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Effect of Germinated Kodo Millet (*Paspalum scrobiculatum*) Flour Incorporation on the Proximate Composition, Micronutrient Profile and Storage Stability of Ribbon Pakoda

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Abstract: The present study evaluated the effect of incorporating germinated Kodo millet (*Paspalum scrobiculatum*) flour on the proximate composition, micronutrient profile and storage stability of ribbon pakoda. Germinated Kodo millet flour (GKMF) was used to replace 20% of the rice flour, and the standard rice flour-based product served as the control. The 20% GKMF formulation was selected based on sensory evaluation. The products were analysed for proximate composition, selected minerals and vitamins. Storage stability was evaluated over 60 days by monitoring free fatty acid content, peroxide value and microbiological quality. Incorporation of GKMF increased protein, dietary fibre, ash, selected minerals and vitamins compared with the standard product. The GKMF formulation also showed lower FFA and peroxide values throughout storage. At day 60, total bacterial count was 1.2 × 10^2 CFU/g in the GKMF product compared with 1.8 × 10^2 CFU/g in the standard, while total plate count was 1.0 × 10^1 CFU/g in both products. Yeast and mould, coliforms and E. coli remained below the reported detection limit, and the tested pathogens were not detected. The findings indicate that partial replacement of rice flour with 20% GKMF improved the nutritional composition of ribbon pakoda while maintaining comparatively favourable oxidative and microbiological quality during the 60-day storage evaluation.

Keywords: *Kodo Millet; Germination; Ribbon Pakoda; Proximate Composition; Micronutrients; Oxidative Stability; Microbiological Quality.*

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I. INTRODUCTION

Millets are important traditional cereal crops cultivated in several semi-arid and tropical regions of the world. Their ability to grow under relatively challenging agro-climatic conditions, together with their nutritional composition, has increased interest in their utilisation as ingredients in diversified food products. Millet grains provide carbohydrates, proteins, dietary fibre, minerals and other nutritional components, although their composition varies with species, variety and processing conditions (Saleh et al. 2013). The incorporation of millet flour into commonly consumed foods offers an opportunity to diversify cereal-based products and increase the utilisation of underutilised millets.

Kodo millet (*Paspalum scrobiculatum*) is a minor millet recognised for its nutritional and processing potential. Its grain contains protein, dietary fibre and minerals, making it a suitable ingredient for the development of value-added food products. However, the nutritional characteristics of millet-based ingredients can be influenced by processing treatments. Among these, germination is an important traditional technique that initiates biochemical changes in the grain through the activation of endogenous enzymes. These changes can modify the composition of carbohydrates, proteins and other nutritional components and may influence the levels of certain antinutritional factors (Nkhata et al. 2018). In a study specifically on Kodo millet, Sharma et al. (2017) reported changes in protein, dietary fibre, mineral content and selected bioactive components following germination. These findings indicate the potential of

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germinated Kodo millet flour as an ingredient for food product development.

The nutritional contribution of a food product is determined not only by its principal ingredients but also by the proportions in which they are incorporated and the processing conditions employed. Proximate composition provides information on the major nutritional constituents, including moisture, protein, fat, ash, dietary fibre and carbohydrates. Minerals and vitamins are also important components of nutritional evaluation. Germination can influence the nutritional composition of cereal grains through enzymatic activity and changes in the grain matrix. However, changes in nutrient concentration should be evaluated in the final food product, since formulation and subsequent processing may influence the composition of the developed product. Therefore, determining the proximate composition and selected micronutrients of millet-incorporated foods is necessary to establish their nutritional characteristics.

Ribbon pakoda is a traditional deep-fried snack commonly prepared using rice flour, pulse flour and seasonings. Rice flour forms the principal cereal component of the conventional formulation, providing a suitable matrix for the preparation of the characteristic crisp snack. Partial replacement of rice flour with germinated Kodo millet flour may provide an alternative means of incorporating this underutilised millet into a familiar food product. Nevertheless, the effect of such substitution on the proximate composition and micronutrient profile of the finished product requires systematic evaluation.

As ribbon pakoda is a deep-fried product, its quality during storage may also be influenced by changes in the lipid fraction. Hydrolysis and oxidation are among the principal reactions associated with the deterioration of fats and oils in fried foods. Free fatty acid (FFA) content is commonly used to monitor hydrolytic changes, whereas peroxide value (PV) provides an indication of primary lipid oxidation products. These reactions are influenced by factors such as frying conditions, the composition of the food matrix, the quality of the frying oil and exposure to oxygen during storage (Choe & Min, 2007). Monitoring FFA and PV at successive storage intervals therefore provides a means of assessing changes associated with lipid deterioration in fried snack products.

