

## A STUDY OF LABELING OF RAJASTHANI FOOD PRODUCTS AND ENLIGHTENMENT ON THE NUTRITIONAL QUALITY OF PRIVATE-LABEL AND BRANDED FOOD PRODUCTS SOLD IN BHILWARA CITY

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### ABSTRACT

*Packaged foods sold in food stores can be "private-label" products, are branded by supermarkets, and they become "branded" products. Private-label products are generally cheaper than branded counterparts, and this is perceived by consumers as a sign of general lower quality when these private-label items are compared with their branded counterparts. Thus, the aim of the present study was to shed light on the labeling of Rajasthani food products and the nutritional quality of private-label and branded food products sold in Bhilwara city. The main objective of this paper is to evaluate the nutritional declarations reported on food packs of products on home-shopping websites by major retailers present in the Rajasthani food products market. A total of 3,775 items (~58% branded and ~42% private-label) collected over the period July 2018 to March 2019 and updated in March 2020 were included in the final analysis. Data were analyzed by means of the Mann–Whitney non-parametric test, for two independent samples, for differences between branded and private-label categories and types. Overall, branded products showed higher content of total and saturated than private-label items. When products were grouped for categories and types, the items differed only for the content of total fat, saturated, total carbohydrate, protein and salt. Instead no difference was found for energy and sugar content in either category. However, we did not find any consistency and significant in the direction of the results. These results may be useful for future education activities aimed at helping consumers make informed food choices.*

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**Keywords:** *Rajasthani Food Products, Nutrition Declaration, Private Label, Food Labeling, Brand, Nutrition and Health Claims.*

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### Introduction

Food labels are one of the main tools used by industries to convey information about their products. Among the various information reported on food packs, mainly the brand name or logo is certainly one of the main aspects, which prominently attracts the customer's interest at the time of purchase, also associates the product with positive emotions, and may in turn influence purchase behavior and consumption.

With regard to brands, over the past decades, two forms of products have been proposed for customers: "private-label" (PL) and "branded products" (BR). The first form describes all food categories of packaged foods that are typically produced by small-medium food companies, but are branded by supermarkets and sold exclusively in the supermarket's own stores. These products, also known as "own labels", are considered a competitive alternative to so-called "branded products", which are produced by national and international food manufacturers and labeled with their own brand. and are distributed in general trade.

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Private-label products continue to gain market share despite some signs of decline in "branded products" over the years. However, they are not evenly distributed around the world, being more widespread in Rajasthan, Gujarat and less penetrating into Madhya Pradesh. Large variability also exists in terms of penetration for different categories of food products. For certain categories that require a high level of confidence (eg, baby food), consumers actually show a higher attitude for branded than for private-label. In Bhilwara, the share price for private-label products is reported to be ~20%, with a few more performing categories, such as eggs and frozen vegetables, and other low-value portions such as biscuits, pasta and snacks. The balance between branded and private-label products in the market represents an important task. In fact, on the one hand, branded food companies drive traffic and product diversity and are more engaged in innovation processes, while private-label products are necessary to enhance the retailer's value image and profitability, and at the same time, be Can be used by consumers as a means of saving money. Private-label products were actually developed to emulate traditional national brands and their success was based on price, as they were always considered a cheaper alternative than branded ones. In fact, a Gujarat study compared the cost of branded food products with their private-label counterparts across a range of food categories, reporting 44% cost savings by buying private-label over branded products. It cannot be denied that, in most past years, the association between the absence of a known brand and a lower price led to the perception of private-labels as products of lower nutritional quality than branded goods.

Few studies have been conducted in Rajasthan examining potential differences between private-label and branded products in terms of nutritional quality, focusing on specific food components such as sodium, or considering a wider range of nutrients. However, to the best of our knowledge, there have been no studies comparing the nutritional quality of branded and private-label Rajasthani food products on the market, as well as looking at the prevalence of nutrition and health claims (NHC).

Based on these premises, the present study aims to study the labeling of Rajasthani food products and insights on the nutritional quality of private-label and branded food products sold in Bhilwara city. This work is part of Food Labeling of Rajasthani Products, which is envisaged to systematically evaluate and clarify the nutritional quality of various food categories sold in the Rajasthani food products market. Whether those specific information pertains to the pack of food, they can be considered a marker of overall nutritional quality.

## **Materials and Methods**

### **Food Product Selection and Data Collection**

For information on home-shopping websites of major retailers present in Rajasthani Food Products Market (Dal BatiChurma - Traditional Food of Rajasthan, Mohan Thal, Lal Mas, MawaKachori, MirchiBada, Mohan Mas, Kalakand, Onion Kachori etc.) Searched online. In which we have included all pre-packaged food products, as stated in Council Regulation (EC) no. Mandatory food information will appear directly on the package or on the label attached to it.

The exclusion criteria for product selection were as follows:

- Food products should not be pre-packaged,
- Food product packs should not contain incomplete images of all sides,
- the nutrition declaration or ingredients list must not contain vague images, and
- All online stores selected during the data collection period should not have products marked as "Products currently unavailable".

The online research was done from July 2018 to March 2019 and was updated on March 2020.

### **Data Repository**

Data was collected from complete images of all sides of the pack for all selected products. As described previously, the following qualitative-quantitative and specifically regulated (mandatory) information was retrieved for each food item: company name, brand name, descriptive name, energy (kcal/100 g), total fat (g/100 g), saturated fatty acids (saturated fatty acids, g/100 g), total carbohydrates (g/100 g), sugars (g/100 g), protein (g/100 g), and salt (g /100 grams). In addition, numbers of few nutritional claims (NC) and few health claims (HC) also include, as listed in the Council Regulation (EC), were collected.

The data was extracted just once, but the accuracy of the extracted data was double-checked by two researchers (DAVV, RAJASTHAN UNIVERSITY), and inaccuracies were resolved through secondary findings made by the third researcher.

A compact dataset was created with all the collected data. And the items were subgrouped for specific comparison by considering all the descriptive name stated on the pack and brand.

On the basis of brand, the food items were classified as following:

- private label food articles for branded products by the supermarkets of Bhilwara and
- Branded food articles and labels with their own brand for the food items produced by the food manufacturers of Bhilwara.

Based on the descriptive name, foods were divided into the following categories and into related types, as previously described:

- breakfast (muesli, flax, bran cereal, puffed cereal, and others),
- biscuits (tea cookies, shortbread biscuits, cream-filled wafer biscuits, covered biscuits and/or sandwich cookies biscuits, Rajasthani traditional biscuits, and other biscuits),
- Cakes and sweet snacks (cream-filled sponge cake, plain or cream/jam-filled croissant or "pain or chocolate," yogurt plumcakes and muffins, sponge cakes, cream/jam-filled shortbread cakes, cream-filled and/ or covered cold snack),
- Bread (bread, rolls and sliced bread),
- Bread substitutes (crackers, breadsticks, rusks, wraps, "croutons, bruschetta, and frisella bread," and taralli, rice and corn cakes),
- fresh pasta (stuffed pasta, semolina, egg), and
- Dry pasta (semolina, special pasta, egg, stuffed).

### Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics® (version 26.0, IBM Corp., Chicago, IL, USA) and was performed at  $p < 0.05$  of the significance level. The normality of the data distribution was first verified by means of the Kolmogorov–Smirnov test and rejected. Therefore, variables were expressed as the median and the interquartile range. Energy and nutrient content per 100 g of products were analyzed for each item by means of the Mann–Whitney non-parametric test for two independent samples to account for differences between branded and private-label categories and types. Comparisons between product types for each category were shown graphically using Origin software (Origin Pro 2019, OriginLab Corp., Northampton, MA).

