Original Research Article

Chemical and Microbial Quality Assessment of Non-Branded Snacks Sold on the BSMRSTU Campus, Bangladesh

ABSTRACT

Introduction: Non-branded street food provides affordable and quick meals for students around university campuses. However, concerns regarding their nutritional content have surfaced, particularly in comparison to branded alternatives. This study investigates the chemical composition and microbial quality of non-branded snacks (bread, cakes, cream rolls, and laddu) sold near the Bangabandhu Sheikh Mujibur Rahman Science and Technology University (BSMRSTU) campus.

Methodology: Samples of non-branded and branded food items, including bread, cakes, cream rolls, and laddu, were collected from vendors and nearby stores. Chemical and microbial analyses were conducted using standard AOAC methods. The nutritional data of non-branded items were compared with their branded counterparts to assess disparities.

Results and Discussion: The results revealed significant nutritional disparities between branded and non-branded food items. Non-branded bread contained 51.88% carbohydrates, while branded bread had only 23%, showing a 28.88% difference. Similarly, non-branded cakes exhibited a carbohydrate content 25.15% higher than branded cakes. Cream rolls showed the most significant variation, with non-branded versions containing 67.33% carbohydrates, 52.33% higher than branded versions. Protein analysis showed that branded food items consistently contained higher protein levels, with branded bread showing 20% protein compared to 10.21% in non-branded bread. Fat content was also lower in non-branded cakes, which contained 28.01% fat compared to 37% in branded cakes. All the samples exceeded the recommended level of acceptance for the total plate count while only cake showed growth in the MacConkey medium indicating the potentiality of harboring pathogenic bacterial species.

Conclusion: The findings indicate that non-branded food items sold near the BSMRSTU campus contain higher carbohydrate content and lower protein levels compared to branded food items, posing potential nutritional risks. These differences underscore the need for improved nutritional standards and greater consumer awareness of food quality.

Keywords: Non-branded food, nutritional composition, microbial quality, bread, cakes, cream rolls, laddu.

1. INTRODUCTION

Food encompasses a complex interplay of chemical constituents and microbial communities that influence our health and cultural identity. Food can be derived from plants, animals, fungi,

or other sources and is typically categorized into fruits, vegetables, grains, proteins, and fats (Alam,2020). At its core, food is a source of nutrients vital for bodily functions. However, food extends beyond its nutritional value to encompass cultural, social, and economic dimensions (Aredes,2024).

The necessity of food is fundamental to the sustenance, growth, and vitality of all living organisms. Food comprises various components, including macronutrients (carbohydrates, proteins, and fats), micronutrients (vitamins and minerals), fiber, water, and non-nutrient compounds such as phytochemicals and antioxidants. At its essence, food provides the energy required for metabolic processes that sustain life. Through digestion, nutrients derived from food sources are broken down into glucose, amino acids, and fatty acids, serving as the body's primary sources of fuel (Bold, 2011). Macronutrients such as carbohydrates, proteins, and fats provide structural components for cells and tissues, while micronutrients including vitamins and minerals facilitate biochemical reactions, enzyme functions, and immune responses. The absence of these nutrients can lead to deficiencies, impairing physiological processes and predisposing individuals to various health ailments. Furthermore, non-nutritive components like fiber, phytochemicals, and water, confer additional health benefits. Dietary fiber in fruits, vegetables, and whole grains aids digestion, promotes satiety, and regulates blood sugar levels. Phytochemicals in plant-based foods exhibit antioxidant and anti-inflammatory properties, reducing the risk of chronic diseases.

Bangladeshi cuisine is characterized by a harmonious blend of flavors, textures, and aromatic spices, offering a tantalizing array of dishes to suit every palate (Goldberg,1980). Street food culture thrives here, offering an array of savory snacks and sweets, from spicy chaat and samosas to sweet delights like rasgulla and Sandesh. Bangladesh boasts a vibrant bakery industry with numerous brands catering to diverse tastes and preferences. Among the most prominent brands, Well Food, All-time, Cooper's Bakery, Shumi's Hot Cake, etc. offer a wide range of bakery items including biscuits, bread, and snacks that are beloved by consumers across the country. Moreover, international bakery chains like Paris Bakery, Bakers Boutique, and Bread & Beyond have made their mark in Bangladesh, bringing with them a global standard of quality and craftsmanship. Health-conscious consumers gravitate towards brands like NutriBake, FitFusion, and Clean Crumbs, which specialize in gluten-free, sugar-free, and organic bakery options, catering to dietary restrictions and wellness trends (Drouard, 2015).

The comparison between local and branded bakery products in Bangladesh reveals a dynamic interplay between tradition, convenience, and consumer preferences. Locally produced bakery items encompass traditional recipes, and regional flavors passed down through generations. Branded items offer consistency, convenience, and a wide variety of choices, and often rely on preservatives, additives, and artificial flavors to extend shelf life and enhance taste, raising concerns about their nutritional value and long-term health effects.

