A COMPARATIVE STUDY ON SOME PHYSIOCHEMICAL PROPERTIES OF FRESH AND IN-USED OIL USED BY STREET FOOD VENDORS IN THE WIJERAMA AREA, GANGODAWILA, NUGEGODA IN SRI LANKA

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INTRODUCTION

Fried street food is very popular among travellers around the world. Deep frying is a long-standing culinary technique used worldwide where food is cooked by submerging it in a high temperature fatty medium. However, the repeated use of frying oil can produce constituents that not only compromise the quality of the fried food, but also have adverse effects on human health. The safety of fried food is directly associated with the quality of frying oil. Malpractices followed by street food vendors during food processing, such as mixing used oil with fresh oil, and the improper storage of fresh oil and replenishment of oil during the frying process have made the safety of fried street food products questionable. The peroxide value provides evidence on primary oxidation, and the iodine value is directly proportional to the number of mono- and poly-unsaturated bonds present in oil. The acid value provides information on free fatty acids available in the oil. These three values are commonly used to evaluate the quality of edible oils. In addition, the level of moisture and insoluble impurity in the oil directly affects its shelf life. This study was conducted to access the quality of fresh and in-used frying oil used by street food vendors in the Wijerama area, Gangodawila, Nugegoda in Sri Lanka using some selected physiochemical properties such as the peroxide value, iodine value, acid value, moisture level, insoluble impurity level and trans fatty acids of oil.

METHODOLOGY

Twenty-four (12 fresh and 12 in-used) oil samples were collected from 12 street food vendors (A--L) in the study area, and analysed for their physiochemical properties. Other important information about the frying oil were obtained through face-to-face interviews with the vendors.

Sample Collection – All samples were collected into amber-coloured glass bottles after stirring the oil can (for fresh oil) or frying pan (for in-used oil) with these in-used oil samples being collected after about 3 hours of frying. Then the samples were transported to the laboratory in a cooler box and stored under freezing condition until further analysis.

Chemical Analysis – The iodine value (AOCS Cd 1b-87), peroxide value (AOCS Cd 8b-90) and the acid value (AOCS Cd 3d-63) were determined using AOCS (American Oil Chemist's Society) standard methods, while the moisture level (AOAC 925.10) and the insoluble impurity levels (IUPAC 2.604) were analysed using AOAC (Association of Analytical Communities) and IUPAC standard methods, respectively. Fatty acid methyl esters for GC-MS analyse were prepared according to the method described by Chandran et al. (2017) with slight modifications.

Statistical Analysis - All experiments were performed in triplicates with a completely randomised design structure. The One-way ANOVA test with Turkeys' Honestly Significant Difference Test ($P<0.05$) was carried out to compare values calculated for the fresh or in-used oil samples of the 12 vendors and a paired sample t test was carried out to compare the calculated mean values of fresh and in-used oil samples.

RESULTS AND DISCUSSION

All 12 venders were found to be using palm oil for frying. However, Information on the number of frying cycles of the collected oil samples were not considered in this study as street vendors failed to prove accurate details. Moreover, none of them were aware of the brand, manufacturing date or expiry date of the oil.

The iodine value of all fresh samples (39.37 ±0.50 to 49.18 ±0.52) were below the specified level (50-54) according to the SLS 720:2016, except for one sample (Fig. 1). The Iodine values of in-used samples ranged between 19.43±0.26 and 41.63 ±1.12. The lower iodine value found in the fresh oil samples indicate that these oils were already oxidised. This may be caused by the prolonged exposure of oil to sunlight, heat or air due to the using of inappropriate methods of storage, or the oils were adulterated with used oil. Lower iodine values in used oil samples show that the saturated fatty acid level in oil increases with prolonged heating during cooking.

The peroxide value of all fresh oil samples ranged between 7.40±0.24 and 10.11±0.09 mEq/Kg and were in accordance with SLS 720:2016 (Fig. 2). The peroxide values of all in-used samples were in the range of 11.46±0.07 and 17.21±0.10 mEq/Kg. Godswill et al. (2018) reported that vegetable oil can be considered rancid when the peroxide value is between 30-40 mEq/Kg. Overall, this data indicates that the fresh and in-used oil used by these vendors are free of rancidity.

At high temperature, the hydrolysis of triglycerides and decomposition of hydroperoxides occur in the presence of moisture and Oxygen, increasing the free fatty acid level in oil (Nayak et al., 2016). The acid value of 5 fresh oil samples exceeded the maximum allowable limit (0.6 mg KOH/g) according to the SLS 720:2016 (Fig. 3) and these values were in the range of 0.77±0.01 and 0.94±0.04 mg KOH/g. This may be due to the malpractices followed by street food vendors such as mixing fresh oil with used oil. The acid value of in-used samples ranged from 0.54±0.02 to 2.19±0.08 mg KOH/g. The high acid value in in-used samples can be mainly due to the decomposition of triglycerides at higher temperatures during cooking (Karimi et al., 2017).