### Results

- **Number and Characteristics of Retrieved Food Items**

**Table 1: Number and types of Private-Label (PL) and Branded (BR) Items**

Category	Brand	Number of items	Description
Breakfast cereals (n = 370)	PL	176	Cereal bars (n = 15), muesli (n = 26), flakes (n = 81), bran cereals (n = 6), puffed cereals(n = 16), and others (n = 32)
	BR	194	Cereal bars (n = 62), muesli (n = 28), flakes (n = 48), bran cereals (n = 8), puffed cereals(n = 13), and others (n = 35)
Biscuits (n = 814)	PL	310	Tea cookies (n = 69), shortbread biscuits (n = 173), cream-filled wafer (n = 32), covered and/or sandwich cookies (n = 14), Rajasthani traditional biscuits (n = 17), and others (n = 5)
	BR	504	Tea cookies (n = 184), shortbread biscuits (n = 184), cream-filled wafer (n = 44), covered and/or sandwich cookies (n = 64), Rajasthani traditional biscuits (n = 17), and others (n = 11)

Sweet snacks (n = 476)	PL	227	Cream-filled sponge cake (n = 11), plain or cream/jam-filled croissant or "pain au chocolat"(n = 76), yogurt plumcake and muffin (n = 83), sponge cake (n = 36), cream/jam-filled shortbread cake (n = 21), cream-filled and/or covered chilled snack (n = 0)
	BR	249	Cream-filled sponge cake (n = 40), plain or cream/jam-filled croissant or "pain au chocolat"(n = 74), yogurt plum cake and muffin (n = 66), sponge cake (n = 53), cream/jam-filled short bread cake (n = 10), cream-filled and/or covered chilled snack (n = 6)
Bread (n = 339)	PL	141	Loaf (n = 34), rolls (n = 26), and sliced bread (n = 81)
	BR	198	Loaf (n = 67), rolls (n = 44), and sliced bread (n = 87)
Bread substitutes (n = 1,020)	PL	424	Rusks (n = 48), wraps (n = 65), rice and corn cakes (n = 60), crackers (n = 93), breadsticks (n = 71), "croutons, bruschetta, and frisella bread" (n = 49), and taralli (n = 38)
	BR	596	Rusks (n = 69), wraps (n = 81), rice and corn cakes (n = 114), crackers (n = 93), breadsticks (n = 126), "croutons, bruschetta, and frisella bread" (n = 51), and taralli (n = 62)
Fresh pasta (n = 269)	PL	131	Semolina (n = 14), egg (n = 21), stuffed pasta (n = 96)
	BR	138	Semolina (n = 2), egg (n = 24), stuffed pasta (n = 112)
Dried pasta (n = 487)	PL	173	Semolina (n = 68), egg (n = 71), stuffed (n = 1), special pasta (n = 33)
	BR	314	Semolina (n = 89), egg (n = 135), stuffed (n = 4), special pasta (n = 86)
Total	PL	1582	
	BR	2193	

Table 1 reports the number and type of items retrieved with a total of 3,775 items included in the final assessment, of which ~58% were branded and ~42% were private-label products. The largest number of food categories were bread substitutes with over 1,000 items and biscuit substitutes with 814 items. The least number of categories were bread with 339 items and fresh pasta with 269 items. For all categories, the number of branded items was higher than that of privately-labeled ones, with up to two-thirds of the total for most biscuits and dried pasta. With regard to the NHC, the number of products with at least one nutritional claim or health claim was significantly higher in private-label items than in branded products, except for fresh pasta, in which private-label prevailed over branded (n = 2 and 1, respectively) (Supplementary Table 1).

• **Nutritional Quality of Branded and Private-Label Food Categories and Types**

**Table 2: Comparison of the Nutritional Quality of Branded and Private-Label Cereal-based Items**

Category	Brand	Energy (kcal/100 g)	Total fat (g/100 g)	saturate d fatty acids (g/100 g)	Total carbohydr ates (g/100 g)	Sugars (g/100 g)	Protein (g/100 g)	Salt (g/100 g)
All items	PL	393	9.6	1.9	65.0	4.8	8.5	0.7
	BR	395	10.1	2.0	64.5	4.7	8.6	0.7
	P- VALUE	0.128	0.025	0.025	0.072	0.701	0.149	0.052
Breakfast cereals	PL	384	3.9	1.0	76.0	19.0	8.0	0.5
	BR	388	7.4	1.9	65.2	20.4	8.6	0.5
	P- VALUE	0.119	<0.001	<0.001	<0.001	0.455	0.027	0.176
Biscuits	PL	473	18.8	5.1	66.9	23.1	7.3	0.5
	BR	470	18.7	6.0	66.0	24.7	7.3	0.6
	P- VALUE	0.893	0.363	0.065	0.061	0.349	0.785	0.004

Sweet snacks	PL	407	17.1	6.5	54.0	28.0	6.5	0.6
	BR	408	19.0	7.6	52.0	28.3	6.1	0.5
	P- VALUE	0.774	0.046	0.006	<0.001	0.501	0.062	<0.001
Bread	PL	276	4.6	0.7	48.0	4.6	8.5	1.3
	BR	271	4.3	0.7	47.3	4.4	8.5	1.3
	P- VALUE	0.226	0.580	0.432	0.256	0.472	0.068	0.079
Bread substitutes	PL	412	9.6	1.5	68.9	2.0	10.0	1.8
	BR	410	9.6	1.6	67.5	2.0	10.0	1.7
	P- VALUE	0.542	0.627	0.393	0.301	0.523	0.055	0.304
Fresh pasta	PL	279	6.5	2.6	41.0	2.2	11.0	0.9
	BR	281	8.0	2.9	39.0	2.5	9.9	1.2
	P- VALUE	0.937	0.002	0.148	0.050	0.430	<0.001	0.014
Dried pasta	PL	359	2.0	0.5	68.0	2.8	13.0	0.0
	BR	359	2.8	0.8	68.0	2.8	14.0	0.1
	P- VALUE	0.379	<0.001	0.047	0.010	0.613	<0.001	0.004

Values are expressed as the median (25th–75th percentile). Different lowercase letters indicate significant differences between private-level and branded items belonging to the same category  $p < 0.05$ . (Mann–Whitney non-parametric test for two independent samples)

Values for energy, macronutrients and salt content of the branded and private-label food categories in Bhilwara are summarized in Table 2. Taking into account all 3,775 food items, branded and private-label items were statistically different only for total fat and saturated fatty acid content. Those that were higher in the former [total adiposity: 10.1 (4.2–18.0) versus 9.6 (4.1–17.0) g/100 g,  $p = 0.025$ ; Saturated fatty acids: 2.0 (0.9–5.2) versus 1.9 (0.1–4.8) g/100 g,  $p = 0.025$ , in branded and private-label, respectively].

With respect to the seven categories in the branded and private-label food categories in Bhilwara, overall, no significant differences were found for energy content in either category, while only small significant differences were observed in specific nutrient content for some products. More specifically, higher total fat and saturated fatty acid content were observed in branded food products compared to private-label products for breakfast [total fat: 7.4 (2.9–15.0) versus 3.9 (1.7–7.5) g/100 g],  $p < 0.001$ ; Saturated fatty acids: 1.9 (0.7–4.1) vs 1.0 (0.4–3.0) g/100 g,  $p < 0.001$ , in branded and private-label, respectively], sweetened snacks in branded and private-label food categories in Bhilwara [total fat: 19.0 (16.0–22.0) versus 17.1 (15.0–21.0) g/100 g,  $p = 0.046$ ; Saturated fatty acids: 7.6 (4.1–10.4) versus 6.5 (3.7–9.4) g/100 g,  $p = 0.006$ ], and dry pasta in branded and private-label food categories in Bhilwara [total fat: 2.8 (1.7–4.2) vs. 2.0 (1.4–3.8) g/100 g,  $p < 0.001$ ; Saturated fatty acids: 0.8 (0.4–1.3) versus 0.5 (0.3–1.2) g/100 g,  $p = 0.047$ , in branded and private-label, respectively], while in Bhilwara in the branded and private-label food categories, branded and private-labeled fresh pasta differed for total fat [8.0 (5.5–10.0) versus 6.5 (3.8–8.4) g/100 g,  $p = 0.002$ ] but not for saturated fatty acids.