The World Health Organization (WHO) estimates that each year, between 1.9 and 2.2 million people worldwide die from foodborne and waterborne illnesses (Banik, 2019). Local bakery products often face hygiene challenges due to limited access to sanitation facilities, inadequate food safety regulations, and informal production methods (FEHD, 2001). They are often prepared and sold in open-air markets or informal roadside stalls, where cleanliness and sanitation are compromised. The absence of proper storage facilities and refrigeration exposes bakery items to contamination from dust, insects, and environmental pollutants, increasing the risk of foodborne illnesses and gastrointestinal infections. Additionally, local bakery food often contains high levels of trans fats, refined sugars, and artificial additives, as traditional recipes prioritize taste and texture over nutritional value. Deep-frying, a common cooking method in local bakeries, results in the formation of harmful compounds like acrylamide, which have been linked to an increased risk of cancer and other chronic diseases.

Furthermore, the lack of ingredient labeling and nutritional information on bakery products makes it difficult for consumers to make informed choices about their dietary intake, leading to overconsumption of unhealthy fats, sugars, and calories. The communal aspect of local bakery food consumption, such as shared trays of sweets at social gatherings or festivals, can facilitate the spread of infectious diseases and foodborne pathogens among large groups of people (Jay,1996). Fungal contaminants such as molds and yeast are prevalent in local food items with high moisture content, such as bread, cakes, and fermented products.

A significant portion of BSMRSTU students reside within halls or hostels, while faculty and other students often spend a large period on campus. As a result, local shops situated within the campus premises serve as essential providers of breakfast, inter-class snacks, and afternoon refreshments, offering an assortment of non-branded and openly displayed foods such as laddu, cream rolls, cakes, bread, etc. However, both producers and consumers currently lack awareness concerning the precise chemical composition, nutritional value, and microbiological safety of these food items. The absence of standardized production guidelines has resulted in instances of students falling ill after consumption, prompting growing concern among the campus community regarding the lack of transparency regarding the safety of these foods. Recognizing the significant impact of foodborne illnesses on individuals' well-being and academic performance, there is an urgent need to conduct tests on these non-branded foods to assess their potential risks to consumers and academic or professional endeavors. Following an exhaustive literature review, it became evident that scant research exists concerning the chemical and microbial analysis of non-branded food items such as bread, cake, laddu, and cream rolls within the context of Bangladesh. Again, no studies have been conducted on locally available non-branded bakery items sold at the BSMRSTU campus. This study provides insights into these food items' nutritional quality and safety to identify potential health risks.

2. MATERIAL AND METHODS

2.1 Sample Collection

For this research, the food carts situated in the Newmarket area of the university were selected. Once the sampling area was chosen, the sample collection phase began, and five samples of each commonly consumed snack (bread, cake, cream roll, and laddu) were gathered from four different shops, resulting in a total of twenty samples.

Fig1: Food Sample: Cake, Laddu, Bread, and Cream Roll

2.2 Sample Preparation and Compositional Analysis

The samples were prepared for analysis in the food science laboratory of the Institute of Nutrition and Food Science (INFS), University of Dhaka, Bangladesh, involving processes of cleaning, labeling, weighing, and storing under suitable conditions to maintain their integrity. The moisture content of the samples was determined according to AOAC Method 925.10 by measuring the weight loss after drying the sample in an oven. Ash content was also measured in grams, utilizing a muffle furnace for the complete combustion of the samples (AOAC Method 923.03) (Takahashi,1999).) The salt content was quantified in grams through the Moh'r method (AOAC Method 935.47). The crude fiber content was determined using a gravimetric method, providing a measure of the indigestible portion of the sample. To determine the protein content of the samples, the nitrogen content is first measured using the AOAC Method 2001.11 (AOAC Method 2001). This nitrogen estimation is performed using the Kjeldahl method, which involves digestion, distillation, and titration. The organic solvent extraction method AOAC 948.22 was employed to determine the total lipid content (Kaneko,1999)). The remaining portion of the sample (after all tests) is then weighed, and this weight is subtracted from the total initial weight (assumed to be 100) to determine the carbohydrate content (Method AOAC 996.11)

2.3 Sample Preparation for Microbial Analysis

Sterile techniques were employed to collect samples of bread, cake, laddu, and cream role, minimizing contamination. 10% (w/v) homogenate of each sample was prepared in sterile buffered peptone water using a stomacher blender for 2 minutes. This ensured a uniform distribution of microorganisms for subsequent analysis.

2.3.1 Total Aerobic Plate Count (APC)

The methods outlined in the U.S. Bacteriological Analytical Manual (Maturin, 2001) were used to determine APCs. Up to 10^{-5} serial dilutions were made using 0.1% peptone saline physiologic solutions. The dilutions were poured onto duplicate sterile Petri dishes in one-milliliter aliquot amounts. The inoculated Petri plates (12–15 mL/plate) were then plated with sterile plate count agar (Oxoid, Unipath, UK) that had been tempered to 40–45C. After that, the infected plates were quickly and evenly mixed by rotating them alternately and moving them back and forth on a level surface. For 24 hours, inverted inoculation plates were incubated at 35°C. The findings were expressed as cfu/g of the examined food samples.

2.3.2 Coliform Count

Membrane Filtration: A specific volume of the sample was filtered onto a sterile membrane filter. The filter was placed on a MacConkey agar plate and incubated at 44.5°C for 24 hours.

