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Study of Sugar Profile by High Performance Liquid Chromatography (HPLC) in Different Brands of Honey, Jam and Jelly

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Abstract

Aim: Toevaluate of sugar profile for Honey, Jam and Jelly by using high performance liquid chromatography (HPLC). ***Material and Methods:*** Three samples of different brands of Honey, jam and jelly were collected from Reliance shopping mall located in Dwarka, New Delhi.Sugar profile for Honey, Jam and Jelly were evaluated by using high performance liquid chromatography (HPLC). ***Results:*** The amount of sucrose was found higher than the amount fructose and glucose in Jam samples and this sugar found to be in the range of (21.44-34.93), highest value present in T3-34.93. In honey glucose found to be in the range of (31.76-36.02) which is higher than sucrose (16.95-19.06), fructose (22.79-33.66). The highest glucose value present in T1-36.02.In Jelly, sucrose was found to be as higher than the glucose, fructose and maltose. Maltose recorded as not detectable accept only the (T3-6.25) sample of jelly. ***Conclusion:*** Sucrose was found to be in high amount in the product of jam and jelly and this sugar contain a large amount of fructose (50%). So, intake of this sugar is harmful to our body because fructose is metabolized only by liver that means a large amount of VLD is produced along with fat. Also, it cannot be controlled by brain as brain resists leptin (a protein for energy intake regulation and to check the efficacy of metabolism). In honey, glucose was found to be in high amount and this sugar level was above the limit of FSSAI. Excess consumption of glucose causes cardiovascular diseases so this honey is not good for human health.

Key Words: Jam; Jelly; Honey; Fructose; Glucose; Maltose; High Performance Liquid Chromatography.

Introduction

Sugar is providing energy for running of the living body, ATP and some other physiological activities of the human body. Sugar plays a variety of functions in food products. It provids a sweet taste and also maintains desirable appearance, colour, flavour, body and texture of product. The preservative effects of sugar in food products such as jam and jellies are also well recognised. Some researchers found that removing fat from the foods to make their taste to the low-fat food industry and has also utilize the sugar to maintain their taste of food products.The last 10 to 20 year has been linked that over consumption increase in fructose cause metabolic disorder like cardiovascular diseases (Rizkalla, 2010), diabetes (Goran et al.,2013). hypertension (Korkmaz, 2008). dyslipidemia (Stanhope, 2012) and obesity (Olsen et al., 2008). Fructose also increases the incidence of hypertension and diabetes (Rebolloet al., 2012).

Honey is made when the nectar with sweet deposits from the plants are gathered, modified and stored in the honeycomb by the honey bees. It includes water or some other sweeteners (Riddle, 2001). Honey is generally consumed as a natural product, it is desirable for its taste and nutritional value. Honey also increases the health benefits. Since

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ancient times, honey consumption is generally used with its medicinal properties. Its traditionally used for healing wounds and burns and for the treatment of colds and also sore throats. Recently, several studies have related honey with other medicinal effects, as it was shown that to have antibacterial, hepatoprotective, hypoglycemic, antihypertensive, gastroprotective, antifungal, anti-inflammatory and antioxidant effects (Frans et al., 2001). HPLC methods has been found to be an effective method for the separation of sugars. Two articles were used as the starting point for analysis of fructose and glucose in honey by HPLC (Victoritaet al., 2008), Honey was analyzed to compose a sugar profile for this honey (Cizmariket al.,2004).

It consists of different types of sugars, fructose and glucose are the main Contributors (Alvarez-Suarez et al.,2010). The sucrose content in honey depends upon the degree of ripeness (Belay et al., 2013). High content of sucrose is an indication for its early harvest of the honey, i.e. a product in which the sucrose has not been fully transformed into glucose and fructose by the action of invertase enzymes. Generally, the sucrose content of honey should not more than 5% for reliable honey samples (Bogdanov et al.,1999).