With regard to total carbohydrates in the branded and private-label food categories in Bhilwara, branded products saw a lower content for breakfast than their private-label counterparts [65.2 (57.0–75.0) vs 76.0 (64.8–81.0) g/100 g,  $p < 0.001$ , for branded and private-label, respectively], sweetened snacks [52.0 (49.0–56.6) versus 54.0 (51.0–58.0) g/100 g,  $p < 0.001$ ], and dried pasta [68.0 (66.0)–71.0] vs 68.0 (67.0–71.5) g/100 g,  $p = 0.010$ , for branded and private-label, respectively], Whereas in Bhilwara no difference was found for sugar content in any of the food categories under study in the branded and private-label food categories.

The opposite results were observed for protein with a higher content of branded breakfast [8.6 (7.3–11.0) vs 8.0 (7.0–9.5) g/100 g,  $p = 0.027$ ] and dried pasta [14.0 (12.5–15.0) vs. , 13.0 (12.0–14.0) g/100 g,  $p < 0.001$ , for branded and private-label, respectively] compared to private-label counterparts, whereas branded products were found to have lower protein content than private-label fresh pasta [9.9 (8.7–11.0) vs 11.0 (9.3–13.0) g/100 g,  $p < 0.001$ ]. Similarly, higher salt content was observed in branded than in private-label biscuits [0.6 (0.4–0.8) vs 0.5 (0.3–0.7) g/100 g,  $p = 0.004$ ], fresh pasta [1.2 (0.7–1.4)] vs 0.9 (0.3–1.3) g/100 g,  $p = 0.004$ ], and dried pasta [0.1 (0.0–0.1) vs 0.0 (0.0–0.1) g/100 g,  $p = 0.014$ ], while lower content in branded products observed for sweet snacks [0.5 (0.4–0.6) vs 0.6 (0.5–0.7) g/100 g,  $p < 0.001$ ]. Thus, no consistency was observed in the direction of results, with some favorable results between private-label products and other branded products in the branded and private-label food categories in Bhilwara.

These results are further confirmed by comparing the nutritional quality of private-label and branded types of products within each category across the branded and private-label food categories in Bhilwara. Branded and private-label food categories in Bhilwara Some differences for energy and nutrients between certain types of private-label and branded products in all seven considered food categories actually emerged despite some contrasting results even within the same category.

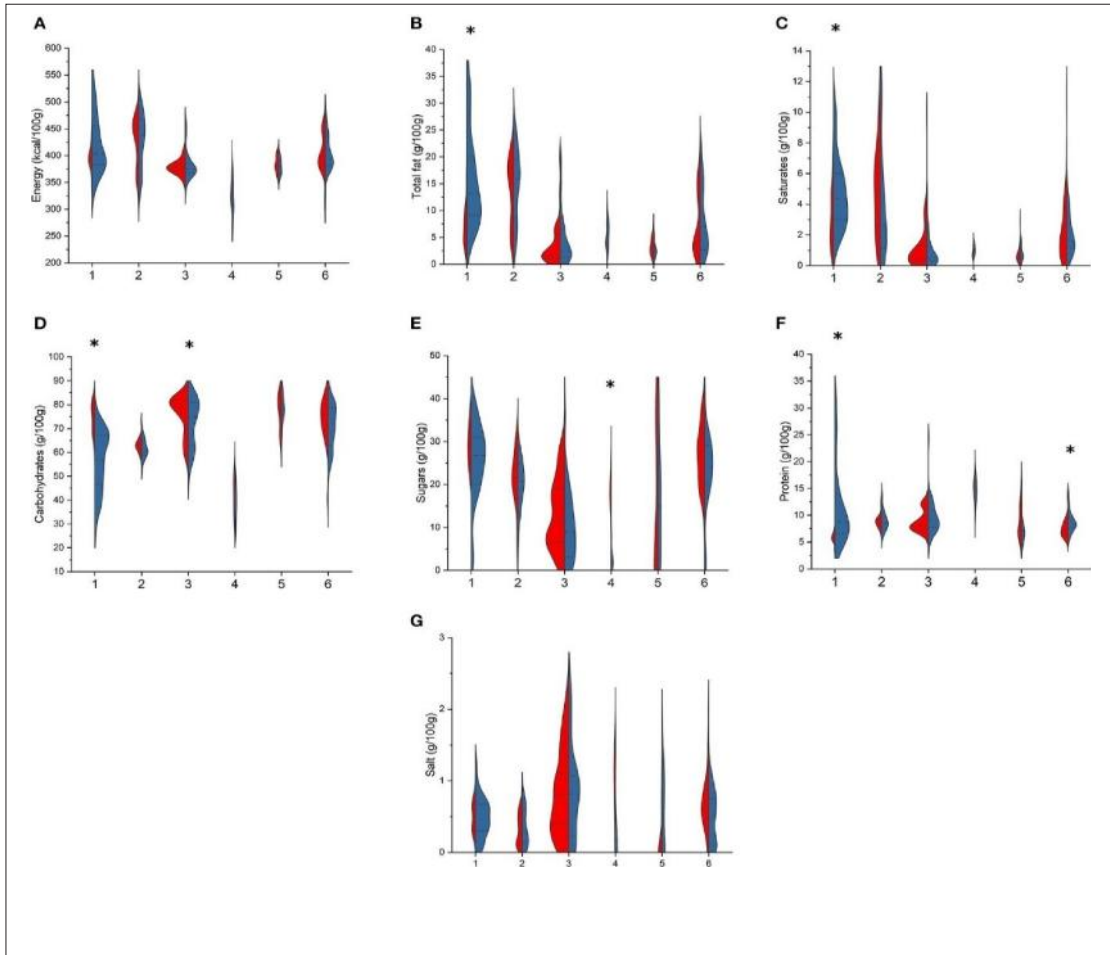


Figure 1. Comparison of Energy (A), Total Fat (B), Saturated (C), Total Carbohydrate (D), Sugar (E), Protein (F), and Salt (G) in Each of the Food Categories in Bhilwara Ingredients in branded (BR, in blue) and private-label (PL, in red) types of breakfast cereals. 1: Cereal Bar; 2: Muesli; 3: flakes; 4: bran cereals; 5: puffed grain; 6: Other cereals. For each type of food categories in Bhilwara, asterisk indicates significant difference between branded and private-label items (Mann–Whitney non-parametric test for two independent samples),  $P < 0.05$ .

In Bhilwara across each type of food categories breakfast (Figure 1), meal bars showed a statistically significant difference between branded and private-label items, with total fat [13.3 (9.2–20.0) versus 7.0 (3.8)–9.0) g/100 g,  $p < 0.001$ ], saturated [4.4 (3.0–6.0) vs 2.5 (1.7–4.7) g/100 g,  $p < 0.009$ ], and protein [6.0 (5.0–7.7) vs 4.1 (2.8–7) g/100 g,  $p < 0.001$ ]. Total carbohydrates were lower in branded flakes compared to private label ones [74.8 (63.0–81.0) versus 79.0 (72.0–82.0) g/100 g,  $p = 0.040$ ] in each of the food categories in Bhilwara, whereas each type in Bhilwara The sugar content in bran cereals was significantly lower in the food categories of In the branded item [2.1 (1.2–3.4) vs 17.5 (17.0–18.0) g/100 g,  $p = 0.013$ , respectively], and in other cereals, protein was higher in the branded than in the private-label item [6.4 (4.0) - 8.1) vs 5.1 (3.0–7.0) g/100 g,  $p = 0.016$ ]. Energy and salt content did not differ for either type.

