create a greater surface area, necessary to remove moisture and prevent entrapment of fat.

Accurately weighed extraction flask containing a few glass beads or boiling chips (carborundum), and then approximately 85 mL of petroleum ether was added. The sample contained in the thimble was extracted from with petroleum ether for at least 80 cycles in a minimum of 4 hours in a Soxhlet extraction apparatus. Upon completion of the extraction, the unit was separated and poured off the ether (and thimble) from the extractor into a large filter (to collect the thimbles) positioned on a container (such as a gallon bottle).

Repeated until most of the ether is removed and the flask has very little ether left. The Soxhlet unit was removed and a flask was placed on a steam bath to evaporate the remaining petroleum ether. The flask was swirled initially to avoid boil-over. Flask and its contents were dried in a mechanical convection oven at 100 - 102°C for time required to obtain constant weight. Cooled to room temperature.

Results and Discussion

The present study was based to evolve effect of Gluten free flour on quality of Banana Bread. The data collected on different aspects were tabulated & analyzed statistically using the methods of analysis of variance & critical difference. The significant & non-significant differences observed have been analyzed critically within & between the treatment combinations.

The results obtained from the analysis are presented in this chapter under the following headings:

1. Chemical characteristics of gluten free banana bread.
2. Organoleptic characteristics of gluten free banana bread.
3. Microbiological characteristics of gluten free banana bread.

Chemical characteristics of gluten free banana bread

Moisture analysis in gluten free banana bread

From the data regarding fat percentage in Gluten free Banana Bread sample of different treatments, it was observed that treatment T_0 (52.45) had maximum Moisture percentage followed by T_1 (52.30), T_2 (52.20), and T_3 (51.74). The treatment can be rated as $T_0 > T_1 > T_2 > T_3$.

Protein percent in gluten free banana bread

From the data regarding Protein percentage in Gluten free Banana Bread sample of different treatments, it was observed that treatment T_3 (5.70) had maximum protein percentage followed by T_0 (5.20), T_1 (5.36), and T_2 (5.64). The treatment can be rated as $T_3 > T_2 > T_1 > T_0$.

Fat analysis in gluten free banana bread

From the data regarding fat percentage in gluten free banana bread sample of different treatments, it was observed that treatment T_3 (11.70) had maximum protien percentage followed by T_0 (10.22), T_1 (11.24), and T_2 (11.67). The treatment can be rated as $T_3 > T_2 > T_1 > T_0$.

Ash analysis in gluten free banana bread

From the data regarding Ash percentage in Gluten free Banana Bread sample of different treatments, it was observed that treatment T_3 (2.06) had maximum Ash percentage followed by T_0 (1.44), T_1 (1.44), and T_2 (1.60). The treatment can be rated as $T_3 > T_2 > T_1 = T_0$.

Carbohydrate analysis in gluten free banana bread

From the data regarding Carbohydrate percentage in Gluten free Banana Bread sample of different treatments, it was observed that treatment T_0 (30.69) had maximum Carbohydrate percentage followed by T_1 (29.66), T_2 (28.89), and T_3 (28.80). The treatment can be rated as $T_0 > T_1 > T_2 > T_3$.

Colour and appearance in gluten free banana bread: The highest mean flavour and taste score recorded in Gluten Free Banana Bread sample of T_0 (8.30), T_2 (8.24) followed by T_1(7.90) and T_3 (7.62).The treatments can be rated as $T_0 > T_2 > T_1 > T_3$.

Flavor and taste in gluten free banana bread: The highest mean flavour and taste score recorded in gluten free banana bread sample of T_2 (8.70), T_3 (8.68) followed by T_1(8.06) and T_0 (7.76). The treatments can be rated as $T_0 > T_2 > T_1 > T_3$.

