Research Paper

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Effect of Packaging on the Microbial Quality of Malted Composite Flour

Home Science

KEYWORDS : Composite flour, coarse grains, vacuum packaging, microbial load, defatted soy flour

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ABSTRACT

The malted composite flour was prepared using malted wheat, malted coarse grain blend (barley + sorghum + pearl millet, 1:1:1) and defatted soy flour in four different combinations. Product making and sensory quality were assessed to find out the most appropriate level of MCG blend incorporation. On the basis of sensory quality, 40% was best and thus selected for further study. This selected malted composite flour was packaged in HDPE bags at room temperature for three months in two different packaging conditions i.e. vacuum sealing and ordinary heat sealing. The microbial quality was assessed at monthly intervals during entire storage period. Microbiological study depicted that microbial counts of flour in both packaging was far below the permissive limit upto three months of storage.

INTRODUCTION

Composite flour technology refers to the process of mixing various cereal based flours to produce high quality food products in an economical way. Formulation of composite flour is vital for development of value-added products with optimal functionality (Rehman *et. al.* 2007). It has not only better nutritional quality but also the necessary attributes for consumer acceptance. The nutritional value of cereal flours that are poor in lysine but rich in the sulphur containing amino acids is improved by the addition of legume flours. The addition of 10% defatted soy flour to wheat flour not only improve the quality of protein but also enhance their quantity considerably (Padmashree *et.al.* 2012). The importance of coarse cereals in direct human consumption is declining even though poses good nutritive value. Coarse cereals like barley, sorghum and pearl millet not only having the better nutritional value but it also has phytochemicals, antioxidants and fiber thus beneficial for health.

Although coarse cereals are nutritionally rich and easily available but its utilization is limited due to the presence of various anti-nutrients, poor digestibility of proteins and carbohydrates and low palatability. Thus to overcome this problem in the present investigation, malting process was applied to the selected grains. Cereal and its products, particularly flour constitutes a major portion of Indian daily meal and is generally considered to be non- perishable thus microbiologically safe product as it has a low water activity (aw 0.40-0.65), the growth of microorganisms is very less but the level of contamination from various external sources cannot be ruled out and thus the study composition of micro flora are very important for risk assessment. The micro flora of flour is composed of a variety of microorganisms including yeasts, moulds, bacteria more specifically pathogenic organisms. Even though flour is not directly related to food born diseases, it is important to know the data on keeping quality of flour for consumption, level of pathogenic bacteria and other microorganisms that would render the flour unfit for consumption in longer period storages (Shobha *et.al.* 2011).

In modern age, food packaging has become very important because of protection of the product from contamination by macro & micro-organisms and their filth, prevention from loss or gain of moisture, shielding the product from oxygen and to facilitate handling (Ball, 1960).

Good packaging actually serves two purposes, which are essentially technical and presentational. Technical aspects in packaging aim to extend the shelf life of the food by better protection from all the hazards during storage. Presentational aspects are not concerned with shelf life but such packaging increases sales by creating a brand image that the buyer instantly recognizes (Peter and Axtell, 1993).

Inefficient packaging system also influenced the keeping quality determination of a food product. Therefore in the present investigation, the keeping quality of malted composite flour kept at room temperature for the three months under two different packaging conditions i.e. vacuum packaging and ordinary heat sealing in the HDPE bags was assessed.

MATERIAL AND METHODS

Development of malted composite flour:

Four whole grains viz wheat (GW -366), barley (RD-2715), sorghum (CSV-23) and pearl millet (RHB-173) were procured from the, Udaipur (Agriculture research station MPUAT) and,Jaipur, (Durgapur agriculture research station), Rajasthan respectively. Defatted soy flour was procured from soy processing unit, Mehsana, Gujarat. Procured raw material was further cleaned and steeped for 12 hours. They were germinated (48 hr), dried and milled for further use. The coarse grain flour blends were prepared by mixing equal proportion of malted flour of barley, pearl millet and sorghum. The prepared malted coarse grain flour blend was mixed with malted whole wheat flour by replacing at a level of 10%, 20%, 30% and 40% and keeping the level of defatted soy flour at 10% in all combinations (T1-T4). Flour standardization was done by preparing food product (*Chapati*) for selecting the best acceptable treatment through nine point hedonic scale In the preliminary trials, *chapati* was prepared with different permutations and combinations of malted composite flour in order to obtain highly acceptable product. The most acceptable developed flour was packed in HDPE polythene bags and sealed by vacuum packaging and ordinary heat sealing. These were stored at room temperature for three months.

Microbiological methods

In the present investigation, the microbial load of flour was enumerated at zero and monthly interval upto three months of storage as per the method described by American Public Health Association (1984). The media, Nutrient agar (NA) used for total viable count (TVC), Potato dextrose agar (PDA) for yeast, molds and Violet Red Bile Agar (VRBA) for coliform estimation. Serial dilutions were made for each sample and 1 ml of the appropriate dilution was poured. 10^{-2} and 10^{-1} serial dilution were used for pour plate in triplicate on selective media. Culture media was incubated at 37°C for 24 h for enumeration of the total microbial load under anaerobic condition. Developed colonies were counted and expressed as colony forming units/gm (cfu/g) of sample.