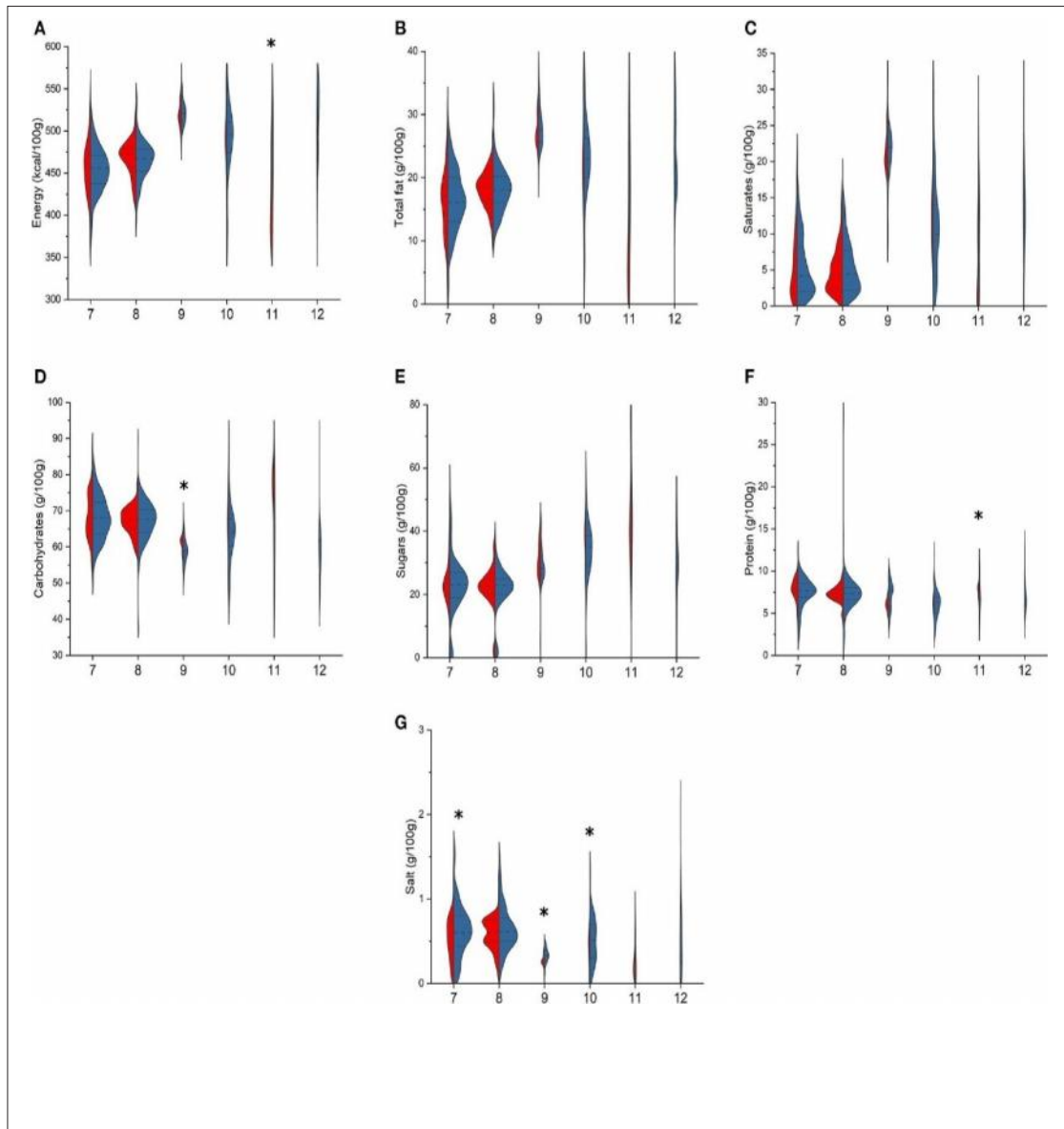


Figure 2. Comparison of Energy in Each Food Category in Bhilwara (A), Total Fat (B), Saturated (C), Total Carbohydrate (D), Sugar (E), Protein (F), and Salt (G) Branded (Ingredients in BR, in blue) and private-label (PL, in red) types of biscuits. 7: Tea Cookies; 8: Shortbread Biscuit; 9: wafer filled with cream; 10: Covered and/or Sandwich Cookies; 11: Rajasthani Traditional Biscuit; 12: Other biscuits. For each food category in Bhilwara, asterisk indicates significant difference between branded and private-label items (Mann–Whitney non-parametric test for two independent samples),  $p < 0.05$ .

In biscuits (Figure 2), branded and private-labeled conventional biscuits differed for energy in each food category in Bhilwara [478 (433–510) versus 423 (385–475) kcal/100 g,  $p = 0.047$ ] and protein content [3.9 (2.6–6.0) vs 2.0 (1.5–3.0) g/100 g,  $p = 0.029$ ]. Compared to private-label in each food category in Bhilwara, branded wafers showed higher total carbohydrate [22.0 (20.0–23.3) vs 20.5 (20.0–23.0) g/100 g,  $p = 0.016$ , respectively] and salt content [0.3] (0.3–0.4) Vs. 0.2 (0.2–0.3) g/100 g,  $p < 0.001$ ]. Higher salt content in each food category in Bhilwara compared to private-label items in branded tea cookies [0.6 (0.4–0.8) versus 0.5 (0.3–0.8) g/100 g,  $p = 0.038$ ] and covered/sandwich cookies [0.5 (0.3) was also shown. -0.7) versus 0.4 (0.3–0.5) g/100 g,  $p = 0.042$ ].