3. RESULTS AND DISCUSSION

Table 1: Composition Analysis of Cake, Bread, Laddu, and Cream Rolls (in %)

	Bread	Cake	Cream Roll	Laddu
		Carbohydrate		
Brand	23	17	15	21
Non-Brand	51.88	42.15	67.33	60.38
Difference	28.88	25.15	52.33	39.38

		Protein		
Brand	20	8.93	7.6	6.16
Non-Brand	10.21	8.15	6.8	5.66
Difference	9.79	0.78	0.8	0.5
		Fat		
Brand	4	37	38	37
Non-Brand	11.23	28.01	16.98	18.52
Difference	7.23	8.99	21.02	18.48
		Moisture		
Brand	35	30	40	20
Non-Brand	24.88	20.81	7.46	14.65
Difference	10.12	9.19	32.54	5.35
		Ash		
Brand	0.75	0.75	0.75	1.5
Non-Brand	0.91	0.75	0.81	0.66
Difference	0.16	0	0.06	0.84
		Salt		
Brand	1.5	0.75	0.3	0.5
Non-Brand	0.86	0.17	0.61	0.14
Difference	0.64	0.58	0.31	0.36

3.1 Carbohydrate Content Analysis

The carbohydrate content in non-branded food items significantly surpassed that of branded products across all four categories: bread, cake, cream roll, and laddu. **Fig2** illustrates the visual differentiation between the ingredients of branded and non-branded foods. The green bars represent branded items, while the red bars indicate non-branded items. The y-axis shows the percentage of carbohydrate content, ranging from 0 to 80, while the x-axis categorizes the food items being analyzed. This graph visually emphasizes the substantial difference in carbohydrate content between branded and non-branded products in all categories.

Starting with bread, there is a marked difference in carbohydrate content. Branded bread contains only **23%** carbohydrates, whereas non-branded bread shows a considerably higher carbohydrate content of **51.88%**. This results in a difference of **28.88%**, indicating that non-branded bread has more than double the carbohydrate content compared to branded bread. The substantial gap suggests that non-branded bread manufacturers using cheaper, carbohydrate-dense ingredients, are likely to reduce costs. Such a high carbohydrate content may indicate the inclusion of fillers, which could contribute to a lower nutritional quality of the product.

In the case of cakes, the trend is similar. Branded cakes contain a lower percentage of carbohydrates compared to their non-branded counterparts. The carbohydrate content in branded cake is around **20%**, while in non-branded cake, it is much higher at around **45%**, resulting in a difference of **25.15%**. This significant gap raises concerns regarding the quality of ingredients used in non-branded cakes. The higher carbohydrate levels may stem from excessive use of sugar, flour, or other inexpensive carbohydrate-based ingredients that may enhance flavor or volume at the cost of nutritional value.

Moving on to the cream roll category, the disparity becomes even more pronounced. Non-branded cream rolls exhibit a staggering carbohydrate content of approximately **70%**, compared to just **17.67%** in branded cream rolls. This represents the largest difference observed in the graph, with non-branded cream rolls containing **52.33%** more carbohydrates than branded ones. Such a vast difference suggests that non-branded versions of this product may rely heavily on carbohydrates as a primary ingredient, likely in the form of refined sugars or starches, which could diminish their overall nutritional value and lead to potential health concerns, such as elevated blood sugar levels or weight gain when consumed regularly.

Finally, for laddu, the carbohydrate content in branded and non-branded varieties also demonstrates a notable gap. Branded laddu contains approximately **30%** carbohydrates, while the non-branded version contains around **69.38%**. This results in a **39.38%** difference, again highlighting the significantly higher carbohydrate content in non-branded products. Given that laddu is traditionally a sweet dish, the excess carbohydrates in non-branded varieties may indicate the use of cheaper sugars or carbohydrate fillers, which can contribute to the product's weight and sweetness but may also lower its overall quality. This graph underscores a concerning trend where non-branded food items consistently have a much higher carbohydrate content compared to branded alternatives. The differences range from **25%** to over **50%**, suggesting that non-branded products may rely on lower-quality, carbohydrate-dense ingredients to reduce production costs or increase the volume of their products. This practice has negative implications for consumer health, particularly if these products are consumed regularly. Excessive carbohydrate intake, especially from low-quality sources, contributes to various health issues such as obesity, diabetes, and other metabolic disorders.