Body and texture in gluten free banana bread

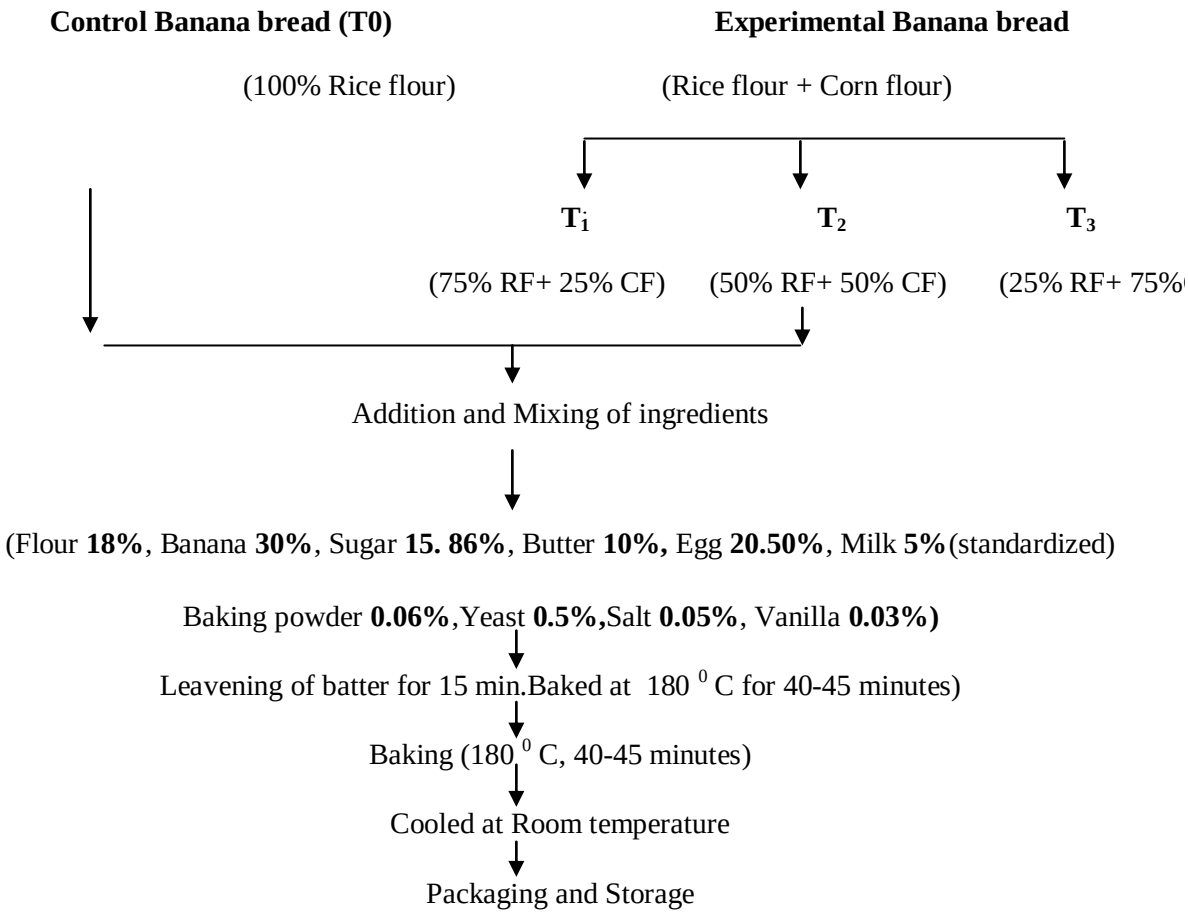
The highest mean Body and Texture score recorded in gluten free banana bread sample of T_3 (8.98), T_2 (8.84) followed by T_1 (8.36) and T_0 (7.74). The treatments can be rated as $T_3 > T_2 > T_1 > T_0$.

Table.1 Mean value of the Parameter of the Control and Experimental Bread under the study are as follows

Parameters	Treatments				C.D. Value
	T_0	T_1	T_2	T_3	
1. Organoleptic scores (9-point Hedonic scale)					
Flavour and Taste	7.76	8.06	8.70	8.68	0.60
Body & Texture	7.74	8.36	8.84	8.98	0.31
Colour & Appearance	8.30	7.90	8.24	7.62	0.40
Over all acceptability	7.13	7.73	8.32	8.41	0.35
2. Chemical Analysis (in per cent)					
Moisture	52.45	52.30	52.20	51.74	0.35
Protein	5.20	5.36	5.64	5.70	0.60
Fat	10.22	11.24	11.67	11.70	0.27
Ash	1.44	1.44	1.60	2.06	0.29
Carbohydrate	30.69	29.66	28.89	28.80	0.57
3. Microbial analysis					
S.P.C. (10^3 cfu/gm)	4.80	4.60	4.20	4.60	NS
Yeast & Mould count (gm)	1.80	1.80	1.40	1.60	NS
Coliform					
Coliform	N	N	N	N	