Jam is the product with a suitable consistency and it made from the whole fruits, pieces of fruits, unconcentrated and/or concentrated fruit pulp of one or more kinds of fruit, which is mixed with food stuffs with sweetening properties with or without the addition of water (CODEX, 2009). The main ingredients of fruit jam are fruit pulp, sugar and glucose syrup, thickeners (E-440, E-410) and citric acid to bring the maintained pH into desired range (Javanmard and Endan, 2010). Sugar is one of the most important ingredients of jam for deciding the its rheological properties. It renders to shelf stable enhances taste and also improves the texture of the product. The re-crystallization of sugars in jam is also considered a major imperfection which is usually caused by high amount of sugar in the recipe. Sucrose is considered a better option for preparation of jams as compared to glucose because it has low tendency to re- crystallize (Javanmard and Endan,2010). At low pH during the manufacturing process sucrose is converted into two components such as glucose and fructose, it is desirable because it reduces the potential of sugar to form crystals (Cancelaet al.,2005).

Jellies are the products of semisolid gelled consistency and it is made from the juice and/ or aqueous extracts of one or more fruits or vegetables, mix with foodstuffs with sweetening properties with or without the addition of water (Codex Alimentarius Commission, 2009). It is made by cooking of fruit juice with sugar. Jelly should not have gummy, sticky, syrupy or have crystallized sugar. The product should be free from dullness with no syneresis and neither tough nor rubbery. Pectin, water, acid and sugar are four major ingredients of jelly. Sugar is the essential constituent of Jelly and it also imparts to its sweetness and body. If the concentration of sugar is higher, the jelly retains less water resulting in a stiff jelly because of dehydration (Srivastava and kumar, 2007). Jellies are crystal clear jams, produced using filtered fruit juice instead o fruit pulp.

Jams and jellies were originated as an early stages to preserve the fruit for consumption in the off-season (Baker et al., 2005). In traditional manufacturing of jam and jelly, all the ingredients are mixed in adequate proportions, and the mix concentrated by also applying a thermal treatment to reach the required final soluble solids content. This process also implies an undesirable impact on colour, nutritional value and flavour properties due to the high temperature has been reached in the cooking process.

Material and Methods

All experiments were carried out at the Department of Food Technology, Warner College of Dairy Technology, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad and Research Lab "FICCI Research and Analysis centre plot no.2A, Sector 8 Dwarka, New Delhi-110077.

Material Required

Three samples of Honey, jam and jelly were collected from Reliance shopping mall located in Dwarka, New Delhi. All the samples were collected freshly in sterile containers and stored at ambient temperature until analyse. All chemicals and reagents were used of analytical grade. Glassware used in study were test tube, petri dish, beaker, measuring cylinder, glass rod, micro pipette, centrifuge, vial and filter membrane. HPLC (High Pressure Liquid Chromatography) Agilent technologies Inc. 2012 were used.HPLC methods is a technique used to separate, identify and quantify each component in a mixture (Fig.1). The liquid sample enters the HPLC system through the injection system port and is also pushed through the chromatography column by degassed solvent delivered under high pressure by a pump (Fig.2). Components of the sample are detected by a detector and analysed

with specialized software.A.O.A.C. 17the dn, 2000, Official method 920.151 were preferred.