Statistical analysis: Analysis of variance (ANOVA) was used to assess the best acceptable ratio of the flour and microbial load of composite flour during storage.

RESULT AND DISCUSSION

Selection of best ratio of malted composite flour by making *chapati*:

Chapati is Indian unleavened flat bread which accounts for the cereal group in a balanced diet. The scores assigned by panel members for individual sensory attributes of chapati were found to be values in the range of 6.96 to 8.30 for malted composite flour (T1-T4) chapatis which permit us to draw conclusion that the product varied from liked slightly to as high as approaching a point of excellence. From the Analysis of variance an insignificant difference was found within treatments (T1-T4). So the highest level of MCG blend incorporated (40%) flour sample was selected for further study on storage, in view of its enhancing the nutritional value of product.

The present findings depicting slightly to high acceptability of the chapati are in conformity with those reported by Kadam *et.al.* (2012) where chickpea, soy and methi leaves powder were incorporated at different ratios in the wheat flour chapatis and the results revealed that the sensory scores of various attributes viz; colour, appearance, flavor, taste, texture and overall acceptability in between 6.0 to 8.7.

Microbial load:

Microbial load is an important determinant indicative of quality of any food product. Every step in handling and preparation of food may be a potential source of contamination. In the course of three months of storage, vacuum packaged and ordinary healed sealed malted composite flour were examined for the presence of total viable organisms, yeast and molds and coliforms at monthly intervals.

Table: 1. Effect of storage on total viable count (cfu/g) of MCF

Packaging	Storage (days)			
	0	30	60	90
P1	Nil	2100	2200	2400
P2	Nil	2470	3100**	5200**
SE(m)	-	54.6	54.6	54.6
CD (1%)	-	NS	236	236
CD (5%)	-	NS	168	168
CV	3.25			

Where, MCF= Malted composite flour, P1= Vacuum sealed malted composite flour, P2= Ordinary heat sealed malted composite flour, NS= Non significant.

** denotes highly significantly at 1 % probability level..

Table: 2. Effect of storage (days) on yeast and mold count (cfu/g) of MCF

Packaging	Storage (days)			
	0	30	60	90
P1	Nil	40	43	45
P2	Nil	51	93**	122**
SE(m)	-	1.46	1.46	1.46
CD (1%)	-	NS	6.31	6.31
CD (5%)	-	NS	4.5	4.5
CV	3.85			

Where, MCF= Malted composite flour, P1= Vacuum sealed malted composite flour, P2= Ordinary heat sealed malted composite flour, NS= Non significant.

** denotes highly significantly at 1 % probability level.

Microbial examination revealed that the total number of surviving microbes (TVC), yeast and mold (Y & M) counts in the malted composite flour were nil prior to their storage (0 day). After that, vacuum packaged flour had no significant changes throughout the storage period. Whereas, ordinary heat sealed flour showed significant increase ($P<0.01$) at second and third month of storage as can be seen in tables 1 and 2. This increase may be attributed to the permeability of packaging material to water and air in ordinary heat sealing.

During the entire storage period, the enumerated values of TVC and Y & M counts i.e. 0 to 5200 cfu/g and 0 to 122 cfu/g, respectively for both packaged (vacuum and ordinary heat sealed) flour are much lower than the wheat flour specification given by Kenya standard, (2009) of maximum permissible level of TVC (10^5 per gram) and Y& M count (10^4 per gram). Moreover, the findings of present study depicts that coliform count was not detected in the vacuum sealed and ordinary heat sealed malted composite flour throughout the storage. Because for the growth of coliform bacteria the maximum moisture content in a food should be 18% (Ballogou *et.al.* 2011) and in the present study maximum moisture content of the flour was 14.5% which was unfavorable for the growth of coliforms.

In a recent study, Munasinghe *et.al*. (2013) prepared a composite flour of mung beans (*Vigna radiata*), soybean (*Glycine max*) and brown rice (*Oryza sativa*). They also reported nil detection of coliform count in the composite flour while TVC was quite higher than the present study i.e. 2.75×10^6 cfu/g. Similar to the findings of present study, Compaore *et.al*. (2011) observed nil growth of coliforms in pearl millet and maize based complementary flours. Further, comparable findings were observed by Ojure and Quadri (2012) regarding the microbial flora of plantain flour. It was reported that the coliform counts was nil and the TVC and Y& M counts were found to be 2.1 $x10^2$ cfu/g and 1.1 x 10^2 cfu/g, respectively.

CONCLUSION

In the present investigation, the results of microbial examination revealed that the developed flour was safe for human consumption as all the indicators of microbial load were within the permissible limit. Low moisture, the hygienic conditions maintained during preparation and storage of sample were the reason behind the observations. The above findings on storage stability of the malted composite flour clearly indicate that the packaging is an efficient tool for improving the shelf life of the multigrain flour. Here, vacuum packaging technique had an edge over ordinary heat sealing in view of delaying the abrupt rise in all the microbial quality determinants.

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