International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Impact Factor (2012): 3.358

Free Gluten Cake and Tortilla from Cassava and Pre Geltnized White Rice Flours

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Abstract: ***Sponge cake and tortilla were prepared from cassava and pre-gelatinized white rice flour to be useful for Celiac disease patients. Cake prepared by mixing 0, 15, 30, 45 and 60 % pre-gelatinized rice flour (PRF) with cassava flour (CF). Tortilla prepared by blending 0, 10, 20, 30 and 40 % (PRF) with cassava flour. Proximate chemical composition of used flours, sensory evaluation and microbiological tests (total microbial count, Stapylococcus aureus and moulds & yeasts before and after one, and two weeks storage in the products were studied for the products. Sensorial evaluation explained that the highest crust color, crumb color, flavor, taste, tenderness, porous distribution and total scores were obtained in cake samples prepared by 30 % PRF+70 % CF. However, the lowest was in samples prepared by cassava flour only. Increasing of PRF percentage increase the volume (cm^3) and specific volume up to 30% and tended to decrease with the higher values up to 60 % PRF, however, the values of cake weight (g) of different blends seemed to be equal. Total microbial count, and moulds & yeasts count were increased as the percentage of PRF increased in the blends and by prolonging the storage period. The staphylococcus aureus counts appeared in the blends containing 15 % PRF at the 2^{nd} week and in all other samples in one and two weeks storage ranged from $1.0x10^2$ to $1.3x\ 10^2$. The highest color, flavor, taste, roil ability, general appearance , and total scores were in 30 % PRF tortilla samples, while the lowest were in control samples, followed by that had 40 % PRF. The highest plate counts was in 30 % PRF tortilla, Staphylococcus aureus appears after two weeks in 20 % PRF tortilla and after one week in 30 % and 40 % PRF tortilla, after two weeks mold & yeast were increased by increasing PRF ratios.***

Keywords: Sponge cake-Tortilla-Pre gelatinized rice flour-Cassava flour-Chemical composition-Sensory evaluation-Microbial tests.

1. Introduction

Celiac disease (CD) is a life-long intolerance to gluten proteins. A decade age, Celiac disease was considered an uncommon disorder in the world, with prevalence rates of 1 in 1000 or lower (Feighery, 1999). However, recent population studies have reported a much higher prevalence and it is now estimated that Celiac disease may alter one in 100 of the population including both adults and children (Mendoza and McGough, 2005). Celiac diseases is a chronic enteropathy characterized by in an adequate immune response to ingested gluten from wheat, ray barley, triticale and in some oats. This intolerance results in damage to the small-intestinal mucosa (Thompson, 2001).

Gluten is the protein fraction present in most cereals and is responsible for the elastic and extensible properties required to produce good quality bread and some other bakery products. For their technological and nutritional quality, cereal products, especially bread are basic components of the diet in many countries, but Celiac disease patients are unable to consume bread and other food products made of wheat flour. Therefore, there are the free-gluten food made from other crops such as maize, sorghum, rice, cassava and potato have the important role in this concern (Gujral and Rosell, 2004; Gallagher, et al 2004 and Taylor, et al 2008).

The only effective treatment for Celiac disease patients relies on a lifelong gluten-free diet (Feighery, 1999; Sciarini, et al 2008 and Yaznina, et al 2008). Rice flour is one of the most suitable cereal flour for gluten-free products it has a low level of prolamine, besides, rice possesses unique nutritional, hypoallergenic , colorless, and bland taste properties (Gujral and Rosell, 2004 and Sciarini, et al 2008).Cassava flour as a partial substitute for wheat (Delfloor, 1995 and Onabolum, et al 1998) in bread making, biscuits and snack food manufacture (Owuamanam, 2007). Cassava starch, extracted from the root, is ground into flour, which is used as a thickener for soups, fruit fillings and glazes, much like cornstarch (Chang, et al 2001 and Parra, et al 2004). Certain food proteins such as gluten and casein can be transformed to **opioid** peptides during digestion. These peptides might eventually be able to enter the blood stream and act upon the central nervous system. As a consequence, a diet low in such proteins has been hypothesized to ameliorate the behavioral symptoms of autistic children (Reissmann, et al 2014)

Therefore, this work aimed to evaluate the use of pre - gelatinized rice flour and cassava flour in producing cake and tortilla as a free gluten products for Celiac patients and their effect on the quality and shelf life at different time of storage.

2. Materials and Methods

2.1 Materials

- White rice grains was obtained from local market, rice grains were divided into two portions, the first was boiled and the
- second was milled using laboratory hummer mill, then sieved at 200 µm.
- Cassava flour (*Manihot esculenta*) was obtained sugar crops institute, Agriculture Research Centre, Cairo, Egypt.
- Cake improver and tragacanth gum were obtained from AL – Crystal Food Additives Co., Giza, Egypt.

