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Full Length Research paper

Creation of bread and biscuits using fermented and cooked pearl millet flour

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Pearl millet that ferments on its own is discovered to harbor probiotic microorganisms. Bakery goods serve as a medium for incorporating various nutrient-dense components. By enhancing its amino acid profiles, fortifying wheat flour with non-wheat proteins improves the quality of the protein. In the cooked fermented pearl millet, the antinutrient phytic acid decreased from 858.4 mg/100 g in the raw millet to 380.3 mg/100 g. After the pearl millet was cooked and fermented, the level of tannin did not decrease from the raw millet. In place of refined wheat flour, the cooked fermented pearl millet was used to make bread and biscuits. The bread that was made with 10, 15, and 20% cooked fermented pearl millet flour had good physical and textural qualities and was on par with bread from the market. Cookies made with 50% cooked fermented pearl millet flour demonstrated acceptable acceptance, as did cookies made with 50% and 100% wheat flour replacement.

Key words: Cooked fermented pearl millet, anti nutrients, fortification, bakery products.

INTRODUCTION

One of the most significant crops in semi-arid regions of Africa and India is pearl millet (Pennisetum glaucum). The pearl millet crop's capacity to withstand heat and drought allows it to adapt widely to local conditions. It is therefore commonly grown in tropical parts of the world, such as Asia and Africa.

A staple food grain for millions of people, pearl millet is currently the sixth most important cereal grain in the world. It is farmed widely in Africa, Asia, India, and the Near East. In terms of both output and area, pearl millet is most abundant in India.

Food fermentation has been a common technique for enhancing food's flavor, texture, and palatability. Because of the presence of antinutritional agents as phytic acid, polyphenols, and tannins, pearl millet has a high nutrient content but a low bioavailability. One method that has been shown to lessen these anti-nutrients is fermentation.

The action of the enzymes that microorganisms produce is what causes the modifications related to the fermentation process.

Substrates based on carbohydrates are frequently fermented by lactic acid bacteria (LAB). The acidity of foods fermented with lactic acid is often lower than pH 4.5. The majority of harmful microbes present in food cannot endure at this low pH; hence, it has been discovered that fermenting food with lactic acid lowers the possibility of harmful microbes growing there. Because they favorably modify the balance of intestinal microflora, prevent the growth of bad bacteria, encourage healthy digestion, strengthen the immune system, and raise resistance to infection, probiotics are considered helpful bacteria. Some strains of the Lactobacillus and Bifidobacteria genera are examples of probiotics that have been used in probiotic products.

MATERIALS AND METHODS

Fermentation of cooked pearl millet

By adding water in different ratios of 1:2, 1:3, and 1:4, the fully cooked pearl millet was given the opportunity to ferment spontaneously. In the selective medium Man, Rogosa, and Sharpe

(MRS), the growth and survival of probiotic bacteria (Lactobacillus sp.) are continually counted using the plate count method every 6 hours until fermentation lasts for 48 hours. The process parameters for cooked fermented probiotic pearl millet are displayed in Table 1. To promote quicker probiotic bacterial proliferation, the cooked fermented probiotic millet water was incubated for 48 hours at 37°C in a BOD incubator (Genuine Equipment MFRS, Coimbatore). Probiotic bacterial survival was observed throughout the course of several days of storage for the fermented cooked pearl millet, which was kept at both room temperature and in a refrigerator.

Preparation of value added products

The cooked fermented pearl millet flour is used for the preparation of bakery products like bread and cookies. The details of process parameter for bread and cookies are highlighted in the Table 2.

Preparation of bread

The bread is made using refined wheat flour and cooked fermented flour in varying proportions. The composite bread is high in fiber thanks to the fiber-rich pearl millet flour. The increased proportion of cooked fermented pearl millet flour reduces the bread's rising volume since pearl millet flour contains very little gluten. Therefore, in the creation of value-added composite bread, the proportion of cooked fermented pearl millet flour to refined wheat flour was restricted to 10, 15, 20, and 25%.

Preparation of cookies

The cooked fermented pearl millet flour was combined with the wheat flour in a 1:1 ratio to make cookies, but it was also mixed separately.