N=Negative

Flow diagram for preparation of banana bread



***C.F. - CORN FLOUR**

**** R.F. – RICE FLOUR**

Fig.1 Moisture percentage in samples of control and experimental gluten free banana bread of different treatments

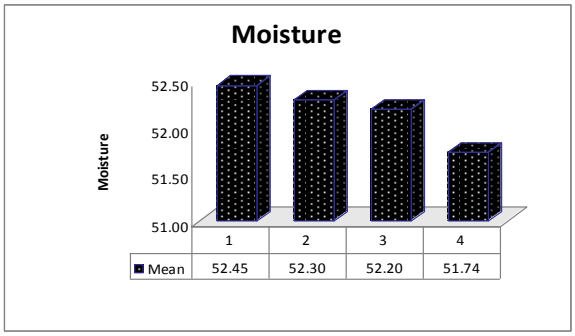


Fig.2 Protein percentage in samples of control and experimental gluten free banana bread of different treatments

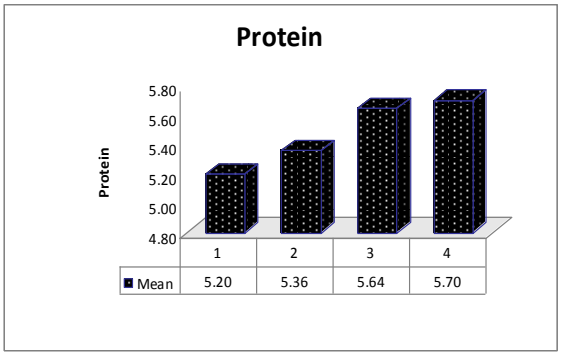


Fig.3 Fat percentage in samples of control and experimental gluten free banana bread of different treatments

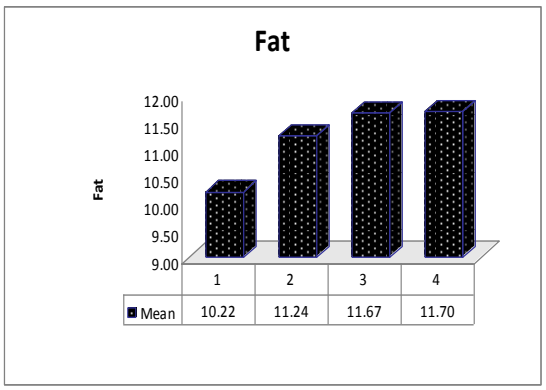


Fig.4 Ash percentage in samples of control and experimental gluten free banana bread of different treatments

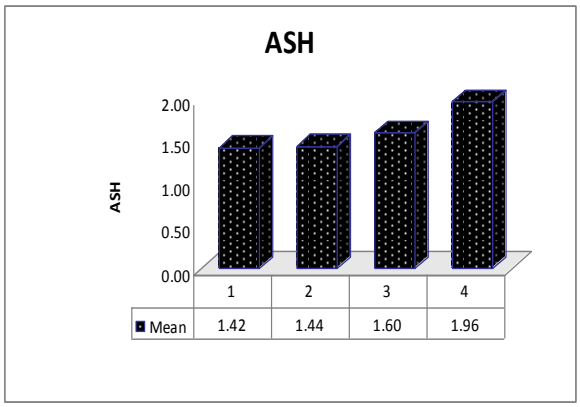


Fig.5 Carbohydrate percentage in samples of control and experimental gluten free banana bread of different treatments