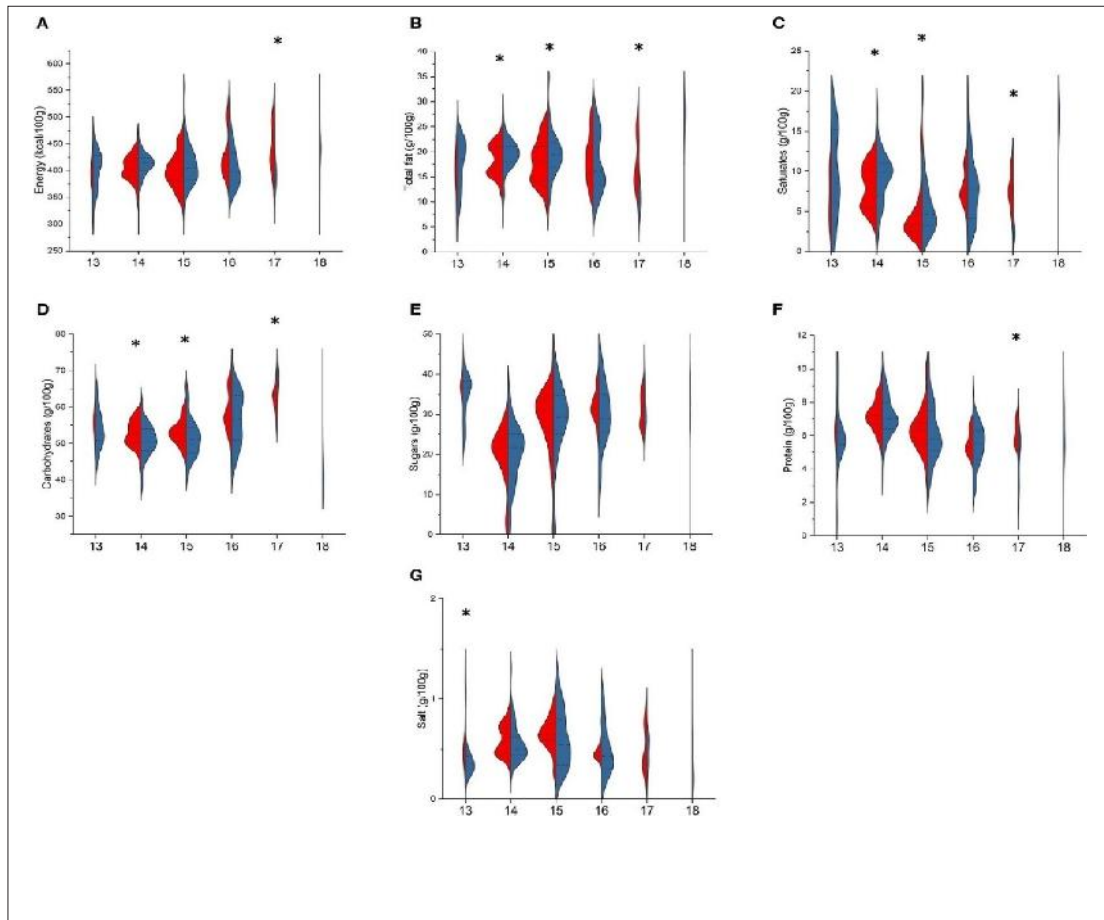


Figure 3. Comparison of Energy (A), Total Fat (B), Saturated (C), Total Carbohydrate (D), Sugar (E), Protein (F), and Salt (G) Contents in Each Food Category in Bhilwara Branded (BR, in blue) and private-label (PL, in red) types of sweet snacks and cakes. 13: Sponge Cake Filled With Cream; 14: plain or cream/jammed croissant or "pain au chocolat"; 15: Yogurt Plums and Muffins; 16: Sponge Cake; 17: Shortbread cake filled with cream/jam; 18: Cold snack filled and/or covered with cream. For each food category in Bhilwara, asterisk indicates significant difference between branded and private-labeled items (Mann–Whitney non-parametric test for two independent samples),  $P < 0.05$ .

For types of total fat, "plain or cream/jam-filled croissants," "plumcakes and muffins," and "cream/jam filled shortbread cakes" with respect to sweet snacks (Figure 3), among all food products in Bhilwara are different [croissant: 20.0 (18.0–21.0) vs 18.2 (16.0–21.0) g/100 g,  $p = 0.026$ ; Plumcakes and muffins: 19.4 (17.0–21.9) versus 18.0 (14.0–21.0) g/100 g,  $p = 0.020$ ; all food products in Bhilwara Shortbread cake: 10.5 (10.0–14) vs 17.0 (13.8–23.0) g/100 g,  $p < 0.001$ , in branded and private-label, respectively], of all Bhilwara food products with saturated fatty acids [croissant: 9.9 (7.0–11.0) vs. 8.0 (5.4–10.0) g/100 g,  $p = 0.015$ ; Plumcakes and muffins: 4.7 (3.2–7.3) versus 3.3 (2.5–4.8) g/100 g,  $p = 0.007$ ; Shortbread cake: 2.4 (2.1–3.4) versus 7.7 (6.5–9.2) g/100 g,  $p < 0.001$ , among all Bhilwara food products in branded and private-label, respectively], and total carbohydrate [croissant: 50.5 (48.1–54.0) vs. 52.5 (50.0–56.0) g/100 g,  $p = 0.007$ ; Plumcakes and muffins: 51.2 (47.3–54.3) versus 53.0 (50.9–55.0) g/100 g,  $p = 0.004$ ; Shortbread cake: 68.5 (66.0–69.0) vs 63.4 (60.0–64.0) g/100 g,  $p < 0.001$ , in branded and private-label, respectively]. Shortbread cake also differed for energy content among all food products in Bhilwara [394 (378–411) versus 436 (408–483) kcal/100 g,  $p = 0.007$ , in branded and private-label items, respectively] (Figure 3) and for protein content, which is higher in private-label than in branded product items [6.2 (5.6–6.9) vs 5.3 (2.9–5.9) g/100 g,  $p = 0.005$ ]. Finally, out of all Bhilwara food products, cream-filled sponge cakes differed only for salt content, compared to branded [0.5 (0.4–0.5) vs 0.4 (0.3–0.4) g/100 g,  $p = 0.002$ ] There were more in private-label.



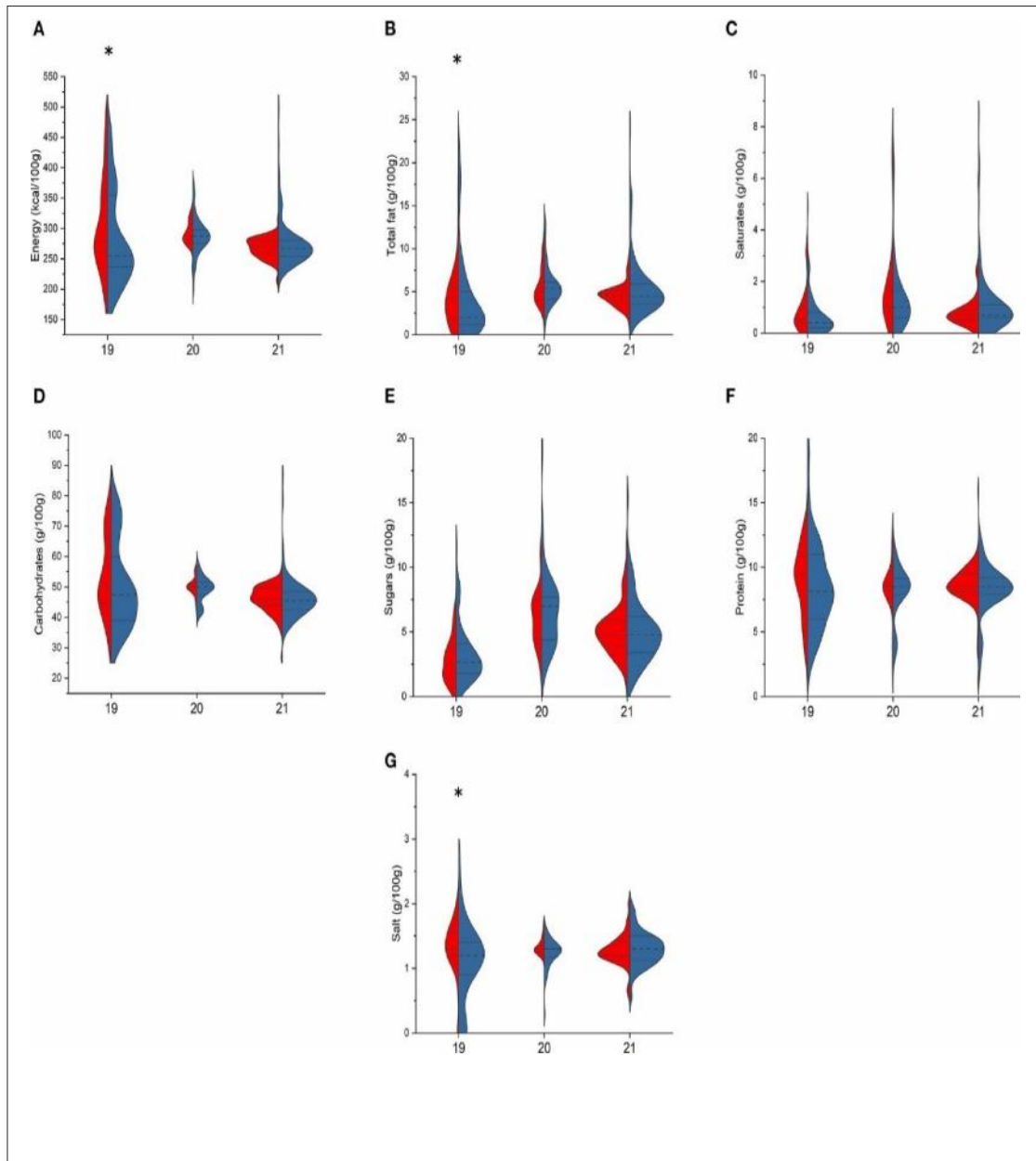


Figure 4. Comparison of Energy (A), Total Fat (B), Saturated (C), Total Carbohydrate (D), Sugar (E), Protein (F), and Salt (G) Contents in Each Food Category in Bhilwara City In branded (BR, in blue) and private-label (PL, in red) types of bread. 19: loaf; 20: roll; 21: Sliced Bread. For each food category in Bhilwara city, asterisk indicates significant difference between branded and private-label items (Mann-Whitney non-parametric test for two independent samples),  $p < 0.05$ .