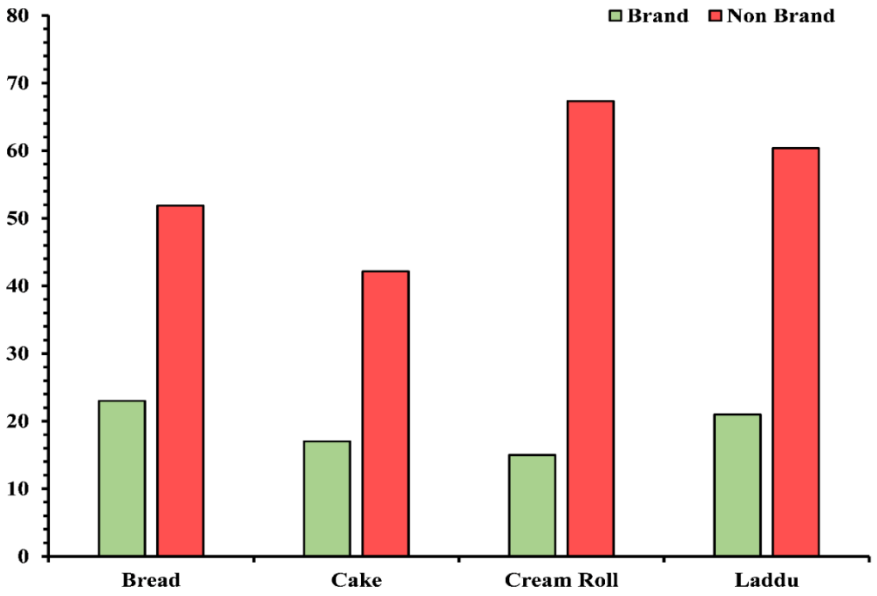

Fig2: Carbohydrate content branded and non-branded food

3.2 Protein Content Analysis

Protein content is a critical indicator of nutritional quality. Consumers are increasingly seeking ready-to-eat products that are rich in proteins and dietary fibers, as these nutrients offer substantial health benefits and contribute to a well-balanced diet (Aksenova, 2020; Alam 2016).

The analysis revealed that branded food items consistently offer higher protein levels compared to non-branded alternatives. **Fig3** effectively demonstrates the protein content differences between branded and non-branded foods. The bar graph displayed compares the protein content in branded and non-branded food items across four categories: bread, cake, cream roll, and laddu. As before, the green bars represent branded products, while the red bars indicate non-branded products. The y-axis measures the protein content as a percentage, ranging from 0 to 25, while the x-axis categorizes the four food items being analyzed. This graph highlights a trend opposite to the carbohydrate content comparison, showing that branded products consistently contain higher protein levels than non-branded alternatives across all categories.

Looking at bread, the branded variety has the highest protein content among the four categories, measuring around **21%**. In contrast, the non-branded bread only contains approximately **11%** protein. This difference of around **10%** indicates that branded bread products are likely made with higher-quality ingredients that contribute more protein to the final product. Non-branded bread, on the other hand, has more cost-effective, lower-protein ingredients, such as refined flour, resulting in a significantly reduced protein content. Given that bread is often a staple food, the higher protein content in branded bread suggests it might provide more nutritional value and better support a balanced diet.

In the case of cake, the protein content in both branded and non-branded items is closer in value, but a noticeable gap still exists. Branded cakes contain approximately **10%** protein, while non-branded cakes contain about **7%**. The **3%** difference, though smaller compared to bread, indicates that branded cakes tend to offer slightly more protein, which could be due to the inclusion of higher-quality ingredients such as eggs or milk proteins. Non-branded cakes, on the other hand, may substitute such ingredients with cheaper alternatives, leading to lower protein content. Since cake is generally considered a treat, this difference may not be as critical as with more frequently consumed products like bread.

Cream rolls follow a similar pattern, where branded items are shown to contain around **8%** protein, while non-branded versions contain slightly less at around **6%**. The **2%** difference, although small, suggests that branded cream rolls may offer a marginally higher nutritional value, which could be important for those looking for snacks with more protein. Given that cream rolls are typically consumed as a snack or dessert, this difference may reflect the quality of ingredients, with branded items potentially including better sources of protein, such as dairy or eggs, compared to non-branded items.

Finally, laddu, a traditional sweet, displays the smallest difference in protein content between branded and non-branded products. Branded laddu contains about **7%** protein, while non-branded laddu contains slightly less at **5%**. The **2%** difference indicates that branded laddu is likely made with slightly higher-quality ingredients, possibly including more nuts, pulses, or dairy products, which are common protein sources in traditional sweets. The non-branded version may rely more on carbohydrate-based fillers, which, as observed in the previous graph, would increase carbohydrate content at the expense of protein.

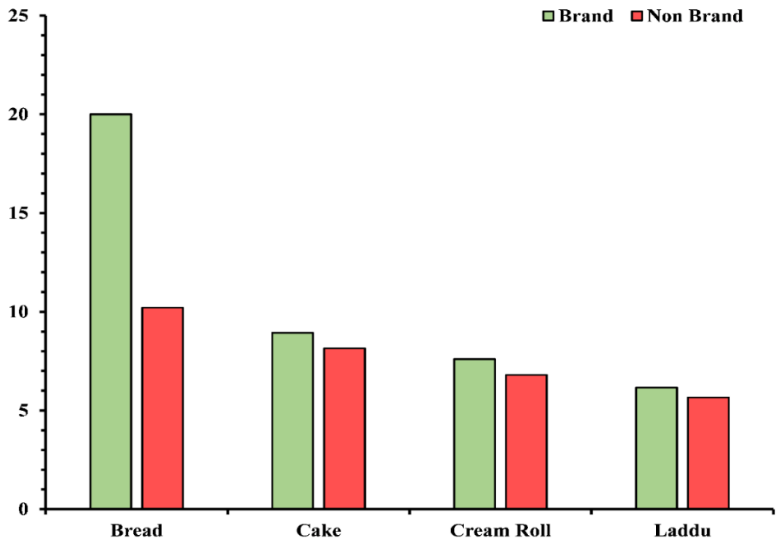

Fig3: Protein content branded and non-branded food

This graph reveals that branded food items across all categories: bread, cake, cream roll, and laddu, consistently contain higher protein levels than their non-branded counterparts. The differences in protein content range from **2%** to **10%**, with bread showing the most significant gap. These disparities suggest that branded products generally use higher-quality ingredients, contributing to their elevated protein content. In contrast, non-branded products, while more affordable, tend to have lower protein content, likely due to the use of cheaper, less nutritious ingredients. Protein is an essential nutrient, important for muscle repair, growth, and overall health, and these differences could play a role in consumer choices, particularly for those seeking more nutritious options in their daily diet. This data underscores the superior nutritional value of branded foods, which are likely produced with higher-quality ingredients and more rigorous quality control standards.

