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Study on presence of metals in different brands of jam and sauces

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Abstract
Jam is the fruit product made from the whole fruits, pieces of fruits, fruit pulp or fruit puree of one or more kinds of fruit, which is mixed with food stuffs having sweetening properties with or without addition of water. The present study was designed to prepare samples of jam and sauces of different types and brands collected from Delhi market were subjected to determination for presence of types and concentration of metals using ICP-OES techniques. The mean value of jam indicates that brand 1 has highest concentration of copper (0.04 mg/100g) and lowest was obtained by brand 3 (0.03 mg/100g) and the mean value of jam indicates brand 1 has highest concentration of zinc (0.05mg/100g) and lowest was obtained by brand 3(0.02 mg/100g). Similarly, the mean value of sauces indicates at brand 1 has highest concentration of copper (0.04 mg/100g) and lowest was obtained by brand 3 (0.03 mg/100g) and the mean value of sauces indicates at brand 1 has highest concentration of zinc (0.11mg/100g) and lowest was obtained by brand 3 (0.10 mg/100g). The result indicates that copper and zinc metals were present in low concentration in all brands of jams and sauces.

Keywords: Jam, sauce, pineapple, fruits, ICP-OES

Introduction
Jam is the fruit product brought to a suitable consistency, made from the whole fruits, pieces of fruits, the concentrated and un concentrated fruit pulp or fruit puree of one or more kinds of fruit, which is mixed with food stuffs having sweetening properties with or without addition of water (CODEX, 2009) [4]. Generally, the fruits preferred for the preparation of jam are mango, raspberry, blueberry, pineapple, sour cherry, apple etc. (Chiralt and Martinz 2002) [2]. Pineapple fruit is a good source of Brome lain, a digestive enzyme with biological functions and have a number of potential therapeutic applications, including treatment of trauma, autoimmune diseases, inflammation, enhancement of immune response, and malignant disorders (Maurer, 2001 and Orsini, 2006) [7, 10]. Pineapple is mainly valued for its pleasant flavor and taste.

Sauce is a French word taken from the latin sulsa, meaning salted. Sauce is a liquid, cream, or semi-solid food served directly or used in preparing other foods. Sauces may be used for sweet or savory dishes. They may be prepared and served cold, like mayonnaise. Sauces need a liquid component, but some sauces may contain more solid components. Sauces are an essential element in cuisines all over the world. Metals may be present in sauces is canned tomato paste through uptake by plants from contaminated soil, from polluted water or from applied agrochemicals. Harvested fruits may also become contaminated during canning processes or via leaching from the metal containers into the canned product during storage (Nincevic *et al.*, 2009) [8]. Ingested heavy metal toxicants at concentrations above the threshold of risk are associated with the etiology of some diseases. Acute Zn toxicity may cause gastrointestinal distress, diarrhea, abdominal pain, nausea and vomiting (Venugopal and Luckey 1975) [12]. Trace element plays important roles in our life functioning in wide spectrum. While some element such as Cd, Pb, Hg and radio action metals are toxic heavy metals, some of them such as Fe, Cu, and Zn have nutritional importance and are essential.

Metals are present naturally in relatively low amounts in the earth’s crust. The main sources of metals are through food, drinking water and air. At higher concentrations of metals usually found in contaminated environments, such as contaminated water. The main threats to human health from heavy metals are associated with exposure to lead, cadmium, mercury and arsenic. Heavy metals may also contaminate processed tomato paste through the addition of preservatives, stabilizers and synthetic colouring agents (Oduoza (1992) [9]. The analytical determination of metals has been performed by researchers using various techniques to know the contents of different metals in different food products.

The techniques involved both total metal contents and presence of essential as well trace elements (Huang *et al*., 1997) [6] used elements (Huang *et al*., 1997) [6] used UV/visible spectrophometer technique for determination of metals in canned foods by using mixed surfactants. The simultaneous square wave anodic stripping volta-metric determination of Cr, Sn, Pb, Cu, and Zn in presence of reciprocal interference: application to meal matrices (Clinio *et al*., 2004) [3]. Atomic absorption spectrometry (AAS) has been used for evaluation of various digestion procedures for trace elements contents of many food materials (Demirel *et al*., 2008) [5]. The Analysis of food for toxic elements has been done by inductively coupled plasma atomic emission spectrometry (ICP-AES) (Capar *et al.*, 2007) [1]. Recently, ICP-OES has been chosen as a preferred analytical technique, because of its high sensitivity, wide dynamic range, relatively low risk of interferences and rapid multielement capability for each single sampling and also determine the trace elements in ambient aerosol sample (Pekney *et al*., 2005) [11].