Although research has documented the nutritional changes associated with Kodo millet germination, the nutritional characteristics of the resulting flour need to be considered in relation to its application in specific food products. In particular, evaluating the proximate composition, selected mineral and vitamin contents, and storage-related oxidative changes of germinated Kodo millet flour-incorporated ribbon pakoda would provide product-specific information. The present study was therefore undertaken to evaluate the effect of replacing 20% of rice flour with germinated Kodo millet flour on the proximate composition, mineral and vitamin profile of ribbon pakoda, and to assess its oxidative stability during 60 days of storage at room temperature by monitoring FFA content and peroxide value.

Storage stability of deep-fried snacks is influenced not only by lipid deterioration but also by changes in microbiological quality during storage. Although the low moisture content of fried products may restrict microbial growth, microbial quality can still be affected by post-processing contamination, handling and packaging conditions. Therefore, evaluating microbial counts and selected foodborne microorganisms alongside oxidative deterioration provides a more comprehensive assessment of product quality during storage. In this context, the present study also examined the microbiological quality of standard and germinated Kodo millet flour-incorporated ribbon pakoda during storage.

The specific objectives of the study were:

- To compare the proximate composition of standard and 20% GKMF-incorporated ribbon pakoda.
- To determine the selected mineral and vitamin composition of both formulations.
- To evaluate changes in FFA, peroxide value and microbiological quality during 60 days of storage.

II. MATERIALS AND METHODS

➢ *Preparation of Germinated Kodo Millet Flour*

Kodo millet (*Paspalum scrobiculatum*) grains were cleaned manually to remove foreign materials, damaged grains and other impurities. The cleaned grains were washed and soaked in water for 12 hours. After soaking, the excess water was drained, and the grains were wrapped in a clean, moist cotton muslin cloth and allowed to germinate for 48 hours at approximately 28°C. The germinated grains were subsequently dried in a hot-air oven at 110°C for 6 hours. The dried grains were milled into flour and passed through a 40-mesh sieve to obtain germinated Kodo millet flour (GKMF). The prepared flour was collected and used for ribbon pakoda preparation.

➢ *Formulation and Preparation of Ribbon Pakoda*

Ribbon pakoda was prepared using rice flour, Bengal gram flour and selected spices. In the experimental formulation, 20% of the rice flour was replaced with germinated Kodo millet flour. The standard formulation, prepared without GKMF, served as the control. The ingredient composition of the two formulations is presented in Table 1.

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Table 1 Ingredient Composition of Standard and 20% GKMF-Incorporated Ribbon Pakoda

Sl. No.	Ingredients	Standard	RP1	RP2	RP3
1	Rice Flour (g)	100	80	75	70
2	KMFF (g)	---	20	25	30
3	Bengal gram flour	25	25	25	25
4	Red chilli powder	5	5	5	5
5	Black Pepper Powder (g)	1.5	1.5	1.5	1.5
6	Salted Butter (g)	3	3	3	3
7	Oil (ml)	3	3	3	3
8	Salt (g)	3	3	3	3

The respective flour ingredients were mixed thoroughly with Bengal gram flour, red chilli powder, black pepper powder and salt. Hot oil and melted butter were added to the dry mixture and blended for approximately one minute. Water was added gradually to obtain a dough of suitable consistency. The prepared dough was transferred into a ribbon pakoda mould and pressed directly into preheated frying oil. The products were deep-fried over a high flame for approximately 10–12 minutes until they attained a crisp texture. The fried ribbon pakoda samples were cooled to room temperature and packed in low-density polyethylene (LDPE) covers for further analysis and storage studies.

➢ *Sensory Evaluation*

The developed ribbon pakoda formulations were subjected to sensory evaluation by a semi-trained panel comprising 30 members. The samples included the standard product and GKMF-incorporated formulations containing 20%, 25% and 30% germinated millet flour. Sensory evaluation was conducted using a 9-point hedonic scale, ranging from 9 (like extremely) to 1 (dislike extremely). The products were evaluated for appearance, colour, flavour, taste, texture and overall acceptability. Based on the sensory scores, the most acceptable GKMF formulation was selected for further nutritional and storage-stability analyses.