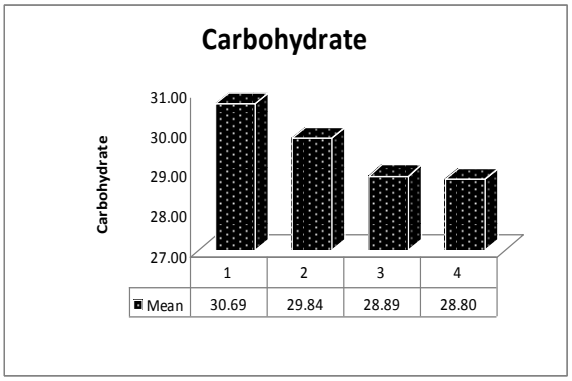


Fig.6 Colour and appearance scores in samples of control and experimental gluten free banana bread of different treatments

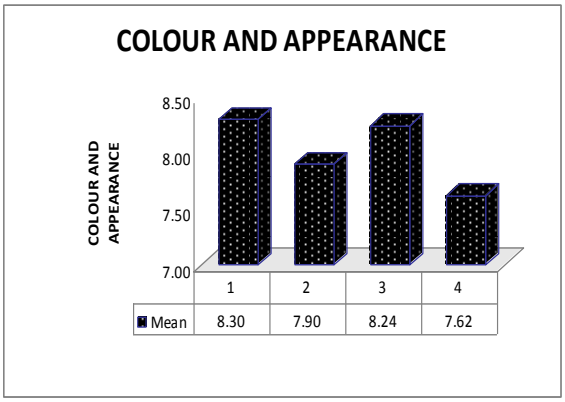


Fig.7 Flavour and taste scores in samples of control and experimental gluten free banana bread of different treatments

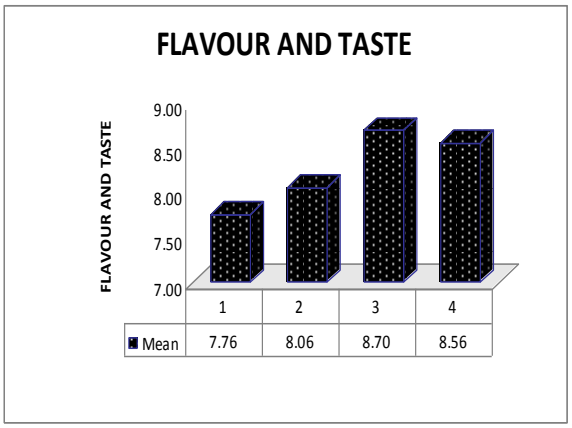


Fig.8 Body and texture scores in samples of control and experimental gluten free banana bread of different treatments

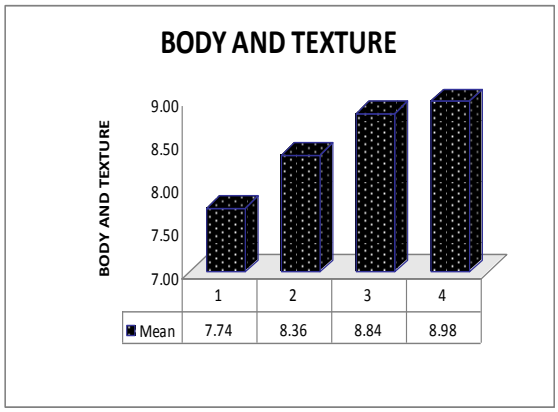


Fig.9 Overall acceptability scores in samples of control and experimental gluten free banana bread of different treatments

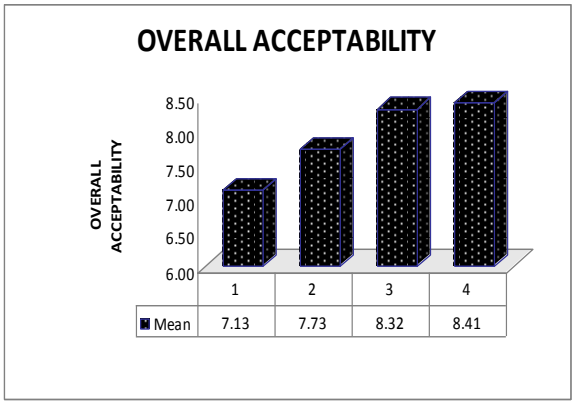


Fig.10 SPC in samples of control and experimental gluten free banana bread of different treatments