3.3 Fat Content Analysis

The fat content analysis revealed a mixed but concerning trend where non-branded foods either match or exceed the fat content of branded foods. **Fig4** highlights the differences in protein content between branded and non-branded foods. The bar graph provided presents a comparative analysis of fat content in branded versus non-branded food items across four categories: bread, cake, cream roll, and laddu. The bars represent the percentage of fat content in each type of product, with green bars indicating branded foods and red bars representing non-branded foods. The distinction between the two types of products allows for an in-depth look into how branding correlates with fat content, which is often associated with quality, ingredient sourcing, and manufacturing practices.

Bread shows a significant difference in fat content between branded and non-branded varieties. The fat content in non-branded bread is notably higher, with the red bar towering above the green one. The non-branded bread has a fat content of about **11%**, while the branded counterpart contains only around **4%**. This **7%** difference is a striking indicator that non-branded bread includes additional or lower-quality fats, which affects not only the nutritional value but also the overall quality and shelf life of the product.

In the case of cake, the trend reverses. Branded cake shows a considerably higher fat content compared to non-branded cake. The branded sample contains around **38%** fat, while non-

branded versions have approximately **29%**, showing a difference of **9%**. This suggests that branded cakes may be richer, likely made with higher-quality ingredients such as butter or cream, which contribute to the increased fat content. On the other hand, non-branded cakes could be made with cheaper alternatives or with reduced fat to cut costs, possibly at the expense of taste and texture.

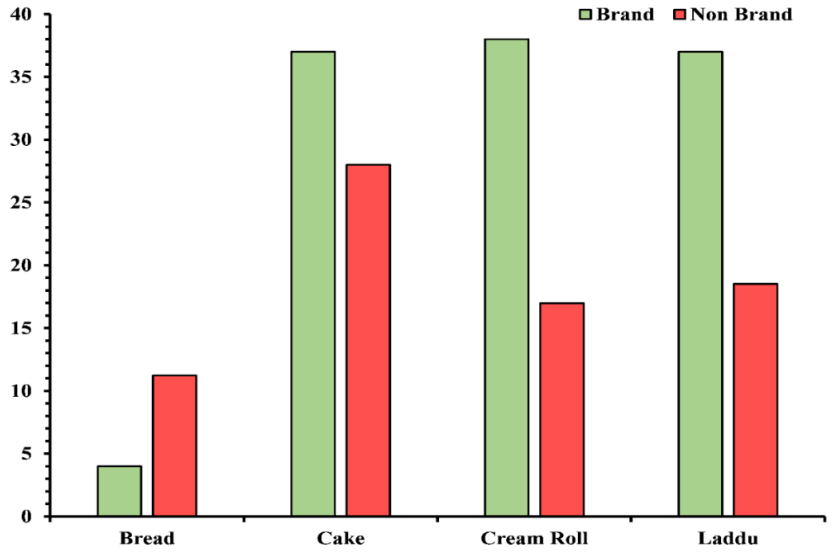

Fig4: Fat content branded and non-branded food

Moving on to cream rolls, the difference in fat content between branded and non-branded items is even more pronounced. The branded cream roll, represented by a high green bar, contains significantly more fat than its non-branded counterpart. This **21%** difference in fat content suggests that branded cream rolls may use richer fillings or coatings, which are typically associated with higher fat content. The lower fat content in non-branded cream rolls could indicate the use of more cost-effective or lower-quality fats, which might affect both the flavor and the mouthfeel of the product.

Lastly, the category of laddu provides an interesting case where the non-branded version contains more fat than the branded one. The red bar for non-branded laddu is taller than the green bar, reflecting a higher fat content in non-branded versions. The branded version contains **36%** fat, while the non-branded version has **32%**, indicating a difference of **4%**. This slight difference could point toward inconsistencies in the production quality of non-branded products, as they vary more significantly in terms of ingredients and manufacturing processes. Branded laddus, though containing slightly less fat, they subject to stricter quality controls and standardized recipes, leading to more consistent nutritional content.

Overall, the graph highlights a mixed pattern in the fat content of branded versus non-branded food items. While non-branded bread and laddu contain more fat than their branded counterparts, branded cake, and cream rolls are significantly higher in fat content. This inconsistency points to potential differences in manufacturing practices, ingredient sourcing, and the use of fats between branded and non-branded products. Branded products tend to maintain a level of consistency, likely due to established quality control measures, while non-branded products may vary more widely in fat content, indicating less uniformity in production.