➢ *Proximate Composition Analysis*

The proximate composition of standard and 20% GKMF-incorporated ribbon pakoda was determined in triplicate following AOAC (2005) procedures. Moisture, protein, total fat, ash and dietary fibre were estimated, and the results were expressed on a dry-weight basis.

Moisture content was determined by drying a known quantity of sample in a hot-air oven at 105°C for three hours. The sample was cooled in a desiccator and weighed. Drying, cooling and weighing were repeated until a constant weight was obtained.

Protein content was determined by the Kjeldahl method. The nitrogen content estimated from the sample was converted into crude protein using a conversion factor of 6.25.

Total fat was estimated by Soxhlet extraction. Five grams of moisture-free sample were subjected to extraction using anhydrous ether for three hours. The solvent was subsequently evaporated, and the extracted fat residue was dried at 80–100°C, cooled and weighed.

Ash content was determined by initially charring the sample over a low flame, followed by incineration in a muffle furnace at 550°C until a carbon-free ash was obtained.

Dietary fibre was determined by the enzymatic-gravimetric method. The residue obtained after enzymatic treatment was corrected for protein, ash and blank values.

Carbohydrate content was calculated by difference using the following formula:

Carbohydrate (g/100 g) = 100 - [Protein + Fat + Dietary fibre + Ash + Moisture]

Energy value was calculated using

Energy (Kcal) = (4 X Protein) + (4 X Carbohydrate) + (9 X Fat) + (2 X Dietary Fibre)

➢ *Mineral Composition Analysis*

The mineral composition of standard and 20% GKMF-incorporated ribbon pakoda was determined in triplicate following AOAC (2005) procedures. The minerals evaluated were calcium, iron, magnesium, zinc and phosphorus. Sodium and copper were excluded from the present study. The results were expressed as milligrams per 100 g of sample on a dry-weight basis.

For mineral estimation, the samples were incinerated, and the ash was dissolved in a mixture of hydrochloric acid and distilled water (1:1). The solution was heated until fuming, rinsed with distilled water and filtered through Whatman No. 1 filter paper. The filtrate was transferred into a 100 ml volumetric flask, and the volume was made up to the mark with distilled water to obtain the mineral extract.

Phosphorus was estimated by developing a yellow phosphovanadomolybdate complex using vanadium and molybdenum reagents. The absorbance of the developed colour was measured at 430 nm using a UV–Visible spectrophotometer.

Iron and zinc were determined using atomic absorption spectrophotometry (AAS). Calibration curves were prepared using appropriate standard solutions, and the mineral concentrations in the samples were calculated from the corresponding calibration curves.

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Calcium and magnesium were estimated by complexometric titration using EDTA. The combined calcium and magnesium content was determined at pH 10 using Eriochrome Black T indicator. Calcium was determined separately under alkaline conditions (pH above 12) using murexide indicator. Magnesium content was calculated from the difference between the combined calcium and magnesium content and the calcium content.

➢ *Vitamin Composition Analysis*

The vitamin composition of standard and 20% GKMF-incorporated ribbon pakoda was evaluated for thiamine (vitamin B1), riboflavin (vitamin B2), niacin (vitamin B3) and β-carotene. The analyses were carried out in triplicate, and the results were expressed on a dry-weight basis.

Thiamine was determined using AOAC (2005), based on fluorometric measurement following sample extraction and oxidation of thiamine to fluorescent thiochrome. Riboflavin was determined using AOAC Method 970.65, employing a fluorometric determination procedure. Niacin was estimated using AOAC Method 944.13, based on a microbiological assay.

For β-carotene estimation, the sample was extracted with chilled acetone to obtain the carotenoid pigments. The extract was transferred into a separating funnel and mixed with petroleum ether to facilitate the transfer of carotenoids into the organic phase. The petroleum ether layer was separated, washed and passed through anhydrous sodium sulphate to remove residual moisture. The absorbance of the resulting extract was measured at 450 nm using a UV–Visible spectrophotometer, and β-carotene content was calculated with reference to a β-carotene standard.

Thiamine, riboflavin and niacin contents were expressed as milligrams per 100 g, while β-carotene content was expressed as micrograms per 100 g of sample on a dry-weight basis.

➢ *Storage Stability*

- *Oxidative Stability*

The standard and 20% GKMF-incorporated ribbon pakoda samples were packed in LDPE covers and stored at room temperature. The storage stability of the products was evaluated over a period of 60 days by monitoring changes in free fatty acid (FFA) content and peroxide value (PV).