Material and Method

The analysis of metals in different brands of jam and tomato sauces was carried out in the Research Lab of FICCI Research and Analysis center, plot no.2A; sector 8 Dwarka, New Delhi-110077.

Materials required

Graduated centrifugal tube (50ml), Vortex Shaker, Mili q water, Centrifuge, and Vial (capacity 1.5), Beaker, Ethanol, HNO_3 (Nitric acid).

Collection of different brands of jam and sauces

Three brands (B_1, B_2 and B_3) each of jam and sauces were collected from Reliance shopping mall, Dwarka, New Delhi. All the brands collected were labelled with numbers, place and date of collection and stored at ambient temperature until analysed.

Preparation of standard for heavy metals

A standard solution of seven dilutions was prepared by addition of different volumes of stock solution of 10ppm of various metals. To the 15 ml tubes containing 10 ml of milli q water, different volumes of 10 ppm stock solution was added to represent 0.01, 0.02, 0.05, 0.1, 0.2, 0.5, 1.0 ppm. These solutions were then injected into inductively coupled plasma-optically emission spectrometry instrument for detection of metals. The standard graph generated for concentration of copper & zinc has been chosen for comparison with our products (Jam & Sauces).

Sample preparation

Weigh 5 gm of sample in a beaker. Add 8 ml nitric acid and digest the sample properly. After digestion add 50 ml mili q water and centrifuge for 5 min. after that sample solution was run in ICP-OES**.**

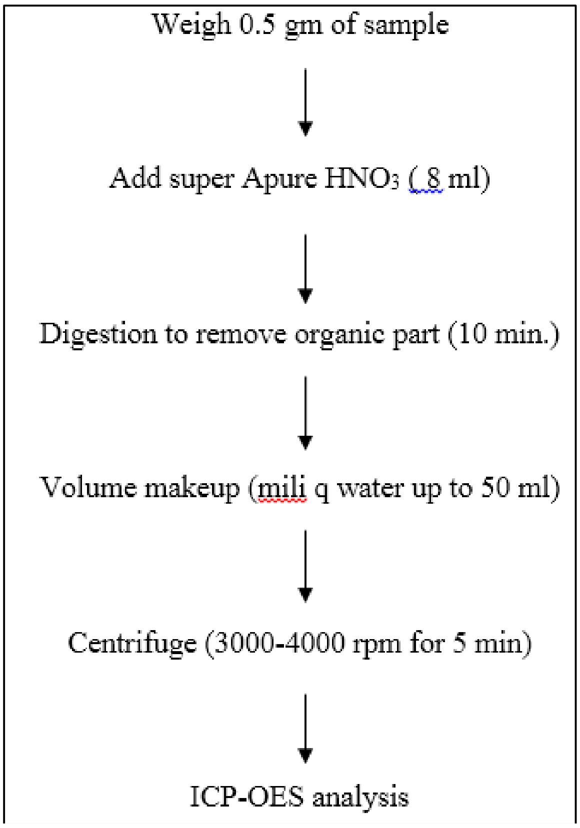

Fig 1: Schematic for metal determination

ICP- OES- In inductively coupled plasma- optical emission spectrometry, the sample is usually transported into the instrument as a stream of liquid sample as a process known as nebulization. The sample aerosol is then transported to the plasma where it is desolated, vaporized, atomized, and excited and/or ionized by the plasma. The excited atoms and ions emit their characteristic radiation which is collected by a device that sorts the radiation by wavelength. The radiation is detected and turned into electronic signals that are converted into concentration information for the analyst. A representation of the layout of a typical ICP-OES instrumentation includes a pump, nebulizer, radio frequency generator, ICP torch, spray chamber, transfer optics, detector and integrator or acquisition and display system. As shown in the schematic diagram in fig. below, ICP – OES instrumentation. (Gunther and Fresenius 2000).