Specific volume of bread

By dividing volume (cc) by weight (g), the specific volume of bread was determined using the AACC method 10-05.01 (AACC, 2000). Rapeseed displacement was used to measure the loaf volume as soon as it was taken out of the oven and weighed. Loaves were put in a known-volume container, then rapeseeds were poured into it until it was full. The loaf volume was defined as the volume of seeds that the loaf displaced. Loaf specific volume (LSV), was calculated according to the following formula:

L.S.V = Loaf volume (cc)/Loaf weight (g) (1)

Physical properties of cookies

Cookies diameter (D) and thickness (T) were determined using a vernier caliper while weight of cookies was determined by using electronic analytical weighing balance. Spread was calculated using the formula given by Akubor (2004):

Spread ratio = Diameter/thickness (2)

Texture analysis

Insti The quality and acceptance of fermented pearl millet and value-added goods made from pearl millet are greatly influenced by the product's texture. Using a texture analyzer, the textural characteristics of value-added bread and cookies were identified.

Firmness

In terms of hardness, Bourne (1982) defined firmness as the highest force measured during the initial compression stroke. The force (in grams, kilograms, or Newtons) needed to compress the product by a predetermined distance (measured at 25% compression of 25 mm) is the definition of firmness according to this approach (AACC, 1983). The sample was compressed to a depth of 10 mm in order to perform firmness tests in the texture analyzer using a compression plate with a diameter of 75 mm (P/75). The compression plate was attached to the movable bar using a probe adapter. Prior to starting the studies, the probe was calibrated to make sure there was enough room between the heavy-duty platform and the compression plate.

Determination of firmness of composite bread

One bread slice at a time was subjected to firmness testing, and the graph was then used to obtain the necessary values. The sample was compressed to a predetermined distance of 10 mm by moving the probe. After the probe made contact with the sample, the greatest force needed to pierce the chicken piece from the spent layer was noted and contrasted between the samples. The AACC (74-09) standard method is used to measure the hardness of the bread. TA-XT2 Configuration, Strain: 40%; pre-test speed: 1.0 mm/s; test speed: 1.7 mm/s; post-test speed: 10.0 mm/s; mode: measure force in compression; option: return to start; Type of Trigger: Auto: 5 g; Rate of Data Acquisition: 250 pps; Probe: AACC 36 mm cylinder probe with a 5 kg load cell and a radius of P/36R

The cylinder's edges are "rounded" to eliminate sharpness from the probe's perimeter, which lessens the probe's propensity to cut the sample when it penetrates. The bread loaf is automatically cut into uniform slices that are 12.5 mm thick. The test was conducted using the '% strain' data in order to calibrate the probe. The probe was lowered such that it was near the test surface in order to do this. The menu bar's T.A. was selected, followed by CALIBRATE PROBE to define the approximate 30-mm distance that the probe should return to following the recommended sample compression. Before starting the testing, the auto height box in the 'Run a Test' window was checked. The test was started once the sample was positioned in the middle of the cylinder probe, away from any uneven or non-representative crumb patches. The probe compresses the sample until it reaches 40% of the product height once the trigger force is reached. After that, it leaves the sample and goes back to where it was before. The outcome is a texture expert surpasses graphs. The graph and result window are then used to make the observation.

Determination of hardness and resistance of composite cookies to bend

One bread slice at a time was subjected to firmness testing, and the graph was then used to obtain the necessary values. The sample was compressed to a predetermined distance of 10 mm by moving the probe. After the probe made contact with the sample, the greatest force needed to pierce the chicken piece from the spent layer was noted and contrasted between the samples. The AACC (74-09) standard method is used to measure the hardness of the bread. TA-XT2 Configuration, Strain: 40%; pre-test speed: 1.0 mm/s; test speed: 1.7 mm/s; post-test speed: 10.0 mm/s; mode: measure force in compression; option: return to start; Type of Trigger: Auto: 5 g; Rate of Data Acquisition: 250 pps; Probe: AACC 36 mm cylinder probe with a 5 kg load cell and a radius of P/36R

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The "hardness" of the sample was defined as the highest force necessary to break the cookies. The distance at the point of break represents the sample's resistance to bending, which is related to its "fracturability"; a sample that breaks at a relatively short distance is said to have a high fracturability. Pre-test speed: 1.0 mm/s; test speed: 3.0 mm/s; post-test speed: 10.0 mm/s; distance: 5 mm; trigger force: auto - 50 g; data acquisition rate: 500 pps; TA-XT2 settings, mode: measure force in compression; option: return to start; probe: a heavy-duty platform (HDP/90) with a 3 point bending rig (HDP/3PB) and a 5 kg load cell
The rig base plate's two adjustable supports are positioned appropriately apart to support the 40 mm sample. This disparity should be recorded and maintained constant for comparison's sake. After that, the base plate is fastened to the sturdy platform. The sturdy platform was moved and secured so that the upper blade was equally spaced from the two lower supports. Just before testing, the sample was taken out of storage and positioned in the middle of the supports. The force was observed to increase once the trigger force was reached until the biscuit broke and fell into two pieces. This was found to be the strongest force and is known as the sample's "hardness." The sample's resistance to bending, or "fracturability," was determined by the distance at the point of break. The graph window provides the outcome.