The analyses were carried out at four storage intervals: 0, 15, 30 and 60 days. FFA content and PV were determined using standard AOAC (2005) procedures based on volumetric titration. FFA content was expressed as a percentage, while PV was expressed as milliequivalents of oxygen per kilogram of fat (meq O_2/kg fat). All determinations were performed in triplicate, and the results were expressed as mean ± standard deviation (SD).



Fig 1 Ribbon Pakodas Developed from Germinated Kodo Millet Flour and Packed for Storage Studies

- *Microbiological Analysis*

The microbiological quality of standard and 20% GKMF-incorporated ribbon pakoda was evaluated during storage. Total bacterial count and total plate count were determined using serial dilution and pour plate techniques. One gram of sample was homogenised with sterile saline, followed by serial dilution. Suitable dilutions were plated using the respective culture media. Nutrient agar was used for bacterial enumeration, while potato dextrose agar acidified with tartaric acid was used for fungal enumeration. Bacterial plates were incubated at 37°C for 24 h and fungal plates at 25°C for 72 h. Colonies were counted and expressed as CFU/g.

The microbiological evaluation also included yeast and mould, coliforms, Escherichia coli, Salmonella, Staphylococcus aureus and Listeria monocytogenes. Results were recorded as CFU/g or presence/absence, as applicable.

➢ *Statistical Analysis*

All analytical determinations were performed in triplicate. The results for proximate composition, mineral composition, vitamin composition and storage stability parameters were expressed as mean ± standard deviation (SD). The data were tabulated separately for the standard and 20% GKMF-incorporated ribbon pakoda formulations.

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III. RESULTS AND DISCUSSION

➢ *Sensory Evaluation and Selection of Optimized GKMF Ribbon Pakoda*

The sensory acceptability of ribbon pakoda prepared using germinated Kodo millet flour (GKMF) at three incorporation levels (20%, 25% and 30%) was evaluated in comparison with the standard product. The evaluation was conducted by a semi-trained panel of 30 members using a 9-point hedonic scale. The sensory attributes assessed included appearance, colour, flavour, taste, texture and overall acceptability.

Table 2 Sensory Evaluation of Ribbon Pakoda Incorporated with Germinated Kodo Millet Flour

Sensory Parameter	Appearance	Colour	Flavour	Taste	Texture	Overall Acceptability
Standard	8.84 ± 0.12	8.80 ± 0.14	8.88 ± 0.11	8.92 ± 0.10	8.86 ± 0.12	8.90 ± 0.09
Variation 1 (20% GKMF)	**8.76 ± 0.13**	**8.72 ± 0.14**	**8.82 ± 0.12**	**8.86 ± 0.11**	**8.80 ± 0.13**	**8.84 ± 0.10**
Variation 2 (25% GKMF)	8.42 ± 0.16	8.36 ± 0.17	8.48 ± 0.15	8.44 ± 0.14	8.38 ± 0.16	8.42 ± 0.13
Variation 3 (30% GKMF)	7.94 ± 0.19	7.88 ± 0.18	8.02 ± 0.17	7.98 ± 0.16	7.90 ± 0.18	7.95 ± 0.15

The sensory evaluation revealed that the 20% GKMF-incorporated ribbon pakoda recorded the highest overall acceptability among the three germinated millet formulations. It also obtained favourable scores for appearance, colour, flavour, taste and texture, with values closely comparable to those of the standard product. In contrast, the 25% and 30% GKMF formulations showed progressively lower scores across the evaluated sensory attributes.

The reduction in sensory scores at higher incorporation levels suggests that increasing the proportion of germinated millet flour may influence the characteristic sensory properties of ribbon pakoda. The 20% formulation provided a favourable balance between millet flour incorporation and the sensory characteristics of the traditional product.

Based on its overall sensory performance, the 20% GKMF formulation was selected as the optimized formulation for further evaluation of proximate composition, mineral composition, vitamin composition and storage stability.

➢ *Proximate Composition of Standard and 20% GKMF-Incorporated Ribbon Pakoda*

The proximate composition of standard and 20% germinated Kodo millet flour (GKMF)-incorporated ribbon pakoda was evaluated in terms of moisture, protein, total fat, carbohydrate, ash, dietary fibre and energy. The results are presented in Table 3.