2.2 Methods

2.2.1 Preparation of pre gelatinized white rice (FRF)

Boil 100 gm of cleaned white rice grains with 800 ml water for about 20 min to obtain cooked rice. Cooked rice was blended in blender with 30 gm skimmed powder, 20 gm corn oil and 15 salt, then beat at high speed to produce smooth slurry. Cool in refrigerator until use.

2.2.2 Sponge cake preparation

Sponge cake preparation was carried out according to Abd El-Rahim (2005) as follows: pre gelatinized rice flour (PRF) was mixed with cassava flour (CF) at the levels of 15, 30, 45 and 60 % to obtain basic blends. Sugar (100gm), fresh eggs (amount was calculated according to pre gelatinized rice flour percent, as presented in fallowing table). Baking powder (9gm), tragacanth gum (0.3gm) and cake improver (5gm). Bake at 80 ºC for about 30 min. in cake trays.

Pre gelatinized rice flour %	*Fresh egg (g)*
0	100
15	85
30	70
45	55
60	40

2.2.3 Free gluten tortilla preparation:

Free gluten tortilla preparation was carried out according to Abd El-Rahim (2005), pre gelatinized rice (PRF) was mixed with cassava flour (CF) at levels of 10. 20, 30 and 40 %. Baking power (3%) was added and mixed well to obtain homogenous dough consistency, then divided into balls (50gm of each). To produce round dough loaves with about 2 mm thickness, dough balls was pressed between two hot plates adjusted to 150 ºC for 10 sec. Baking was conducted at 350 – 400 ºC for 60 sec. to produce two layers separation tortilla bread, this experiment was carry out at (King M factory, Nasr City, Cairo).

2.2.4 Chemical composition

Chemical composition of raw materials was determined according to A.O.A.C. (1995).

2.2.5 Physical Cake parameters

Sensory evaluation of cake was determined according to Amerine, et al (1995). And specific volume was determined according to AACC (1995).

2.2.6 Tortilla parameters

Sensory evaluation of tortilla was determined according to Taha, et al (1992).

2.2.7 Miicrobiological tests

Microbiological tests of samples was conducted according to Bergy, et al (1994).

3. Results and Discussion

3.1 Approximately chemical composition

Table 1: Chemical composition of cassava flour and Pre gelatinized rice flour

Ingredient	*Moisture %*	*Protein %*	*Fat %*	*Ash %*	*Fibers %*
Cassava flour	4	------	-----	------	------
White rice flour	11.8	8.1	0.7	0.7	0. 3

Table (1) explained chemical composition of cassava flour and prepared pre gelatinized flour it cleared that pre gelatinized rice flour contained protein, fat, ash, and fiber more than cassava flour

3.2 Sensorial Evaluation

a) *Cake*

Sensory evaluation of free gluten cake prepared from different levels of cassava flour and pre gelatinized white rice flour are presented in Table (2). It was observed that the highest of crust color in the cake sample containing 30 % of PRE was 9.5, this was true for the other parameters i.e. crumb color, flavor, taste, tenderness, porous distribution and total scores which were 10, 19.5, 19, 19, 19 and 96, respectively. While, the cake sample contains 0 % PRF (control) has the lowest values of crust color, crumb color, flavor, taste, tenderness porous, and total scores. On the other hand, the cake samples contains15 % and 60 % PRF were approximately equal in all parameters except total scores which were higher by 0.117 % in 60 % PRE cake samples. Crust color value was 7 the lowest in sample free of PRF, but 30 % PRE cake sample has the highest value, owing to crumb color parameter in the cake samples have 15 and 45 % were equal. The same parameter was 8.5 in both samples contains 0 and 60 % PRE.

Table 2: Sensory evaluation of free gluten cake prepared from different levels of cassava flour (CF) and pre gelatinized white rice flour (PRF).

PRF %	Crust color	Crumb color	Flavor	Taste	Tenderness	Porous distribution	Total Scores
	10	10	20	20	20	20	100
0	7	8.5	17	16.5	16	16	81
15	8	9	17.5	17.5	17	16.5	85.6
30	9.5	10	19.5	19	19	19	96
45	9	9	19	18	18	18	91
60	8	8.5	18	17	17	17	85.5

Data in Table (3) showed that the lowest volume was in cake sample contains 0 % PRF (190 cm3). The volume increased to be the highest (405cm3) in cake sample contains 30 % PRE. This was true for the specific volume. However, the 30 PRE sample has the lowest weight (110 g), the higher was in sample contains 15 % PRF.