Sensory evaluation

The 50 semitrainned sensory panelists were given the composite bread with 10, 15, 20, and 25% cooked fermented pearl millet flour added to refined wheat flour at room temperature and humidity levels, while the bread made with only refined wheat flour was used as a control. The bread's color, flavor, chewiness, and general acceptance were all assessed. A similar process was used for the composite cookies made with 50% wheat flour and cooked fermented pearl millet flour, as well as cookies made without addition of wheat flour. After every sensory test, panelists were told to rinse their mouths or sip water to clear their palates.

A hedonic scale questionnaire with nine points—1 for extremely dislike, 2 for dislike very much, 3 for dislike moderately, 4 for dislike slightly, 5 for neither like nor dislike, 6 for like slightly, 7 for like moderately, 8 for like very much, and 9 for extremely like—was given to semi-trained panelists to rate the composite bread. Measures of overall acceptability, softness, flavor, mouthfeel, crumb grain, odor, and general look were all assessed for composite bread.

RESULTS AND DISCUSSION

The **Studies on composite bread**

Specific volume of composite bread

Table 3 shows the impact of cooked fermented pearl millet (CFPM) flour on a particular volume of composite bread. As the quantity of CFPM flour substitution increased, the specific volume of bread reduced dramatically. Compared to bread made with pure refined wheat flour, bread made using composite flours had a smaller volume. The maximum specific volume of bread, 5.93 cc/g, was acquired from control loaf, but the bread with the lowest specific volume (5.04 and 5.27 cc/g, respectively) was made using flour that contained 25% CFPM flour. While the particular volume of commercially available bread loaf in the market is 6 cc/g, this conclusion was consistent with that of Aluko and Olugbemi (1989), who observed lower quantities associated with composite as opposed to 100% wheat.

This is explained by the dough having less gluten network and, as a result, a weaker cell wall structure, which limits the dough's capacity to rise. The precise volumes of substitution at the 10, 15, and 20% levels, however, did not differ substantially from one another.

Textural properties of composite bread

When cooked fermented pearl millet (CFPM) flour was added to refined wheat flour in proportions of 10, 15, 20, and 25%, the composite bread's hardness, cohesion, springiness, gumminess, and chewiness were measured. The textural characteristics of composite bread are shown in Table 4. The table shown that as the percentage concentration of CFPM flour grows, so does the composite bread's hardness. The bread that had a 25% CFPM flour to refined wheat flour incorporation had a higher value of 21.15 N. Conversely, the remaining percentage of incorporation has a lower hardness value. The bread's hardness value.

Less variation is seen from the control sample, whose hardness was 11.48 N, and the 10% bread's hardness of 12.22 N, when 10% CFPM flour is added. Despite whatever percentage of integration, there was no discernible variation in the cohesion and springiness ratings. When compared to the manufactured composite bread, the control showed greater cohesion and springiness values of 0.71 and 0.9, respectively. The composite bread with 25% CFPM flour and refined wheat flour demonstrated the lowest values of cohesiveness and springiness. The gumminess and chewiness of bread made with refined wheat flour are 8.19 and 7.41 N, respectively, and they were observed to rise as the percentage of CFPM flour was increased. The 25% CFPM flour composite bread demonstrated higher gumminess and chewiness values of 12.9 and 10.45 N, respectively. According to Abdelghafor et al. (2011), pan bread cooked with whole or decorticated sorghum-wheat composite flour had higher hardness, gumminess, and chewiness and decreased cohesion, springiness, and resilience when the amount of sorghum flour was increased.

Impact of adding cooked fermented pearl millet flours on the color of bread crumb and bread made with refined wheat flour

The colour values L (light-dark), a (red-green), and b (yellow-blue) of the bread and crumb samples of blended Table 5 provides the flour. The findings show that L-values changed dramatically from white to gray, a values changed from green to red, and b values changed from blue to yellow as the percentage of CFPM flour substitution rose.