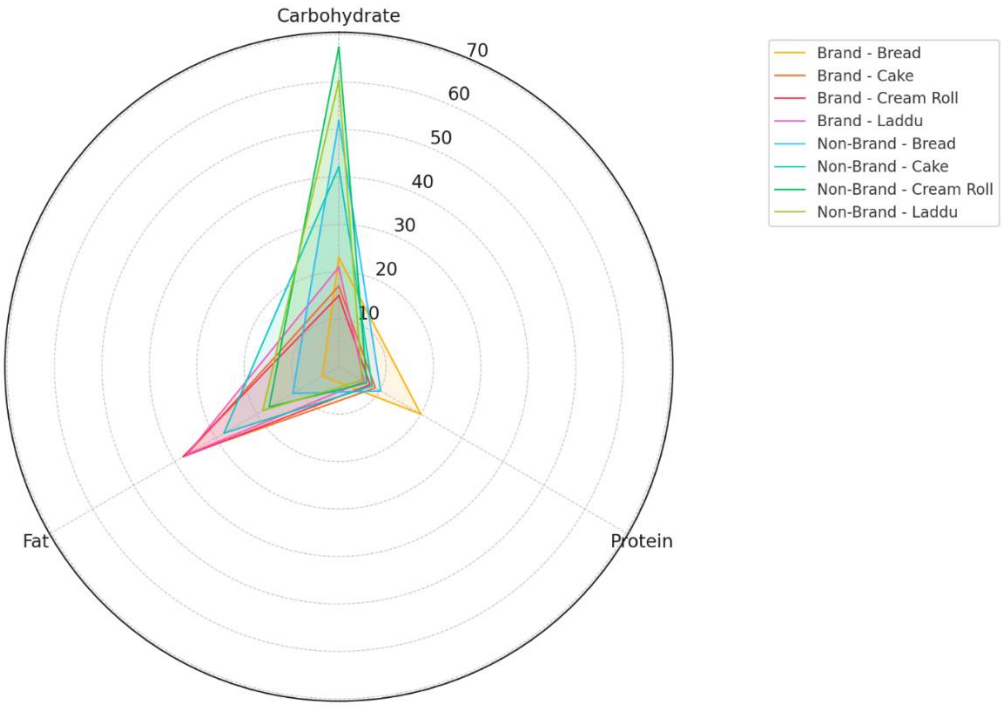

Fig5: Nutritional Comparison of Brand and Non-Brand Food Items

Fig 5 presents a radar chart that compares the nutritional content between brand and non-brand products. The chart reveals that non-brand products generally have a much higher carbohydrate content across all food items, with cream rolls and laddu showing particularly large differences. Brand products consistently offer higher protein levels, most notably in bread, where the brand version contains nearly double the protein of the non-brand alternative. Fat content varies more between the two categories, with brand products showing higher fat content in cake and cream rolls, whereas non-brand products have slightly higher fat levels in bread and laddu.

3.4 Moisture content analysis:

A comparison of the moisture content of branded and non-branded bread, cakes, cream rolls, and laddus is shown in **Fig 6**. One important aspect affecting food products' texture, shelf life, and sensory appeal is their moisture level.

The moisture level of branded bread was almost 35%, whereas that of non-branded bread was 24.88%. This discrepancy implies that branded bread probably makes use of better hydration methods and regulated baking procedures. According to earlier research on bakery products, a higher moisture content promotes softness and freshness, both of which are necessary for consumer acceptability (Kaneko et al., 1999).

When it came to cake, branded products had about 30% moisture content, whereas non-branded versions had 20.81%. Non-branded cakes may have less moisture because of cost-cutting strategies or inferior ingredient quality, which could alter the texture and flavor of the final product.

The biggest difference was shown in the cream rolls, where branded goods had 40% moisture content while non-branded goods only had 7.46%. This significant difference emphasizes how branded products have better formulation and filling quality, which guarantees moisture retention and improves sensory appeal. These variations are in line with research on processed foods, which shows that branded products put quality control first in order to satisfy customers (Van Kampen et al., 1998).

The moisture content of branded laddus was slightly greater (20%) than that of non-branded ones (14.65%). Although branded laddus may include extra precautions to preserve freshness and texture, the smaller variation indicates that the ingredients used in both versions are similar.

Across all categories, the statistic shows that branded products regularly have higher moisture content. This is attributable to improved quality control, ingredient optimization, and sophisticated manufacturing techniques. Increased moisture content in branded products improves texture and freshness, increasing consumer appeal. Conversely, lower-moisture, non-branded products could put affordability ahead of quality. According to Nichols et al. (1999), these results are consistent with past studies on the chemical and sensory distinctions between branded and non-branded foods.