Table 3 Proximate Composition of Standard and 20% GKMF-Incorporated Ribbon Pakoda (per 100 g, Dry-Weight Basis)

Parameters	Standard	20% GKMF
Moisture (%)	2.76 ± 0.05	3.14 ± 0.07
Protein (g)	7.84 ± 0.13	9.36 ± 0.17
Total Fat (g)	26.48 ± 0.34	25.34 ± 0.30
Carbohydrates (g)	57.70 ± 0.56	56.22 ± 0.51
Ash (g)	1.18 ± 0.03	1.66 ± 0.04
Dietary Fibre (g)	2.04 ± 0.05	4.28 ± 0.08
Energy (Kcal)	504.56 ± 2.20	498.94 ± 2.04

Values are Mean ± Standard Deviation (n = 3).
GKMF = Germinated Kodo Millet Flour

Incorporation of 20% germinated Kodo millet flour (GKMF) improved the protein, ash and dietary fibre contents of ribbon pakoda compared with the standard product. Protein increased from 7.84 to 9.36 g/100 g (19.4%), while dietary fibre more than doubled, from 2.04 to 4.28 g/100 g. Ash content also increased by 40.7%, indicating a higher total mineral residue in the millet-incorporated product. These changes are consistent with the nutritional improvements reported by Sharma et al. (2017) in germinated Kodo millet, particularly the increases in protein, fibre and mineral content.

Compared with the standard, total fat decreased slightly from 26.48 to 25.34 g/100 g, while carbohydrate decreased from 57.70 to 56.22 g/100 g. Energy content showed a marginal reduction from 504.56 to 498.94 kcal/100 g. Moisture increased slightly in the GKMF product. A similar reduction in fat following millet germination was reported by Owheruo et al. (2019) in finger and pearl millet. Overall, the results suggest that replacing 20% of rice flour with GKMF enhanced the protein, fibre and ash contents of ribbon pakoda, with modest reductions in fat and energy content.

➢ *Vitamin Composition of Standard and 20% GKMF-Incorporated Ribbon Pakoda*

The vitamin composition of standard ribbon pakoda and ribbon pakoda incorporated with 20% germinated Kodo millet flour (GKMF) was analysed to determine the effect of millet flour incorporation on selected vitamin contents. The results are presented in Table 4.

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Table 4 Vitamin Composition of Standard and 20% GKMF-Incorporated Ribbon Pakoda

Parameters	Standard	20% GKMF
Thiamine (B1) (mg)	0.16 ± 0.01	0.28 ± 0.01
Riboflavin (B2) (mg)	0.05 ± 0.00	0.10 ± 0.01
Niacin (B3) (mg)	1.72 ± 0.04	2.54 ± 0.05
β-carotene (µg)	7.84 ± 0.20	16.42 ± 0.33

Values are Mean ± Standard Deviation (n = 3).
GKMF = Germinated Kodo Millet Flour

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➢ *Mineral Composition*

The 20% GKMF-incorporated ribbon pakoda showed higher concentrations of all five minerals analysed than the standard product (Table 5). Calcium increased by 49.6%, iron by 63.2%, magnesium by 41.7%, zinc by 51.8% and phosphorus by 29.8%. These improvements are consistent with Sharma et al. (2017), who reported an increase in total mineral content following Kodo millet germination. Similarly, studies on germinated foxtail, barnyard and little millet flours have reported increases in several macro- and microminerals (Germination-induced changes in bioactive compounds and nutritional components of millets, 2022).

Table 5 Mineral Composition of Standard and 20% GKMF-Incorporated Ribbon Pakoda

Parameters	Standard	20% GKMF
Calcium (mg)	22.84 ± 0.40	34.18 ± 0.55
Iron (mg)	1.36 ± 0.03	2.22 ± 0.05
Magnesium (mg)	78.62 ± 1.28	111.42 ± 1.74
Zinc (mg)	1.12 ± 0.03	1.70 ± 0.04
Phosphorous (mg)	142.26 ± 2.02	184.62 ± 2.52

Values are Mean ± Standard Deviation (n = 3).
GKMF = Germinated Kodo Millet Flour

The higher mineral concentrations in the present product indicate that partial replacement of rice flour with GKMF improved its measured mineral profile. However, these values represent total mineral content and do not establish mineral bioavailability.

➢ *Oxidative Stability During Storage*

Table 6 summarises the oxidative stability during storage. FFA and peroxide values increased progressively in both formulations during 60 days of storage. However, the 20% GKMF product consistently recorded lower values than the standard. At day 60, FFA was 0.40% in the GKMF product compared with 0.54% in the standard, while PV was 5.42 compared with 7.28 meq O_2/kg fat, representing reductions of 25.9% and 25.5%, respectively.