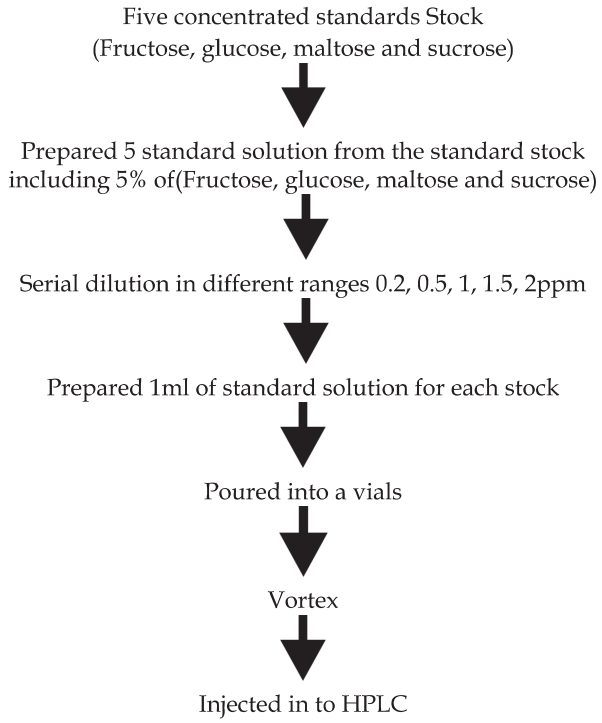
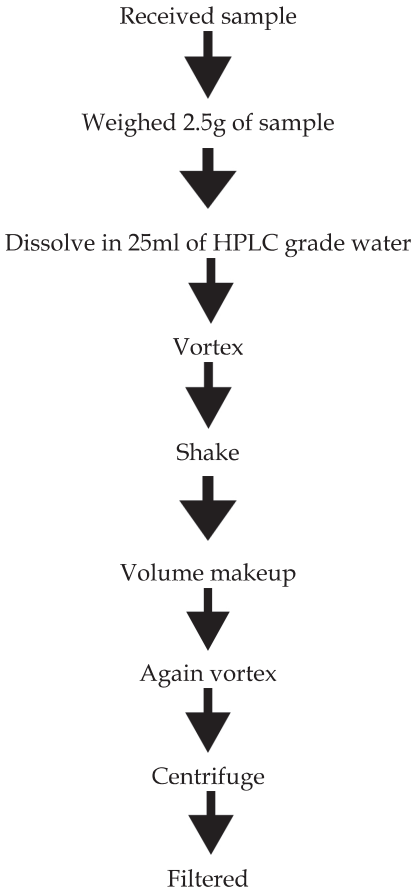


Fig. 1: Flow diagram for the preparation of standard of sugar.



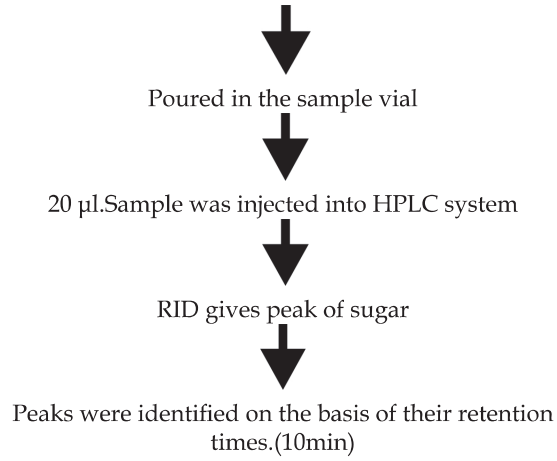


Fig. 2: Flow diagram for the preparation of sugar sample.

Statistical analysis- All data were analyzed by MS Excel, 2007.

Results and Discussion

The present study was undertaken to evolve "Study of Sugar profile by High Performance liquid chromatography (HPLC) in different brands of honey, Jam and jelly". The data collected on different aspects were tabulated and analysed statistically by using the method of analysis of variance (ANOVA) and critical difference (C.D.). The significance and non-significance differences observed were analysed critically within and between combinations of treatments. Yadav et al., (2018) reported that the physicochemical properties in different brands of jam, honey and jelly. The results obtained from the analysis are on the basis of average data of jam, honey and jelly in triplets of different parameters and Sugar analysis of honey jam and jelly.

Sugar Analysis

Jam

Fructose (g/100g)

Fructose in different sample of jam, in triplicate (Table 1), mean value of fructose (g/100g) was found to be 16.68 to 25.09 for different sample (Fig 3).

Table 1: Analysis of sugar profile of jam.

Parameter	Treatment (g/100g)			
	T_1	T_2	T_3	CD
Fructose	19.28[a]	25.09[b]	16.68[c]	0.45
Glucose	20.45[a]	20.61[b]	12.30[c]	0.18
Sucrose	21.44[a]	6.03[b]	34.93[c]	0.15
Maltose	ND	ND	ND	_

Data represent the means of three replicates. Values bearing different superscripts in each row differ significantly (P< 0.05)

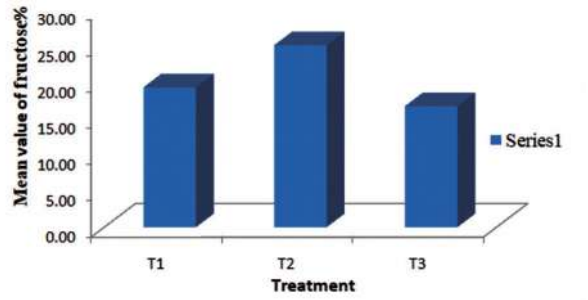


Fig. 3: Graph depicting average percentage of Fructose in different jam samples.