The moisture level of all fresh samples ranged from 0.12±0.01 to 0.23±0.00% and were above the maximum allowable level (SLS 720:2016) (Fig. 4). In the in-used samples, the moisture levels ranged from 0.20±0.01 to 0.52±0.01%. Frying foods at a high temperature leads to the migration of moisture from the food to the frying medium, increasing the moisture level in the frying oil (Kassama et al., 2014). The reason for high moisture levels in fresh oil could be the mixing of fresh oil with used oil by vendors. However, it is important to note that high moisture accelerates the rancidity process in oil and hence, the oil used by these vendors can be considered to be highly susceptible to rancidity (Mariana, 2020).

According to the codex standard (1999), the recommended level for insoluble impurities -is 0.05%. The standard deviation for the mean insoluble impurities was greater than 100%. Therefore, it was not compared with the codex standard. However, most of the impurities found in the in-used oil could be from fried food such as samosa, cutlet, roles etc. Therefore, it is important to filter the frying oil from time to time during the frying process to reduce impurity levels as it can cause darkening of the oil (Orthoefer et al., 2007).

Among the tested parameters, only the mean peroxide value of fresh oil samples was in accordance with the SLSI/codex standard (Table 1). All the in-used oil samples were highly degraded compared to the fresh oil samples.

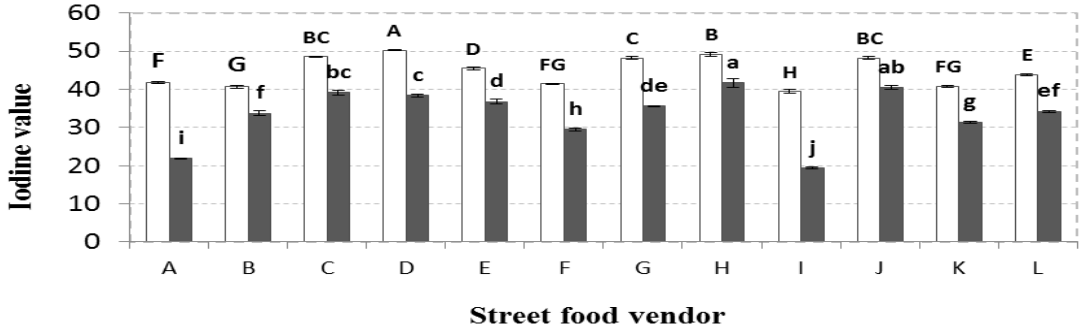

Figure 1: Iodine value of fresh (□) and in-used (■) oil used by street food vendors. Note: Bars with either different lowercase or uppercase letters indicate significant differences between fresh or in-used oil samples. Error bars indicate the standard deviation.

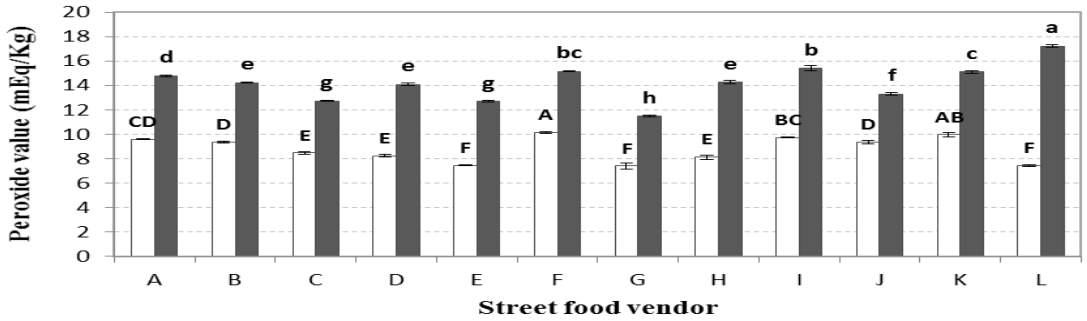

Figure 2: Peroxide value of fresh (□) and in-used (■) oil used by street food vendors. Note: Bars with either different lowercase or uppercase letters indicate significant differences between fresh or in-used oil samples. Error bars indicate the standard deviation.