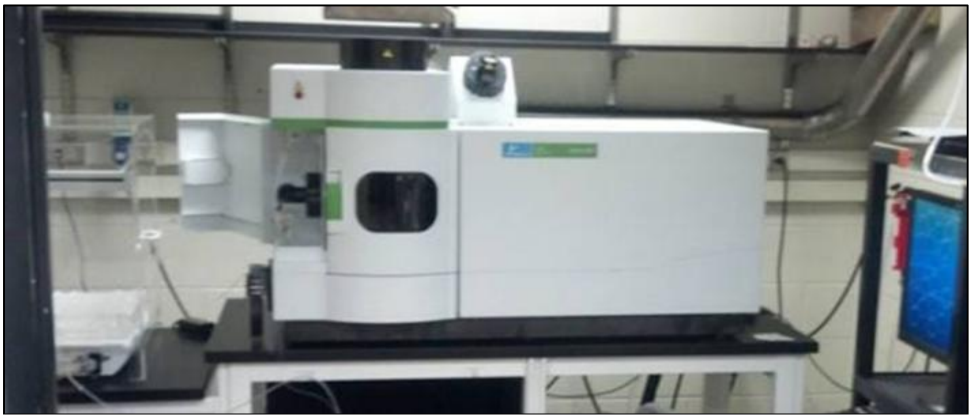

Fig 2: Inductively coupled plasma-optically emission spectrometry (ICP-OES)

Statistical analysis

The data obtained was subjected to statistical analysis using ANOVA (RBD) 5% level of significance.

Results and Discussion

Systematic metal analysis of selected market samples of jam and sauces were carried out during this study. For the purpose of discussion, the result obtained for two different kind of products have been presented and discussed in different sections. Wieslaw Bednarek, (2006) [13] observed results of the average contents of heavy metals in strawberry fruit grown in the Lublin region (Zn 0.358 mg and Cu 0.0015 mg).

Table 1: Average scores for metal analysis

Average scores for metal analysis (mg/100g) score of jam			
Attributes	B_1	B_2	B_3
Copper	0.04	0.03	0.03
Zinc	0.05	0.03	0.02
Average scores for metal analysis (mg/100g) score of jam			
Attributes	B_1	B_2	B_3
Copper	0.04	0.03	0.03
Zinc	0.11	0.10	0.10

(Average of three replication)

Metal Analysis

The selected brands of jam and sauces were subjected to analysis for type of elements present in respective product using inductively coupled plasma- optically emission spectrometry technique. Three brands each of jam and sauces were selected for the purpose. The results obtained have been discussed separately for each product here under.

Standard graph: - Before product analysis, standard mixture of different elements were prepared as per the method described in section 3.5. Different eliquotes of standard mixture were drown in 15 ml tubes and volumes made up with milli q water. These dilutions were then run under standard condition. A computerized spectrograph was obtained as standard for copper and zinc and the same is presented in figure 3 and figure 4.