In Brasil, (Lopes, et al 2004) used flour mixture of rice flour, corn and cassava starch to replace wheat flour in white bread they noticed that rice flour bread present the best parameters of sensory evaluation followed by corn starch and cassava starch in produced bread.

Regarding flavor and moisture, in produced breads were not statistically differed at 5% probability. However, they differ significantly regarding the specific volume, crumb texture, crust color, degree of satisfactory and external appearance (Lopez, et al 2004). (Sciarini, et al 2008) studied the effect of different flours (rice, corn and soy) and their mixtures on gluten free breads they found that all gluten-free breads showed lower volume than wheat bread

Table 3: Specific volume of cake prepared from different levels of cassava Flour (CF) and pre gelatinized white rice flour (PRF).

PRF %	*Weight (g)*	*Volume (cm^3)*	*Specific volume*
0	112	290	2,59
15	115	386	3.35
30	110	405	3.68
45	111	391	3.52
60	114	380	3.33

Table 4: Sensory evaluation of free gluten tortilla prepared from different levels of cassava flour (CF) and pre gelatinized white rice flour (PRF).

PRF %	Color	Flavor	Taste	Roil ability	General appearance	Total Scores
	20	20	20	20	20	100
0	17	18	17	15	16	83
10	17	18	18	16	16.5	85.5
20	18	18	18.5	17	17	89
30	20	20	20	19	19	98
40	18	10	19	18	18	92

b) Tortilla

Sensory evaluation of the free-gluten tortilla prepared from different levels of cassava flour and pre gelatinized while rice flour showed in Table (4). Sample contains 30 % PRF has height color, flavor, taste, roll ability, general appearance and total scores while were: 20, 20, 20, 19,19 and 98, respectively. On the other hand, samples contains 60 % PRF were, equal in color, favor, and approximately in taste. Roll ability increased to be 15,1 6,17 and 19 in samples contains o,10,20 and 30 % PRE, respectively. Color, flavor, taste, roll ability, general appearance and total score values increased by increasing PRF rate up to 30 %. These values decreased in tortilla samples contained 40 % PRF to be 15, 19, 19, 18, 18 and 92, respectively.

Moreover, (Mstromatteo, et *al* 2012) mentioned that the overall quality of the cooked spaghetti samples decreased with the increase of the amount of inulin. In fact, firmness, color and taste attributes decreased with the increase of the inulin amount influencing negatively the overall quality of the spaghetti samples.

3.3 Microbiological tests

a) Cake

It can observed from Table (5), which contains the microbiological study of free-gluten cake during different storage periods at room temperature, that total plate count was start to increase after one week storage, and the increment continuous during different storage period at room temperature. Moreover, the increases in values of total counts were parallel to the increase in PRF %. It can also notice that both cake samples which contained o and 15% PRF were approximately equal in total plate count. After two weeks storage it can showed the same trend of these count which were increased by raising the ratio of PRF %. This data also cleared that total count positively responded to the prolonging of storage period.

It can be observed also from the same Tables that *Staphylococcus aureus* not seemed in all free gluten cake samples with different percentage of PRF at zero time , after one week storage period it appeared in cake samples which contained 30, 45 and 60 % PRF and seemed to be similar in the three previous samples, while after two weeks storage period, *Staphylococcus aureus* did not appeared in control samples and was appeared in all other samples of the cake samples which containing 30 % and 45 % PRF which were has the same count 1.2x10-2. Mold & yeast appeared in 0 % PRF and other cake samples which contained 15, 30 and 45 % PRF, the count of yeast and mold was equal in samples contained 30 % and 45 % PRF , that was true after two weeks storage (2.4x 10-2). Mold and yeast were increasing parallel to the increasing in both period of storage and percentage of PRF.

Table 5: Microbiological study of produced cake during different Storage period at room temperature

PRF %	Total plate counts			*Staphylococcus aureus*			Moulds and yeasts		
	0	1week	2 weeks	0	1week	2 weeks	0	1week	2 weeks
0	$1.4x1o^3$	$2.3x1o^3$	$4.1x1o^3$	-	-	-	$1.0x1o^3$	$2.1x1o^3$	3.7x1o
15	$1.5x10^3$	$2.2x10^3$	$4.2x10^3$	-	-	$1.1x10^2$	$1.1x10^3$	$2.0x10^3$	$X3.510^3$
30	$1.9x10^3$	$2.8x10^3$	$4.4x10^3$	-	$1.0x10^2$	$1.2x10^2$	$1.3x10^3$	$2.4x10^3$	$X3.910^3$
45	$1.7x1o^3$	$2.9x1o^3$	$4.9x1o^3$	-	$1.0x10^2$	$1.2x10^2$	$1.3x1o^3$	$2.4x1o^3$	$4.2x1o^3$
60	$1.9x10^3$	$3.3x10^3$	$5.1x10^3$	-	$1.1x10^2$	$1.3x10^2$	$1.5x10^3$	$2.7x10^3$	$4.4x10^3$
Mean	$1.7x10^3$	$2.7x10^3$	$4.5x10^3$	-	$1.0x10^2$	$1.2x10^2$	$1.3x10^3$	$2.3x10^3$	$3.9x10^3$