Overall, the L values of the bread and bread crumb samples that were made with CFPM flour showed a substantial rise in grayish hue, falling from 72.54 to 62.47 and from 64.54 to 55.47, respectively. Bread made with 25% CFPM flour had the highest a-value (-0.13), whereas bread made with 100% refined wheat flour had the lowest value (-0.75), as seen by higher intensities of green hue. Conversely, bread prepared with 25% CFPM flour had the highest b value (12.67), while bread made with 100% refined wheat flour had the lowest value (9.51). The color of the bread crumb was more clearly affected by the substitution of CFPM flour than the color of the bread itself. Compared to the samples manufactured with additional CFPM flour, the bread crumb samples created with 100% refined wheat had higher a and b values and lower L values. However, Torres et al. (1993) found that the color of tortilla flour was not significantly ($p<0.05$) affected by the addition of decorticated pearl millet flour. However, the look of tortillas made using sorghum flour was hampered by undesired black dots. Additionally, Morad et al. (1984) investigated how the millet variety affected the baking qualities of Balady bread, cookies, and ordinary bread in the United States. They discovered that the hue At thirty percent, the values of pocket bread made with whole wheat flour were comparable to those created with brown and yellow millet. The color of the bread crumb may rival that of whole wheat bread, particularly in samples made with brown sorghum.

The study's findings show that CFPM flour affected the color of the crumb. This might be because the fibers and pigments lessened the green component of the crumb's hue and slightly changed it from red to gray.

Sensory evaluation of composite breads

A hedonic scale questionnaire with nine points—1 for extremely dislike, 2 for dislike very much, 3 for dislike moderately, 4 for dislike slightly, 5 for neither like nor dislike, 6 for like slightly, 7 for like moderately, 8 for like very much, and 9 for extremely like—was given to semi-trained panelists to rate the composite bread. Measures of overall acceptability, softness, flavor, mouthfeel, crumb grain, odor, and general look were all assessed for composite bread.

Table 6 displays the sensory characteristics of both the 100% wheat bread and composite breads formed from mixes of wheat and cooked fermented wheat flours. The blend of CFPM flour showed substantial differences in all sensory categories, including general look, color, flavor, softness, mouth feel, and overall acceptability.

Table 6 indicates that there was a significant difference in overall acceptability between refined wheat flour and a higher amount of CFPM flour. Composite loaves prepared with 5 and 10% substituted CFPM flour had colors that were comparable to the control, which was 100% refined wheat flour; samples were noticeably darker at greater substitution levels. As the amount of CFPM flour rose, the mouth feel score dramatically decreased. With mean scores of 7.59 and 7.5, it was discovered that the mouth feel scores of 10% and 15% composite bread were comparable. The composite bread's sensory evaluation score when CFPM flour was substituted for 25% of the refined wheat flour in terms of sensory qualities, flour falls between 5.22 and 6. These findings concur with those of Summer and Nielsen (1976), who found that adding 25% millet flour to the bread recipe darkened the color of the loaf on the inside as well as the outside. Overall bread quality at the various cooked fermented pearl millet flour substitution levels, ranging from 10% to 20%, was determined to be satisfactory in this investigation. However, as the amount of CFPM flour substituted dropped, acceptance rose. These findings concur with Kyomugisha's (2002) research.

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Studies on composite cookies

Spread ratio of composite cookies

The spread ratio difference between the composite cookies made with 50% and 100% cooked fermented flour and wheat flour is displayed in Table 7. The control group consisted of cookies made with whole wheat flour. The weight of the composite cookies decreased as the replacement ratio of cooked fermented pearl millet flour with whole wheat flour increased, causing the thickness to grow dramatically. Comparing the composite cookies to the control, the diameter grew. The whole wheat flour cookies are 30.80 mm in thickness and 40 mm in diameter. While the cookies made with cooked fermented pearl millet flour decreased to 6.45 g, the control group showed a higher mass of 7.22 g. This decrease in mass could be the result of fermentation reducing the flour's volume. Chinma and Gernah (2007) found a similar outcome with composite cookies made with flour from soy beans, cassava, and mango.