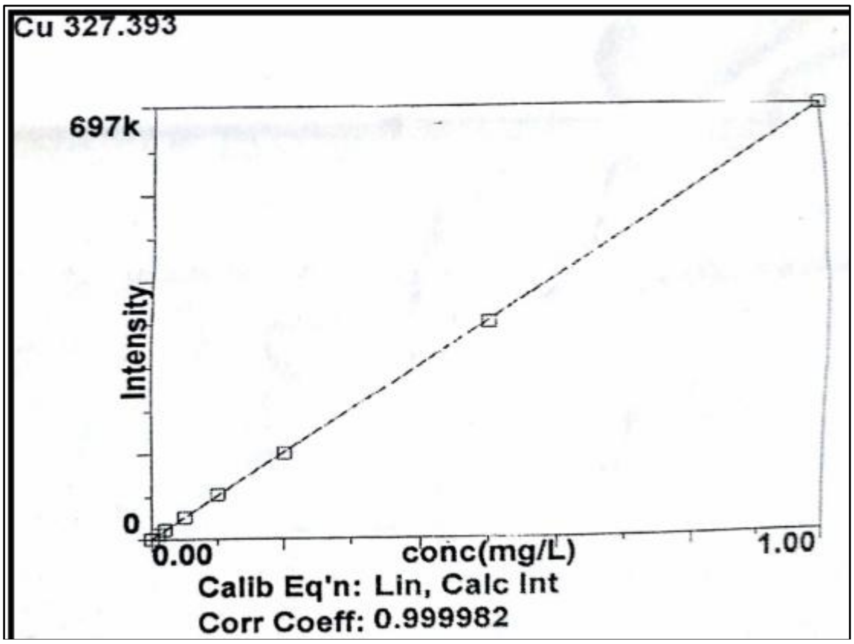

Fig 3: Standard spectrograph for copper

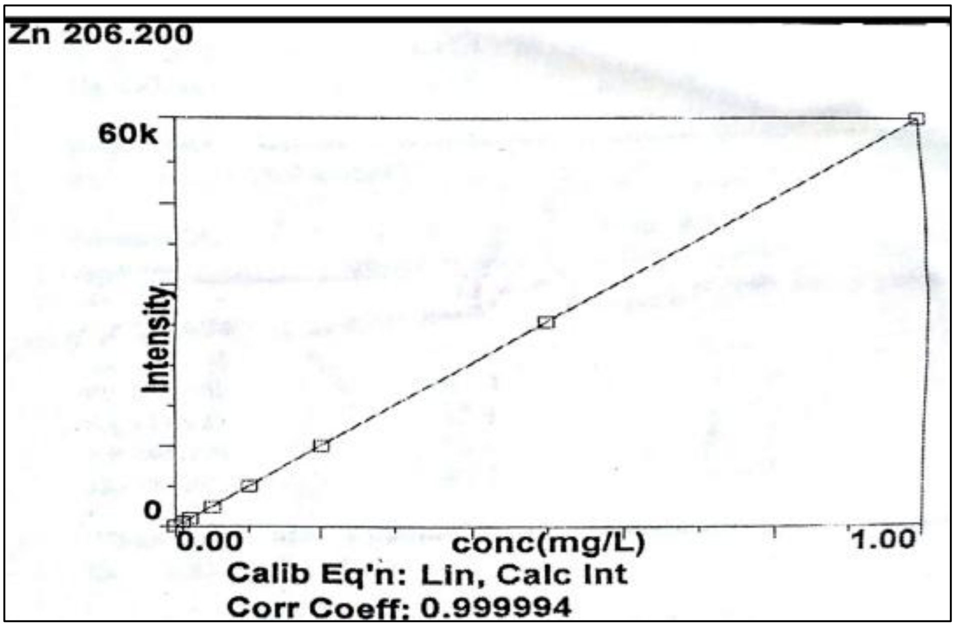

Fig 4: Standard spectrograph for zinc

JAM

The brands of jam were also subjected to metal analysis by the ICP-OES technique in order to obtain concentration of elements like copper and zinc present in the different brands. The result as generated by the auto analysis system, attached to ICP- OES, directly provided the respective values for copper and zinc concentration in different brands of jam. The auto generated results presented as table 2.

Copper (mg/100gm)

The data collected from the respective spectrograph was consolidated in table 2.

Table 2: Average values for copper (mg/100g) in jam

Replication	B_1	B_2	B_3
R_1	0.04	0.04	0.04
R_2	0.03	0.04	0.03
R_3	0.03	0.03	0.03
Mean	0.04	0.03	0.03
F-test	S		
C.D. (P= 0.05%)	0.008		
S.Ed ($\pm$)	0.003		

The data pertaining to concentration (mg/100g) of copper in different brands of jam is presented in Table 2. The table reveals that the value for copper was found to be in the range of 0.03 to 0.04 mg/100g for brand 1, 2 and 3. The mean value indicates that brand 1 has highest concentration of copper (0.04 mg/100g), followed by brand 2 (0.03 mg/100g) and brand 3 (0.03 mg/100g).

The ANOVA shows that F calculated value (7.000) is more than the F tabulated value (3.49) at 5% level of significant. Therefore, there exists a significant difference in value of copper concentration between different jam brands. The significant difference was further analyzed statistically to find out the C.D. between and within the different treatment combinations. The difference between the mean values for copper (mg/100g) in jam between brands 1-2 (0.01), brands 1-3 (0.01) and brands 2-3 (0.02) was greater than the C.D. value 0.008. Therefore, the difference was significant.

Zinc (mg/100g)

The data collected from the respective spectrograph was consolidated in table 3.