The mean value indicate that sample T2 has highest concentration of fructose (25.09) followed by the sample T1 (19.28) and the lowest value was obtained by sample T3 (16.68).

As evident from the result of ANOVA shows that F calculated value (1383.794) is more than the F tabulated value (6.944) at 5% level of significant. Therefore, the difference was significant between different jam samples. It was further analysed that the difference between the mean value of T1-T2 (5.81), T1-T3 (2.60) and T2-T3 (8.41) was more than the C. D. Value (0.45). Therefore, the difference was significant.

Glucose (g/100)

Glucose in different sample of jam, in triplicate, the mean value of glucose (g/100g) was found to be 12.30 to 20.61 for different sample (Fig. 4). The mean value indicate that sample T_2 has highest concentration of Glucose (20.61) followed by the sample T_1 (20.45) and the lowest value was obtained by sample T3 (12.30).

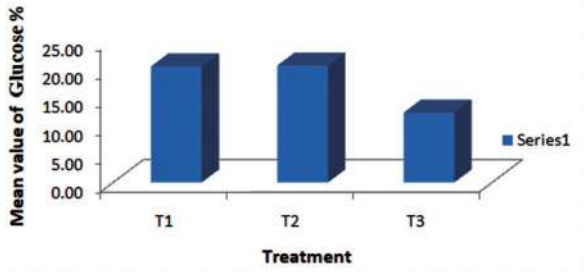


Fig. 4: Graph depicting average percentage of Glucose in different jam sample.

The ANOVA resultsshows that F calculated value (10811.26) is more than the F tabulated value (9.944) at 5% level of significant. Therefore, the difference was significant between different jam samples. The difference between the mean value of T_1-T_3 (8.15) and T_2-T_3 (8.31) was more than the C. D. value (0.18). Therefore, the difference was significant and the difference between the mean value of T_1-T_2 (0.15) was less than the CD. Value (0.18). Therefore, the difference was non-significant.

Sucrose (g/100g)

Sucrose in different sample of jam, in triplicate, the mean value of sucrose (g/100g) was found to be 6.03 to 34.93 for different sample (Fig. 5). The mean value indicate that sample T_3 has highest concentration of sucrose (34.93) followed by the sample T_1 (21.44) and the lowest value was obtained by sample T_2 (6.03). C.D. value at 5% was observed 0.15 and S.Ed. value was 0.05.

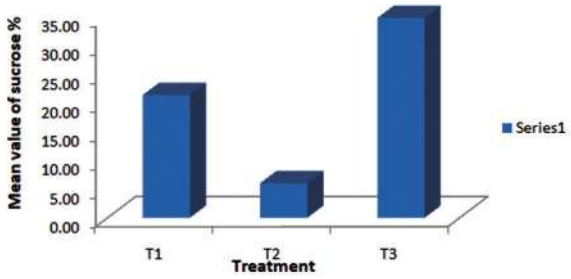


Fig. 5: Graph depicting average percentage of Sucrose in different jam sample.

The result of ANOVA table shows that F calculated value (147803.1) is more than the F tabulated value (6.944) at 5% level of significant. Therefore, the difference was significant between different jam. It was further analysed that the difference between the mean value of T_1-T_2 (15.42), T_1-T_3 (13.49) and T_2-T_3 (28.90) was more than the CD. Value (0.15). Therefore, the difference was significant.

Maltose (g/100g)

Maltose in different sample of honey, in triplicate, the mean value of maltose (g/100g) was found to be as ND for different sample.

Honey

Fructose (g/100g)

Fructose in different sample of Honey, in triplicate (Table 2), the mean value of fructose (g/100g) was found to be 22.79 to 33.66 for different sample (Fig. 6).

Table 2: Analysis of sugar profile of honey.