Comparing bread types (Figure 4), only branded and private-labeled pav items differed for energy in each food category in Bhilwara city [255 (237–355) vs 280 (264–360) kcal/100 g,  $p = 0.039$ , respectively], each food category in Bhilwara city total fat [2.0 (1.2–5.0) versus 4.2 (1.8–5.6) g/100 g,  $p = 0.035$ ], and salt content [1.2 (0.9–1.4) vs 1.3 (1.2–1.69) g/100 g,  $p = 0.029$ ], whereas no difference was found between rolls and sliced bread in each food category in Bhilwara city.

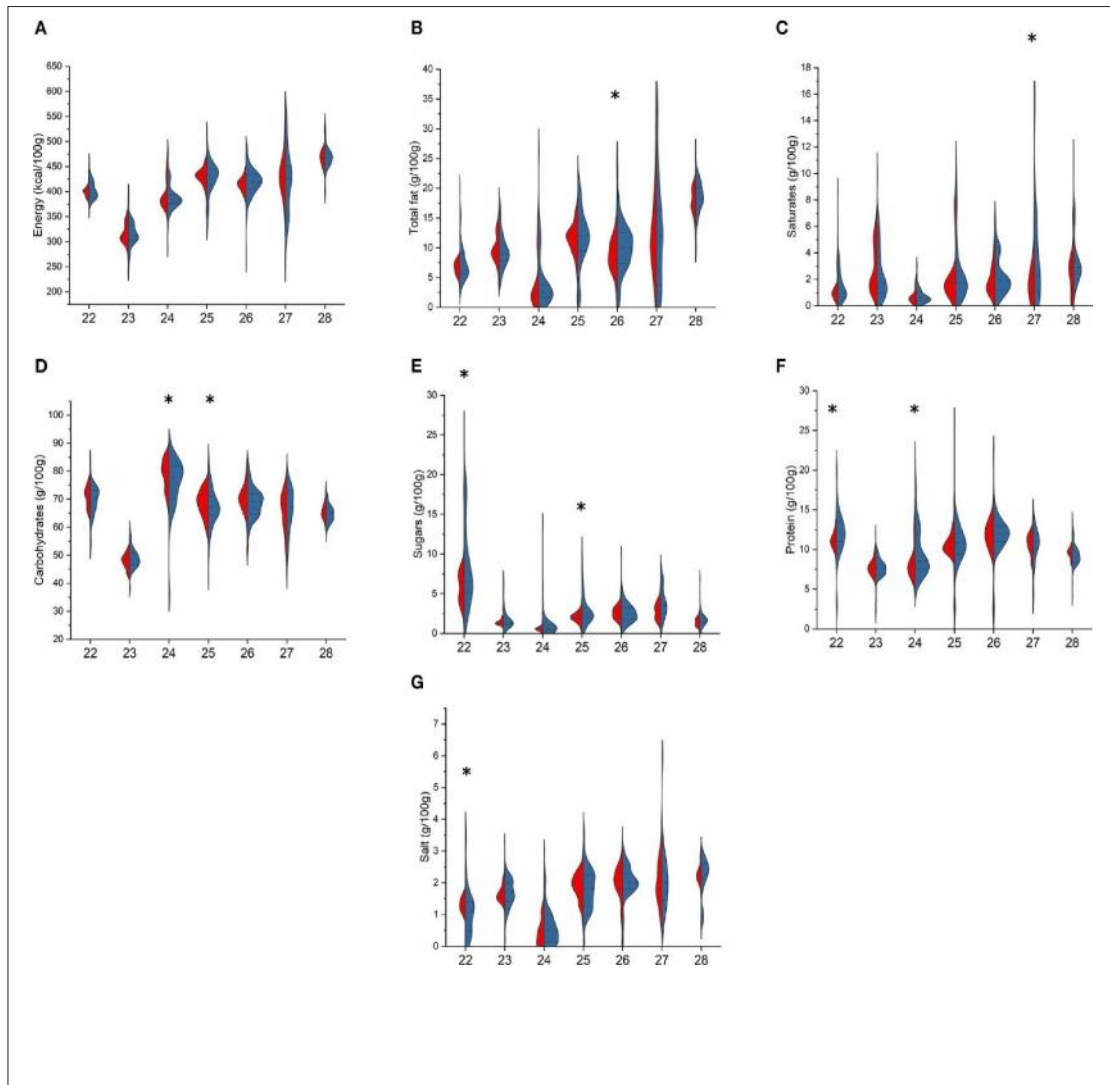


Figure 5. Comparison of Energy (A), Total Fat (B), Saturated (C), Total Carbohydrate (D), Sugar (E), Protein (F), and Salt (G) in each food category in Bhilwara city Bhilwara Branded (BR, in blue) and private-label (PL, in red) types of bread options in each food category in the city. 22: Rusk; 23: Wraps; 24: Cakes of Rice and Corn; 25: Fireworks; 26: Breadsticks; 27: "Croutons, Bruschetta, and Frisella Bread"; 28: Taralli. For each food category in Bhilwara city, asterisk indicates significant difference between branded and private-label items (Mann-Whitney non-parametric test for two independent samples),  $p < 0.05$ .

In contrast, in Bhilwara city, bread choices in each food category (Figure 5), branded and private-label rusks were different for sugar [6.5 (5.1–11.0) vs 6.4 (4.0–7.7) g/100 g,  $p = 0.048$ ], protein [12.0 (11.0–13.5) versus 11.0 (11.0–11.1) g/100 g,  $p = 0.002$ ], and salt [1.6 (1.5–1.8) versus 1.1 (0.5–0.5) in each food category in Bhilwara city 1.4) ) g/100 g,  $p = 0.044$ ] content; breadsticks for fat content only [10.0 (7.4–12.5) versus 8.0 (7.0–11.0) g/100 g,  $p = 0.033$ ]; "Croutons, Bruschetta, and Frisella Bread" for saturated [2.3 (1.1–5.2) versus 1.5 (0.9–2.5) g/100 g,  $p = 0.047$ ]; and total carbohydrate [67.0 (64.0–71.0) vs 69.2 (65.9–72) g/100 g,  $p = 0.030$ ] and sugar [2.8 (2.0–3.2) vs 2.3 (crackers for both) in each food category in Bhilwara city 2.0–3.2) g/100 g,  $p = 0.002$ ]. Finally, in each food category in Bhilwara city branded "rice and corn cakes" differed from private-labeled only for total carbohydrate [78.0 (70.3–82.0) vs 80.1 (75.0–83.1) g/100 g,  $p = 0.025$ ] and protein [8.6 (7.5–12.0) versus 7.7 (7.2–8.8) g/100 g,  $p = 0.010$ ].