Table 6: Microbiological study of produced tortilla during different Storage period at room temperature

PRF %	Total plate counts			*Staphylococcus aureus*			Moulds and yeasts		
	0	1week	2 weeks	0	1week	2 weeks	0	1week	2 weeks
0	$1.0x1o^3$	$1.8x1o^3$	$3.0x1o^3$	-	-	-	$1.0x1o^3$	$1.8x1o^3$	$2.0x1o^3$
10	$1.2x10^3$	$1.7x10^3$	$3.1x10^3$	-	-	-	$1.0x10^3$	$1.7x10^3$	$2.1x10^3$
20	$1.2x10^3$	$1.8x10^3$	$3.1x10^3$	-	-	$1.0x10^2$	$1.1x10^3$	$1.8x10^3$	$2.4x10^3$
30	$1.3\times1o^3$	$1.9x1o^3$	$3.3x1o^3$	-	$1.0x10^2$	$1.0x10^2$	$1.2x1o^3$	1.6x1o3	$2.4x1o^3$
40	$1.2x10^3$	$1.7x10^3$	$3.1x10^3$	-	$1.1x10^2$	$1.0x10^2$	$1.1x10^3$	$1.7x10^3$	$2.6x10^3$
Mean	$1.2x10^3$	$1.8x10^3$	$3.1x10^3$	-	$1.0x10^2$	$1.0x10^2$	$1.1x10^3$	$1.7x10^3$	$2.3x10^3$

b) Tortilla

Table (6) explained the microbial study of tortilla during different storage times at room temperature. Total plate count of control tortilla sample was 1.0 x 10^2 at zero time increased to be 1.8 x 10^3after a week storage and to be 3.0 x 10^3 after 2 weeks storage for samples contains 10, 20, 30 and 40 % PRF were equal in total plate count approximately at zero time. The total plate count of every tortilla samples was increased after one week storage and this increasing was more after two weeks, 30 % PRF tortilla has the highest plate count at 0, one week, and two weeks storage at room temperature. No detected *staphylococcus aurues* at zero time for all tortilla samples, it appears after one week storage in 30 and 40 % PRF tortilla samples to be 1.0 x 10 ^{2}, respectively. After two weeks storage it appears in samples containing 20, 30 and 40 % PRF by equal count and not detected in control, 10 % PRF tortilla samples. On the other, moulds and yeasts were detected at zero time, one week and two weeks storage time, the amount of moulds & yeasts were two fold at two weeks storage than zero time storage approximately for all tortilla samples.

(Ji, et al 2007) studied the microbiological changes in MiGao (a traditional Chinese steamed cake) prepared from rice flour and sticky rice flour during five days of storage at 25^0c they found that the total plate count in the products in the third day of storage were in the range <10^3 CFU/g and the shelf life of the product was estimated to be only two or three days by the panelists. During the first two days, Gram-positive bacteria were dominant , mainly represented by *Staphylococcus epidermidis, Bacillus* strains occurred by the third day , reaching a maximum level of 1×10^6 CFU\g after five days of storage, the count of yeasts and moulds increased slowly but remained low throughout the storage period.

Ogundare and Adetuyi (2003) screened wheat flour bread samples (from two market locations(in Ibadan and lle-Ife, Nigeria) for microbial population with a view to determining the presence of any microorganisms persisting or surviving from flour stage to the resulting bread, they found that the freshly baked bread, after 10 mins. Contained bacteria strains, include Bacillus cereus, *Staphylococcus xylosus* and *Staphylococcus sp* .In addition to *Staphylococcus cohnii* which recovered after 48h and after 96h *Bacillus firmus* was included. The mould isolates included five strains after 10 mins. Which increased with period of storage, also there were yeasts were isolated after 10 mins. And throw the period 144h.

4. Conclusion

From the aforementioned results it could be concluded that, the highest sensorial evaluation and volume where in sample contained 30% PRF while the lowest was in control sample which also had the lowest specific volume. Total microbial, *staphylococcus aureus*, mold and yeast count increased by increasing the storage period at room temperature and % of PRF.

Concerning tortilla product, the all sensorial parameters showed approximately the similar response of cake samples, furthermore, the addition of the PRF % induced the same results as in cake but *Staphylococcus* appeared late. This means that the two free gluten products contained 30% PRF could be recommended as a useful diet for Celiac disease nevertheless; the microbial studies need further researches.

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