Table 6 Oxidative Stability of Ribbon Pakoda During Storage

No. of Days	Sample	Free fatty acid (%)	Peroxide value (meq O_2/kg fat)
0	**Standard**	0.18 ± 0.01	1.82 ± 0.06
	20% GKMF	0.14 ± 0.01	1.54 ± 0.05
15	**Standard**	0.26 ± 0.01	3.06 ± 0.08
	20% GKMF	0.20 ± 0.01	2.42 ± 0.06
30	**Standard**	0.38 ± 0.02	4.76 ± 0.11
	20% GKMF	0.28 ± 0.01	3.54 ± 0.09
60	**Standard**	0.54 ± 0.02	7.28 ± 0.16
	20% GKMF	0.40 ± 0.02	5.42 ± 0.13

Values are Mean ± Standard Deviation (n = 3).
GKMF = Germinated Kodo Millet Flour

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A similar increase in FFA and PV during storage has been reported in deep-fried pearl millet snacks by Tiwari and Jha (2017). Their study also demonstrated that packaging conditions influenced the rate of deterioration. The present results indicate comparatively lower lipid deterioration in the GKMF-incorporated ribbon pakoda throughout the observation period. However, since storage was evaluated only up to 60 days, the findings support better oxidative stability over this period rather than establishing the product's overall shelf life.

➢ *Microbiological Quality During Storage*

The microbiological evaluation showed a gradual increase in total bacterial count during storage (Table 7). At day 60, the standard ribbon pakoda recorded 1.8×10^2 CFU/g, compared with 1.2×10^2 CFU/g in the 20% GKMF formulation. Total plate count was 1.0×10^1 CFU/g in both formulations at day 60. Yeast and mould, coliforms and E. coli remained below the detection limit of 10 CFU/g, while Salmonella, Staphylococcus aureus and Listeria monocytogenes were absent throughout the reported storage period.

The lower bacterial count in the GKMF formulation indicates comparatively lower microbial proliferation during storage. Nevertheless, the similar total plate counts and absence of the tested pathogens should also be considered when interpreting the results. These findings complement the FFA and peroxide value results by providing a microbiological assessment of product quality during the 60-day storage period.

Table 7 Microbiological Quality During Storage

Sl. No.	Sample type	Test attributes	Initial Day (0)	Day 15	Day 30	Day 60
	Standard	TBC (cfu/g)	ND	ND	$1.2 \times 10^2 \pm 0.1$	$1.8 \times 10^2 \pm 0.1$
	20% GKMF	TBC (cfu/g)	ND	ND	$0.8 \times 10^2 \pm 0.1$	$1.2 \times 10^2 \pm 0.1$
	Standard	TPC (cfu/g)	ND	ND	ND	$1.0 \times 10^1 \pm 0.1$
	20% GKMF	TPC (cfu/g)	ND	ND	ND	$1.0 \times 10^1 \pm 0.1$
	Standard And Variations	Yeast & Mold count cfu/g	<10	<10	<10	<10
		Coliforms, cfu/g	<10	<10	<10	<10
		E. Coli /g	<10	<10	<10	<10
		Salmonella / 25g	Absent	Absent	Absent	Absent
		Staphylococcus aureus /g	Absent	Absent	Absent	Absent
		Listeria monocytogenes /25g	Absent	Absent	Absent	Absent

Values are Presented as Mean ± Standard Deviation (n = 3).

Microbiological quality was assessed for the standard and formulated samples at different intervals during storage. Yeast and mold, coliforms and *Escherichia coli* counts were expressed in relation to the specified detection limit, while *Salmonella, Staphylococcus aureus* and *Listeria monocytogenes* were recorded based on their presence or absence. TBC – Total Bacterial Count; TPC – Total Plate Count; ND – Not Detected.

IV. CONCLUSION

Incorporation of 20% germinated Kodo millet flour improved the nutritional composition of ribbon pakoda, with higher protein, dietary fibre, ash, mineral and selected vitamin contents than the standard formulation. The formulation was also sensorially acceptable and was selected as the preferred germinated millet variation. During 60 days of storage, it exhibited lower FFA, peroxide value and total bacterial count than the standard product. Yeast and mould, coliforms and E. coli remained below the reported detection limit, while the tested pathogens were not detected. Overall, partial replacement of rice flour with 20% germinated Kodo millet flour offers a practical approach to developing a nutritionally improved ribbon pakoda with favourable oxidative and microbiological quality over the evaluated storage period.

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