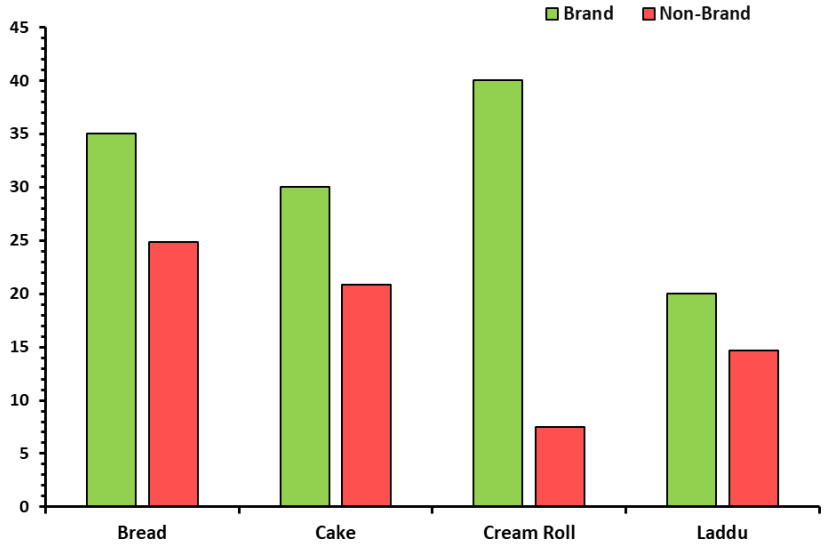

Fig6: Moisture content branded and non-branded food

3.5 Ash content analysis:

The **Fig7** shows a comparison of the amount of ash in bread, cakes, cream rolls, and laddus that are branded and those that are not. The ash percentage of non-branded bread was 0.91%, which was marginally greater than that of branded bread (0.75%). This discrepancy can suggest that unbranded products were contaminated during production or contained raw materials. Conversely, branded bread's decreased ash content indicates improved refining and quality control procedures.

The ash percentage (0.75%) of both branded and non-branded cakes was comparable, suggesting consistency in the makeup of the ingredients and production methods. This resemblance implies that cake production standards, which emphasize uniform recipes and quality, can be the same for both branded and non-branded businesses.

Cream roll ash content varied very little, with branded items having 0.75% and non-branded products having 0.81%. The slight variation suggests that the two categories' ingredient selection is similar, suggesting that cream rolls from different brands are produced using equivalent raw ingredients and processing techniques.

The biggest disparity was seen in Laddus, where branded goods had a far greater ash level (1.5%) than non-branded ones (0.66%). The presence of nutrient-dense components such as almonds, clarified butter, and other additives rich in minerals is suggested by the higher ash content seen in branded laddus. These variations highlight the higher caliber and nutritious content of branded laddus, which could satisfy consumer desire for high-end traditional sweets.

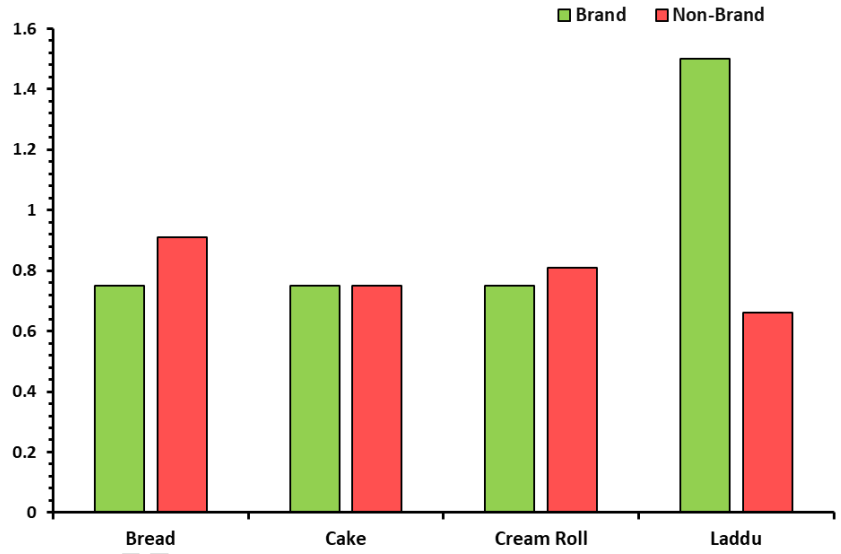

Fig7: Ash content branded and non-branded food

3.6 Salt content analysis:

The salt content of branded and non-branded bread, cakes, cream rolls, and laddus is compared in **Fig8**. Salt has a significant impact on food products' flavor, shelf life, and general quality in addition to the health of the customer.

The salt level of branded bread is 1.5%, whereas that of non-branded bread is 0.86%, which is somewhat less. Branded bread's higher salt content points to a more carefully regulated recipe that may put taste and preservation first, which could improve the customer experience because salt is essential for both flavor and shelf life (Jay, 1996).

The salt content of branded cake is 0.75%, while that of non-branded cake is 0.17%. This substantial difference would suggest that non-branded cakes use less salt to cut expenses or

achieve a distinct flavor character. There may be a trade-off between price and quality because non-branded cakes' lower salt content may affect their overall flavor and preservation capabilities (Van Kampen et al., 1998).

In cream rolls, branded items have a significantly lower salt level (0.3%) than non-branded products (0.61%). As is typical in less regulated product categories, this implies that non-branded cream rolls might employ extra salt to make up for flavor or preservative variations.

The biggest difference is seen in laddus, where branded laddus have 0.5% salt and non-branded laddus only have 0.14%. This significant difference would indicate that the branded laddus have a more balanced flavor profile, with the extra salt serving as a preservation and flavor enhancer. Overall, studies comparing branded and private-label snacks found that both categories often exceed WHO sodium benchmarks, but private labels tend to be less expensive and more accessible for lower-income consumers (McCann et al., 2023).