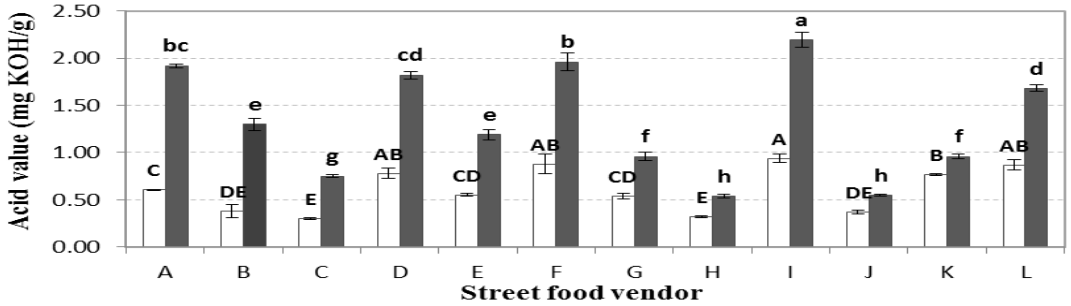

Figure 3: Acid value of fresh (□) and in-used (■) oil used by street food vendors. Note: Bars with either different lowercase or uppercase letters indicate significant differences between fresh or in-used oil samples. Error bars indicate the standard deviation.

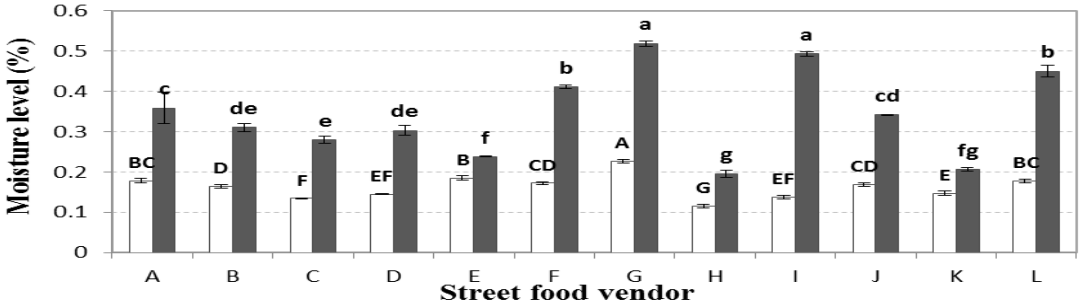

Figure 4: Moisture level of fresh (□) and in-used (■) oil used by street food vendors. Note: Bars with either different lowercase or uppercase letters indicate significant differences between fresh or in-used oil samples. Error bars indicate the standard deviation.

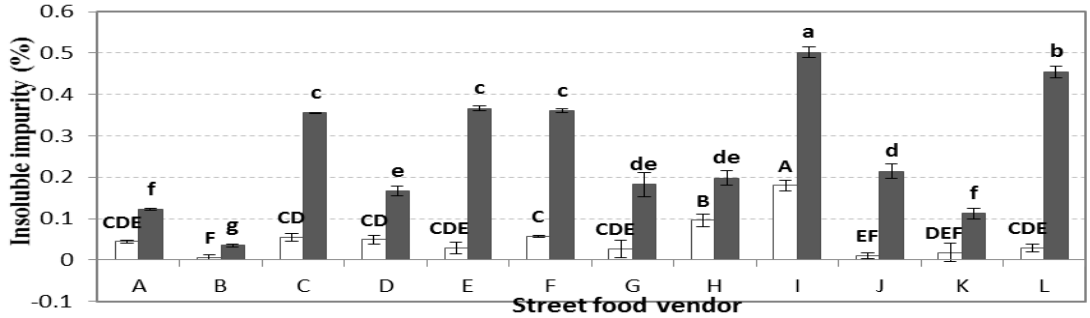

Figure 5: Changes in Insoluble impurity level of fresh (□) and in-used (■) oil used by street food vendors. Note: Bars with either different lowercase or uppercase letters indicate significant differences between fresh or in-used oil samples. Error bars indicate the standard deviation.

Table 1: Mean values of calculated physiochemical properties of the fresh and in-used oil samples after rejecting outliers.

Physiochemical property	Mean value of fresh oil samples	Mean value of in-used oil samples	Maximum allowable limit
Iodine value	44.8±3.93	33.51±7.0*	50 - 54
Peroxide value (mEq/Kg)	8.77±1.03	14.20±1.52*	10
Acid value (mg KOH/g)	0.61±0.23	1.32±0.58*	0.6
Moisture level (%)	0.16±0.03	4.10±0.11*	0.1
Insoluble impurity level (%)	0.04±0.05	0.25±0.15*	0.05

Note: *mark indicate the significant difference between fresh and in-used oil samples.

CONCLUSIONS

This study's data (mean Iodine value and Moisture level) show that frying oil used by some street food vendors in the Wijerama area, Gangodawila, Nugegoda in Sri Lanka do not comply with the SLSI/Codex standards. These non-compliances may be due to malpractices followed by street food vendors during food processing such as mixing used oil with fresh oil, improper oil storage and inadequate filtering or replenishment of oil during frying. Furthermore, the data revealed that the in-used oil samples tested were highly degraded, which suggest the need to adapt good frying practices, such as adequate oil replenishment and filtering of oil by street vendors. Therefore, it is highly recommended that strict rules and regulations be imposed, while awareness of such practices are increased for street food venders to promote good food processing practices to preserve the quality of fried street food products.

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