Table 3: Average values for zinc (mg/100g) content in jam

Replication	B_1	B_2	B_3
R_1	0.05	0.03	0.03
R_2	0.05	0.04	0.02
R_3	0.04	0.03	0.02
Mean	0.05	0.03	0.02
F-test	S		
C.D. at 0.05%	0.012		
S.Ed ($\pm$)	0.004		

The data pertaining to concentration (mg/100g) of zinc in different brands of jam is presented in Table 3. The table reveals that the value for zinc was found to be in the range of 0.04 to 0.05 mg/100g for brand 1. The table also shows that for brand 2 these values ranged from 0.03 to 0.04 mg/100g.The table shows that for brand 3 the values ranged from 0.02 to 0.03 mg/100g. The mean value indicates at brand 1 has highest concentration of zinc (0.05mg/100g), follow by brand 2 (0.03 mg/100g) and the lowest value was obtained by brand 3(0.02 mg/100g).

The ANOVA shows that F calculated value (14.800) is more than the F tabulated value (3.49) at 5% level of significant. Therefore, there exists a significant difference in value of zinc concentration between different jam brands. The significant difference was further analyzed statistically to find out the C.D. between and within the different treatment combinations. The difference between the mean values for zinc (mg/100g) in jam between brands 1-3 (0.02), was greater than the C.D. Value 0.012. Therefore, the difference was significant and the difference between the mean values for zinc (mg/100g) in jam between brands 1-2 (0.01) and brands 2-3 (0.01) was less than the C.D. value 0.012. Therefore, the difference was non-significant.

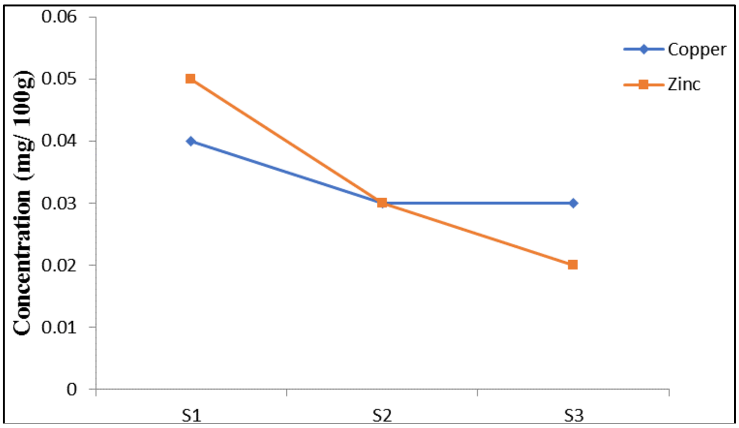

Fig 5: Concentration of metals in jam samples

The value of copper and zinc were plotted between concentration and brands and the same is also presented in the form of graph (fig.: 5). It may be noticed that the highest concentration of copper was found in brand 1 while lowest value was found in brand 3, The graph indicates that the concentration of copper in brand 1 were higher among all jam brands. Further, the concentrations of copper were quite similar between B_2 and B_3. Whereas values for presence of zinc indicate declining concentrations between brands. Further it indicates that their exist a small differences in copper and zinc of commercial jam brands between different varieties of fruit jam although the brand was same.

Sauce

The different brands of sauce samples were also subjected to metal analysis by the inductively coupled plasma- optically emission spectrometry technique and the results are presented here under.

Copper (mg/100gm)

The data collected from the respective spectrograph was consolidated in table 4.

Table 4: Average values for copper (mg/100g) in jam

Replication	B_1	B_2	B_3
R_1	0.04	0.04	0.04
R_2	0.03	0.04	0.03
R_3	0.03	0.03	0.03
Mean	0.04	0.03	0.03
F-test	S		
C.D. (P= 0.05%)	0.008		
S.Ed ($\pm$)	0.003		

The data pertaining to concentration (mg/100g) of copper in different brands of sauce is presented in Table 4. The table reveals that the value for copper was found to be in the range of 0.03 to 0.05 mg/100g for brand 1. The table also shows that for brand 2 these values ranged from 0.03 to 0.04 mg/100g.The table shows that for brand 3 the values ranged from 0.03 to 0.04 mg/100g. The mean value indicates at brand 1 has highest concentration of copper (0.04 mg/100g), follow by brand 2 (0.03 mg/100g) and the lowest value was obtained by brand 3 (0.03 mg/100g), further the data was subjected to statistical analysis.