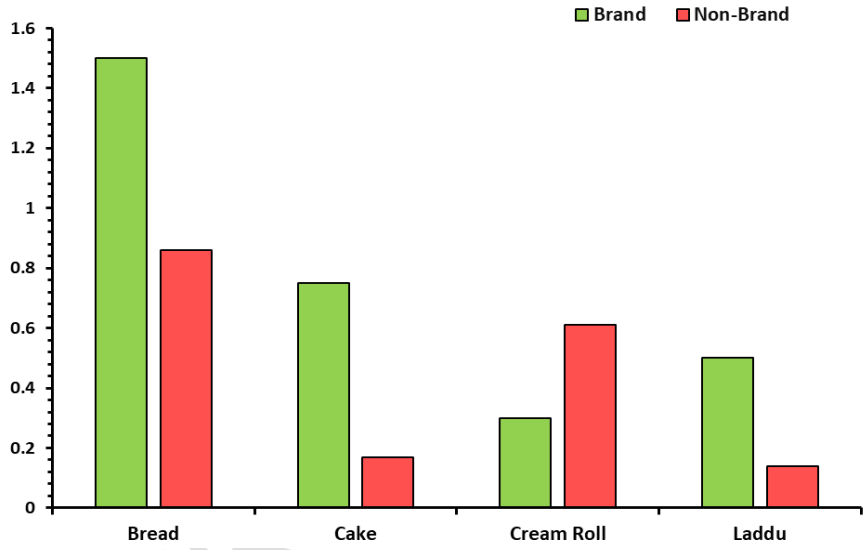

Fig8: Salt content branded and non-branded food

3.7 Microbial Analysis

Ready-to-eat (RTE) food items; for instance, snacks we have chosen as our samples only need to be reheated or cooked through; or no additional preparation is necessary (FEHD 2001; FSAI 2001). While many studies in more developed nations have examined the microbial quality of many ready-to-eat foods (Van Kampen et al. 1998; Kaneko et al. 1999; Nichols et al. 1999), little is known about the safety and microbial quality of these food products in Bangladesh.

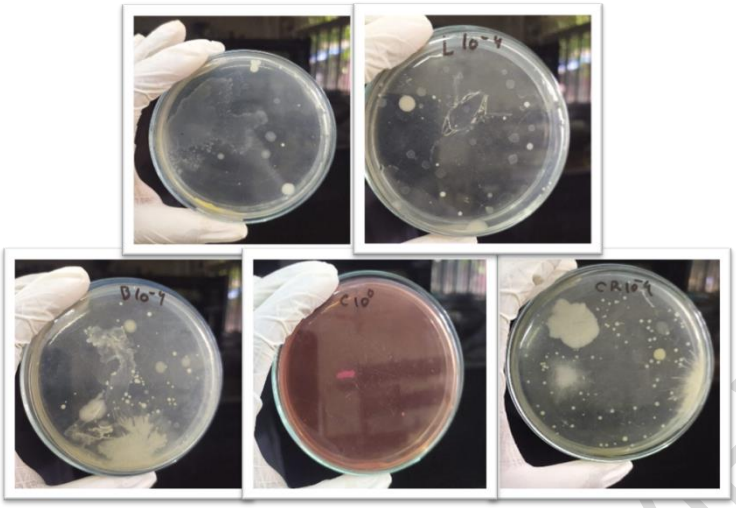

Fig9: Microbial growth on agar plates at various dilutions from cake, laddu, bread, and cream roll samples

Table 2: Microbial analysis for cake, bread, laddu, and cream rolls (PCA & MacConkey Agar)

S/N	Food Types	No of the samples examined	Total Aerobic Plate Count (CFU/g)	Coliform Count (CFU/g)
1	Bread	5	37×10^6	-
2	Cake	5	2.1×10^6	1×10^2
3	Laddu	5	18.75×10^6	-
4	Cream roll	5	8.1×10^6	-

The results of the microbiological analysis of non-branded and locally sold bread, cake, laddu, and cream rolls revealed that all the sampled products exceeded the recommended safety threshold for total plate count. The standard for acceptable TPC for Ready to Eat (RTE) food items is ≤ 10^5 colony-forming units per gram (cfu/g), which is typically used to ensure food safety and hygiene during production and handling (Solberg et al. 1990; Shapton 1991; Jay 1996). However, the TPC values in the sampled products ranged from 2.1×10^6 cfu/g to 37×10^6 cfu/g, indicating significant microbial contamination. Additionally, the cake sample showed growth in the MacConkey medium indicating the potentiality of harboring pathogenic bacterial species.

4. CONCLUSION

The comparative analysis of branded and non-branded food items sold near the BSMRSTU campus revealed significant disparities in macronutrient content. Non-branded foods generally exhibited lower nutritional quality, particularly in terms of carbohydrate and protein content.

Overall, the study emphasizes the nutritional differences between branded and non-branded food items, highlighting the health risks associated with the consumption of non-branded products. The higher carbohydrate levels in non-branded foods, coupled with lower protein content, and sub-optimum microbial quality underscore the need for greater consumer awareness and stricter regulatory measures to ensure the safety and quality of non-branded food items. Therefore, consumers are advised to prioritize branded food items, especially

those seeking healthier and more balanced nutrition. This study underscores the importance of informed food choices and the need for stricter regulations and quality control for non-branded food products to ensure public health and safety.

CONSENT

The specific food brand names for the samples used in this study have been withheld and are included solely for comparative purposes.

ETHICAL APPROVAL

The authors confirm that this study does not involve human samples or animal experiments.

Disclaimer (Artificial intelligence)

Authors hereby declare that no generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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