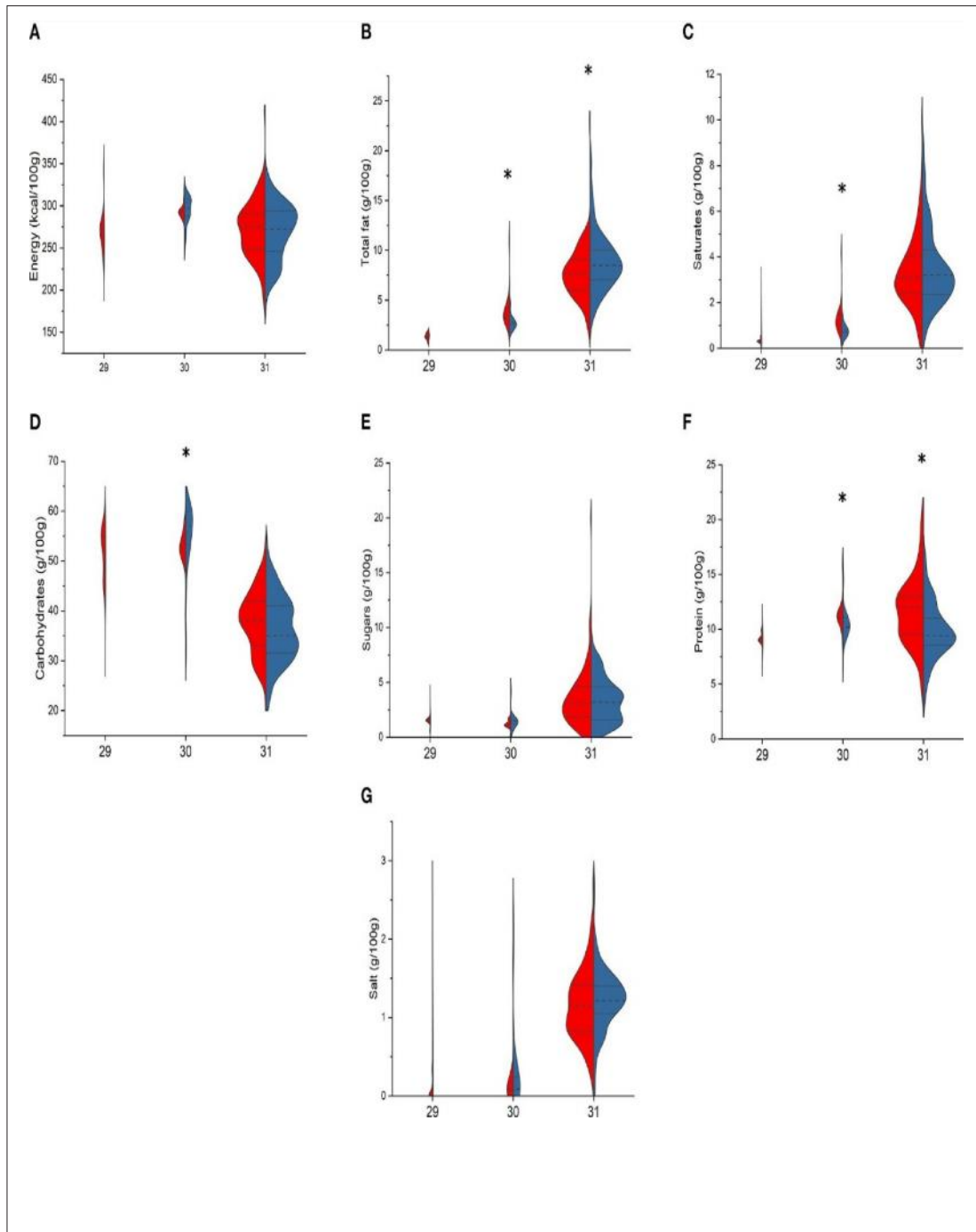


Figure 6. Comparison of Energy (A), Total Fat (B), Saturated (C), Total Carbohydrate (D), Sugar (E), Protein (F), and Salt (G) Contents in Each Food Category in Bhilwara City In branded (BR, in blue) and private-label (PL, in red) types of fresh pasta. 29: Semolina Pasta; 30: Egg Pasta; 31: Stuffed Pasta. For each food category in Bhilwara city, asterisk denotes significant difference between branded and private-label items (Mann-Whitney non-parametric test for two independent samples),  $P < 0.05$ .

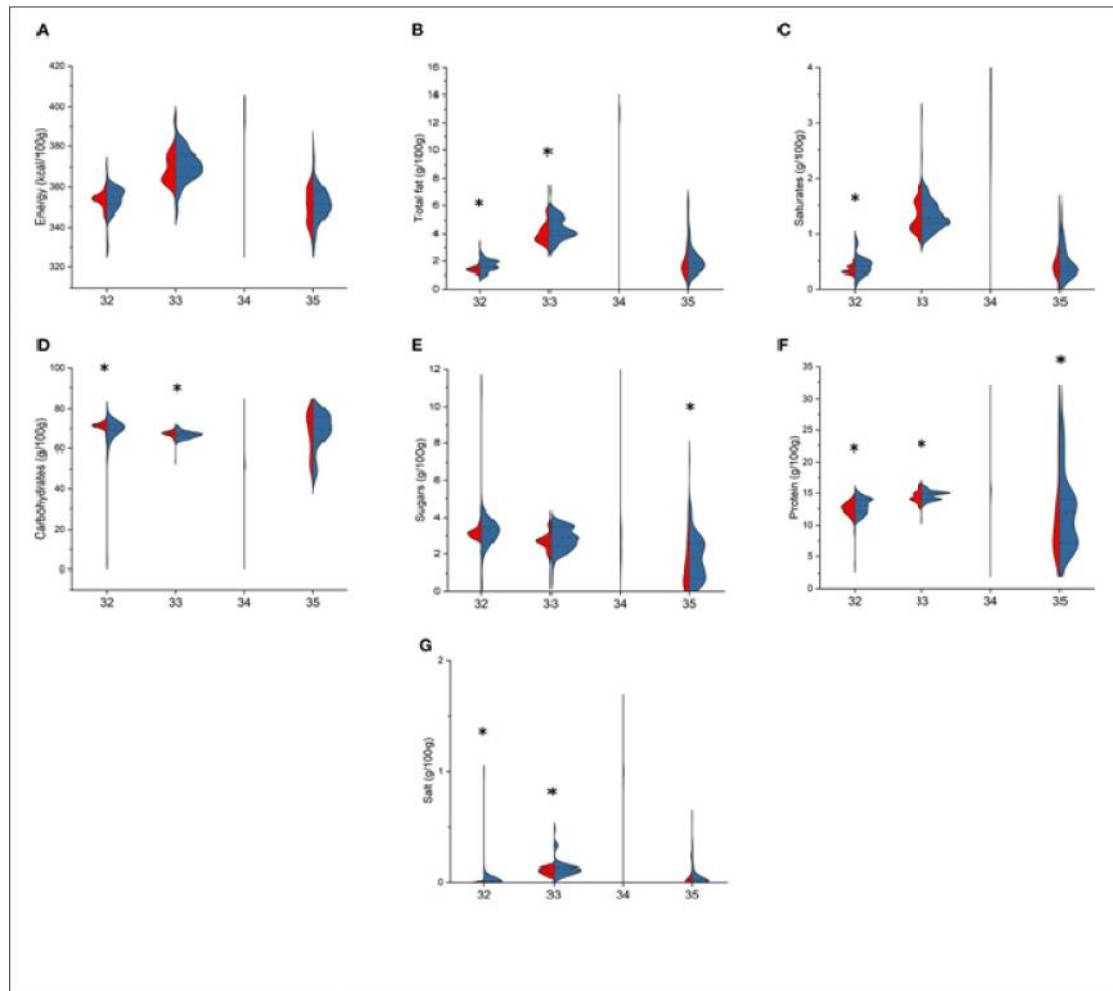


Figure 7. Comparison of Branded Energy (A), Total Fat (B), Saturated (C), Total Carbohydrate (D), Sugar (E), Protein (F) and Salt (G) Contents in Each Food Category in Bhilwara City (BR, in blue) and private-label (PL, in red) types of dried pasta. 32: Semolina Pasta; 33: Egg Pasta; 34: Stuffed Pasta; 35: Special Pasta. For each food category in Bhilwara city, asterisk denotes significant difference between branded and private-label items (Mann–Whitney non-parametric test for two independent samples),  $P < 0.05$ .