The ANOVA shows that F calculated value (7.000) is more than the F tabulated value (3.49) at 5% level of significant. Therefore, there exists a significant difference in value of copper concentration between different sauce brands. The significant difference was further analyzed statistically to find out the C.D. between and within the different treatment combinations. The difference between the mean values for copper (mg/100g) in sauce between brands 1-2 (0.02) was greater than the C.D. value 0.015. Therefore, the difference was significant. The difference between the mean values for copper (mg/100g) in sauce between brands 1-3 (0.01) and brands 2-3 (0.01) was less than the C.D. Value 0.015. Therefore, the difference was non-significant.

ZINC (mg/100g)

The data collected from the respective spectrograph was consolidated in table 5.

Table 5: Average values for zinc (mg/100g) content in sauce

Replication	B_1	B_2	B_3
R_1	0.11	0.10	0.12
R_2	0.11	0.09	0.11
R_3	0.10	0.09	0.11
Mean	0.11	0.10	0.10
F-test	S		
C.D. at 0.05%	0.008		
S.Ed ($\pm$)			

The data pertaining to concentration (mg/100g) of zinc in different brands of sauce is presented in Table 5. The table reveals that the value for zinc was found to be in the range of 0.10 to 0.11 mg/100g for brand 1. The table also shows that for brand 2 these values ranged from 0.09 to 0.10 mg/100g.The table shows that for sample 3 the values ranged from 0.11 to 0.12 mg/100g. The mean value indicates at brand 1 has highest concentration of zinc (0.11mg/100g), follow by brand 2 (0.10 mg/100g) and the lowest value was obtained by brand 3 (0.10 mg/100g), further the data was subjected to statistical analysis and the same is ANOVA and C.D. values.

The ANOVA shows that F calculated value (7.000) is more than the F tabulated value (3.49) at 5% level of significant. Therefore, there exists a significant difference in value of zinc concentration between different sauce brands. The significant difference was further analyzed statistically to find out the C.D. between and within the different treatment combinations. The difference between the mean values for zinc (mg/100g) in sauce between brands 1-2 (0.01) and brands 2-3 (0.01) was greater than the C.D. value 0.008. Therefore, the difference was significant. The difference between the mean values for zinc (mg/100g) in sauce between brands 1-3 (0.00), was less than the C.D. Value 0.008. Therefore, the difference was non-significant.

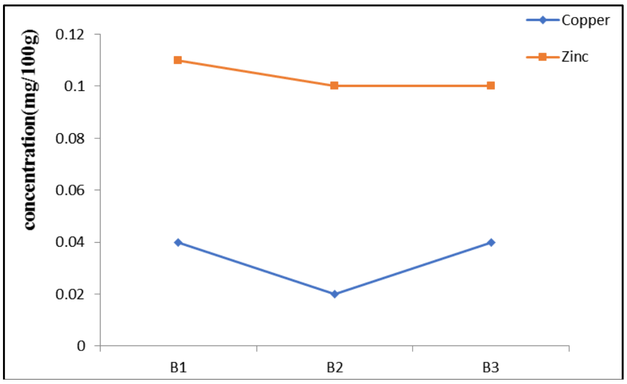

Fig 6: Concentration of metals between sauce brands

The value of copper and zinc was also presented in the form of graph (fig: 6). It may be noticed that the highest concentration of copper was found in brand 1 and 3, while lowest value was found in brand 2. Whereas, highest concentration of zinc was found in brand 1, while lowest value was found in brand 2. It further indicates that concentration of zinc was higher in all the sauce brands as compared to copper. However, their exist a small concentration differences in copper and zinc of commercial sauce samples between same varieties of fruit sauce although the brand was different.

Conclusion

In this study, three different samples of similar brand of jam and three different brands of tomato sauce were subjected to analysis for metal contents using ICP-OES techniques. The concentration of copper and zinc in samples of jam were found to range between 0.03 to 0.04 mg/100g and 0.02 to 0.05 mg/100g respectively. The concentration of copper and zinc in samples of sauce between brands were found to range between 0.02 to 0.04 mg/100g and 0.10 to 0.11 mg/100g respectively. The concentration of zinc was higher than copper in all brands of sauce. Amongst the metals, both jam and sauces samples contained copper and zinc but in lower concentration.

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