Textural properties of composite cookies

Textural characteristics such as chewiness, hardness, gumminess, and fracturability or breaking strength (the ability of the cookies to withstand bending) were observed for the composite cookies when 50 and 100% (CFPM) flour were mixed with refined wheat flour. As more cooked fermented pearl millet flour was added, all of the textural qualities—hardness, gumminess, chewiness, and fraturability—were enhanced. Half of the cooked fermented pearl millet flour was substituted in the composite cookies. shown a minor departure from the control in terms of textural characteristics, however the 100% value displays greater values of 28.9 N hardness, 15.22 N gumminess, 13.68 N gumminess, and 27.94 N fraturability. The samples did not differ significantly in terms of fracturability or hardness. For the control sample, a lower hardness value of 19.24 N was noted. The findings imply that the value of textural qualities is increased when the amount of cooked fermented pearl millet flour is incorporated. These findings concur with the conclusion reached by Chinma and Gernah (2007).

Colour difference in composite cookies

The color of the cookies made with cooked fermented pearl millet differed from that of the control. The color values of whiteness (L), redness (a), and yellowness (b) for crust colors are displayed in Table 6. When comparing the cooked fermented pearl millet flour samples to the control, the L value decreased. It was verified that the cookies made with CFPM flour had a higher browning index (BI) and were redder and darker (a-values) than the control samples. The findings demonstrated that the composite cookie samples with increased levels of CFPM flour from 50 to 100% had higher a-values (redness). These findings are in line with those of Kenny et al. (2000), Barron and Espinoza (1993), Ahmed (1999), and Eissa et al. (2007). Additionally, the data showed that the composite cookies' b value decreased as the amount of CFPM flour substituted increased. The cookies made with 100% cooked fermented pearl millet flour had a higher b value.

The information in Table 6 indicates that the composite cookies' color was darker than that of the control cookies, which were made with wheat flour.

Sensory evaluation of composite cookies

Table 7 shows how the sensory qualities of composite cookies are affected when 50 and 100 percent cooked fermented pearl millet flour is added. Comparing the composite cookies to the control sample, the sensory characteristics score decreased significantly as the amount of cooked fermented pearl millet flour substituted increase.

Cookies made with 100% CFPM flour had a less than ideal flavor. Therefore, the cookie taste score was 5.11, and the 50% taste score was 7.99, which does not significantly differ from the control level of 8.2. The information about the cookies' color and look, which varies from 8.2 to 9 on the 9-point hedonic scale, was not statistically significant and is shown in Table 7. The results shown in Table 7 show that as the amount of cooked fermented pearl millet flour substituted with wheat flour increased, the overall acceptability declined. These findings are consistent with those of Takumil et al. (2006), who discovered that millet seeds taste bitter when compared to cookies made with wheat flour.

Conclusion

This Bakery goods were also made with the cooked fermented pearl millet (CFPM). Due to the lower fiber content, regular intake of bakery products, which are often manufactured with refined or whole wheat flour, might cause constipation and colon cancer in users. Pearl millet is used in baking when cooked fermented pearl millet flour is substituted for refined whole wheat flour. There is no discernible difference in the physicochemical and textural characteristics of the bread made with 10% CFPM flour and wheat flour compared to the commercially available bread, which has a hardness of 11.48 N and 12.22 N for 10% CFPM. The morphological and textural characteristics of the 25% integration were unacceptable. Because cooked fermented pearl millet flour is not glutinous, its rising level decreases when bread is being made. As a result, only 25% of refined wheat flour could be replaced with cooked fermented pearl millet (CFPM) flour.
Both a 50% and a 100% substitution of cooked fermented pearl millet flour for wheat flour were used to make the composite cookies. Compared to cookies made with 100% CFPM flour, those made using 50% CFPM flour substitute have superior color and texture qualities.

Compared to the composite cookies made with 50% CFPM flour and refined wheat flour, the cookies made with 100% CFPM had a darker color. As the percentage of CFPM flour grew, so did the hardness and fracturability. Despite being made with 100% CFPM flour, cookies made with 50% CFPM flour demonstrated a satisfactory sensory score and acceptability. Because of their high fiber content and lack of gluten, cookies made with 100% CFPM flour had increased hardness and fracturability of 28.9 and 27.9 N, respectively. Its higher phenol and tannin content was the cause of its darker color.

10% of CFPM flour combined with bread's refined wheat flour is appropriate, while 50% of CFPM flour combined with cookie flour is safe to eat..

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