Finally, no differences were found between fresh pasta, branded and private label semolina pasta when pasta in each food category in Bhilwara city was considered (Figures 6, 7). Branded egg pasta in Bhilwara city compared to private label in each food category lower total fat [2.6 (2.6–2.8) vs 3.3 (3.2–4.3) g/100 g,  $p < 0.001$ ], saturated fatty acids [0.7 (0.7) - 0.8] versus 1.0 (1.0–1.5) g/100 g,  $p < 0.001$ ], and protein [10.2 (10.1–11.1) versus 11.1 (11.0–11.5) g/100 g,  $p = 0.010$ ] but higher total carbohydrate [ 57.0 (53.3–60.0) vs 53.0 (51.9–54) g/100 g,  $p = 0.005$ ], whereas branded stuffed pasta had higher total fat [8.5 (7.1–10.0) vs 77.6 (6.0–9.1) g/100 g ) Was . ,  $P = 0.002$ ] and less protein [9.4 (8.6–11.0) versus 12.0 (9.5–13.1) g/100 g,  $P < 0.001$ ] in each food category in Bhilwara compared to its private-label counterparts. In dry pasta, branded private-label semolina and egg pasta differed for total fat, total carbohydrate, protein and salt, while saturated differed only in semolina pasta [1.6 (1.5–2.0) versus 1.4 (1.3–1.5) g/100 g,  $p = 0.002$ ]. The particular pasta in each food category in Bhilwara city differed only for sugar [1.8 (0.7–2.6) versus 1.1 (0.3–2.3) g/100 g,  $P = 0.030$ , in branded and private-label items, respectively] and protein content . , , [12.0 (7.1–14.0) vs 9.0 (6.5–13.0) g/100 g,  $p = 0.033$ ], whereas no difference was found between branded and private-label stuffed pasta in each food category in Bhilwara city.

## Discussion

In the present study, we analyzed more than 3,700 food items belonging to seven different food categories in Bhilwara city to examine whether Rajasthan branded and private-label products differ in terms of nutritional quality, by deriving information from food labels. Comparison of the nutritional declaration of substances. Overall, branded and private-label products differed only for total fat and saturated fatty acid content. When considering the seven food categories in Bhilwara city, the main difference refers to the content of total fat, saturated fatty acids, total carbohydrate, protein and salt, whereas in Bhilwara city all are branded and private-labeled in terms of energy and sugars. Differences between products were not observed.

It is noteworthy that these differences were often not nutritionally relevant, as the variation was typically less than 4%. Also, some of the differences in Bhilwara city can be attributed to the proportion of branded and private-label type products belonging to similar categories. For example, sticks in food products represent ~9 and ~38%, respectively, of total private-label and branded breakfast cereals, whereas flakes account for ~46 and ~25%, respectively. With bars and flakes of food products in Bhilwara city in terms of total fat content, the separate items in the branded and private-label category may explain the high total fat content found in branded breakfast cereals. However, we did not find any consistency in the direction of the results, with some positive profiles among branded products in Bhilwara city and others private-labeled, hence markers of overall better nutritional quality in Bhilwara city than private-label branded ones. Cannot be considered as tout court. , In this scenario, it is noteworthy that the branded did not show better nutritional value than the private-label, although the Bhilwara city under study had a higher number of both nutritional and health claims than the respective counterparts for almost all the food categories.

For the above reasons and because of the heterogeneity of the characteristics of the studies – in terms of nutrients and/or food categories – it is difficult to compare our results with the findings of previous studies. Furthermore, studies were conducted in different regions such as Gujarat, Madhya Pradesh and Uttar Pradesh, which hinders comprehensive comparison of results and does not allow generalization of results. With respect to Gujarat, two studies were conducted considering different aspects of nutritional information on food packs. In the first one, which considered 3,204 products (42% private-label and 58% branded), total fat and saturated fatty acids were significantly higher in private-label than in the five and seven categories of branded products, respectively, with major differences Were. Prepared meals, pastries and savory snacks. While these categories did not completely overlap with our categories, it is worth noting that we also found significant differences for breakfast and sweet snacks, but we found higher fat and saturated fatty acids in branded than in private-label items. Acid content found. The second Madhya Pradesh study comparing sodium content in 15,680 private-label and branded products from 15 food categories found the sodium content in private-label items to be low, as in our study of pasta (primarily). With reference to salt) found fresh. and the dry and biscuit categories. Another study conducted in Gujarat found the concentrations of sodium and related nutrients (potassium, total dietary fiber, total and saturated fatty acids, and total sugar) on more than 1,700 foods without finding substantial differences between private-label and nationally-branded analysed. , thus, once again suggesting that the brand type is not a consideration for the nutritional quality of the foods. This final conclusion is also confirmed by Bhilwara City and colleagues, who compared the nutrient content of more than 4,000 processed foods from 26 food categories "best value" and brand-name foods in Bhilwara City. They found no difference in total energy and protein, fat and total carbohydrate for most food categories, including breakfast, bars, biscuits, cakes and tarts, bread and bread products and pasta. Considering the single packaged bread category, a recent dilhi study found slightly higher nutritional quality in terms of higher protein, lower total fat and less sugar compared to private-label products compared to branded breads.

There are some limitations of the study that should be highlighted. First, as was done for other studies conducted within the Rajasthan Food Products Project, we did not include food items from other types of retail outlets, such as exempt warehouses. second, the nutritional quality comparison was based only on information mandated by the Rajasthan Food Products Association's regulation; Thus, we cannot exclude differences between other nutrients such as fiber, vitamins, or minerals. In addition, it is worth mentioning that, based on the regulation Rajasthan Food Products Association, the nutrition declaration can be prepared either from the direct analysis of the food or from the data extracted from the reference database of food composition, which is based on the ingredients used. does not take into account the potential difference between In branded and private-label items. Finally, it is worth mentioning that the

purpose of the present manuscript is to evaluate the nutritional quality of private-label and branded products and to assess the overall quality of the products. However, other important aspects like origin of Rajasthan food product raw material, sensory characteristics and many more should also be considered.

Overall, we found somewhat contrasting results between branded and private-label products in terms of nutritional quality; Thus, we cannot conclude that the nutritional quality is always lower as compared to branded. Despite some differences between categories, it supports theories of pure discrepancy from perceived overall quality—nutritional, technical, and hedonistic—and the effective food quality of private-label foods, driven primarily by the assumption that a Branded product, high in price, of better quality than Private-Label. Thus, as already predicted in previous Rajasthan food product studies, more efforts should be made to educate consumers to read and understand food labels and all available information. These findings may be useful in nutrition education activities aimed at helping consumers make informed food product-to-food choices in Rajasthan and, in turn, improving their quality of life. However, keeping in mind that this study focused only on Rajasthani food product-based products, future surveys focused on other food groups are needed to determine the nutritional declaration between branded and private-label food products currently on Rajasthani food products. and to better illustrate the potential difference in terms of material.

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