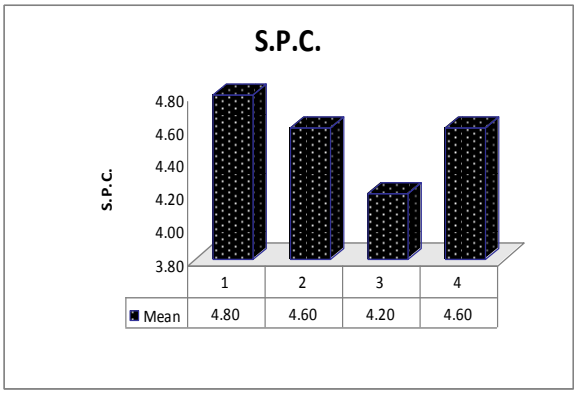
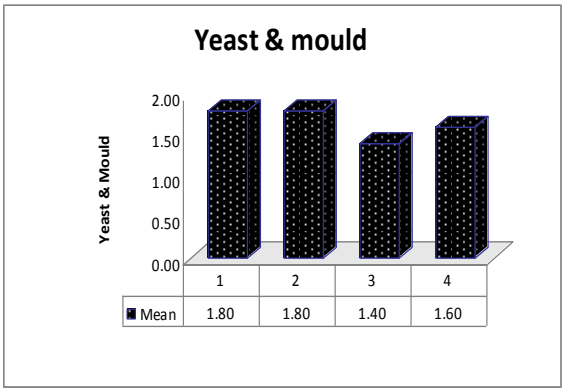


Fig.11 Yeast and mould count at (/gm) in samples of control and experimental gluten free banana bread of different treatments



Overall acceptability in gluten free banana bread

The highest mean overall acceptability score recorded in Gluten Free Banana Bread sample of T_3 (8.41), T_2 (8.32) followed by T_1 (7.73) and T_0 (7.13). The treatments can be rated as $T_3 > T_2 > T_1 > T_0$.

Microbiological characteristics of gluten free banana bread

SPC (10^1 cfu) in gluten free banana bread

According to WHO Standards (1994) the maximum permissible limits in baked products for total plate count (TPC) is $2.0*10^5$ cfu g^{-1},coliform, bacteria<200 MPN g *E. coli* absent, yeast and mould is $<1.0 * 10^4$ cfu g^{-1}. The highest mean SPC was recorded in the Gluten free banana bread sample of T_0 (4.80) followed by T_1 (4.60), T_3 (4.60) and T_2 (4.20). The difference in these values was found non significant indicating by their Non significant effect on treatments in the SPC content between sample of different treatments. The treatments can be rated as $T_0 > T_1 = T_3 > T_2$.

The average viable count yeast & mould (/gm.) for control and experimental gluten free banana bread of different treatments: According to WHO Standards (1994) the maximum permissible limits in baked products for total plate count (TPC) is $2.0*10^5$ cfu g^{-1}, coliform, bacteria<200 MPN g *E. coli* absent, yeast and mould is $<1.0 * 10^4$ cfu g^{-1}. The highest mean yeast and mould count was recorded in the Gluten free banana bread sample of T_0 (1.80) followed by T_1 (1.80), T_2 (1.40) and T_3 (1.60). The difference in these values was found significant indicating by their significant effect on treatments in the yeast and mould count content between sample of different treatments. The treatments can be rated as $T_0 = T_1 > T_3 > T_2$.

Coli form count

According to WHO Standards (1994) the maximum permissible limits in baked products for total plate count (TPC) is $2.0*10^5$ cfu g^{-1}, coliform, bacteria<200 MPN g *E. coli* absent, yeast and mould is $<1.0 * 10^4$ cfu g^{-1}. The coli form test control and experimental sample were 100 percent Negative.

In conclusion, the incorporation of corn and rice flour in the formulation of gluten free banana bread was found to improve the physicochemical properties of the product. It

was concluded that bread with 25% Rice flour: 75% Corn flour (T3) treatment showed a flow behavior more like that of traditional rice bread and was more useful for gluten free bread preparation was highly acceptable in terms of sensory quality. The microbial quality was found satisfactory for all the treatments. Protein content, fat, ash, moisture and carbohydrate differed very little for all bread. Therefore, it may be concluded that, there is a great scope of manufacturing gluten free banana bread as it is proved low in calorie and harmless for people.

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