Parameter	Treatment (g/100g)			
	T_1	T_2	T_3	CD
Fructose	33.66[a]	22.79[c]	23.83[b]	0.23
Glucose	36.02[a]	30.22[a]	31.76[a]	0.12
Sucrose	0.00	16.95	19.06	0.01
Maltose	ND	ND	ND	–

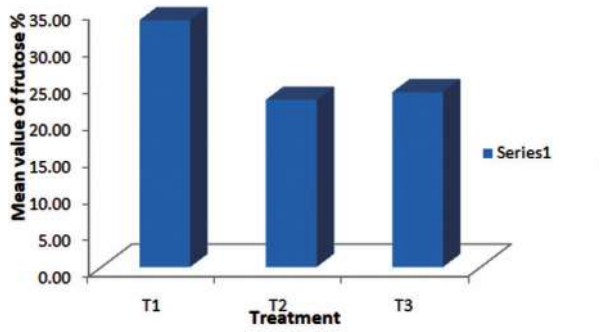


Fig. 6: Graph depicting average percentage of Fructose in different honey samples.

The mean value indicate that sample T_1 has highest concentration of fructose (33.66) followed by the sample T_3 (23.83) and the lowest value was obtained by sample T_2 (22.79).

As evident from the result of ANOVA given that F calculated value (10042.81) is more than the F tabulated value (6.944) at 5% level of significant. Therefore, the difference was significant between different honeys. It was further analysed that the difference between the mean value of T_1-T_2 (10.87), T_1-T_3 (9.83) and T2-T3 (1.04) was more than the C. D. Value (0.23). Therefore, the difference was significant.

Glucose in different sample of honey, in triplicate, the mean value of glucose (g/100g) was found to be 30.22 to 36.02 for different sample (Fig. 7). The mean value indicate that sample T_1 has highest concentration of glucose (36.02) followed by the sample T_3 (31.76) and the lowest value was obtained by sample T_2 (30.22).

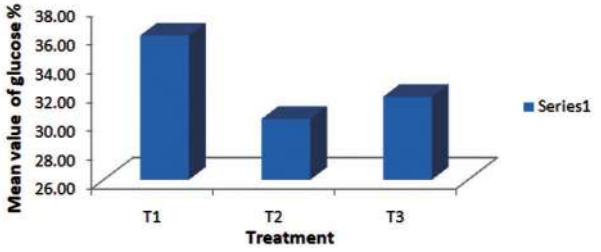


Fig. 7: Graph depicting average percentage of Glucose in different honey samples.

Sucrose in different sample of honey, in triplicate, the mean value of Sucrose (g/100g) was found to be 16.95 to 19.06 for different sample (Fig. 8). The mean value indicate that sample T_3 has highest concentration of Sucrose (19.06) followed by the sample T_2 (16.95) and the zero value was obtained by sample T_1 (0.00).

The ANOVA shows that F calculated value (29481172) is more than the F tabulated value (6.944) at 5% level of significant. Therefore, the difference was significant between different honeys. It was further analysed that the difference between the mean values of T_1-T_2 (16.95), T_1-T_3 (19.06) and T_2-T_3 (2.11) was more than the CD Value (0.01).

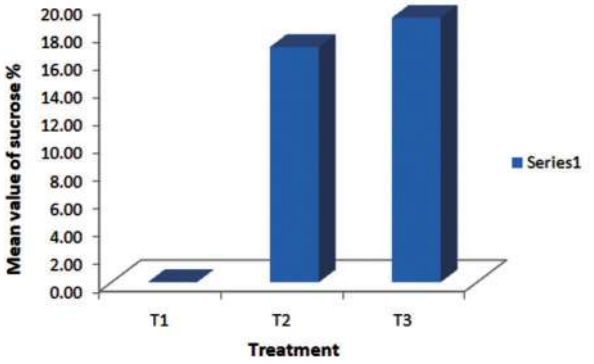


Fig. 8: Graph depicting average percentage of Sucrose in different honey samples.

Therefore, the difference was significant. The data pertaining to maltose in different sample of honey, in triplicate that the mean value of maltose (g/100g) was found to be as ND. for different sample.

Jelly

Fructose in different sample of Jelly, in triplicate (Table 3) that the mean value of fructose (g/100g) was found to be 0.78 to 13.58 for different sample (Fig. 9). The mean value indicate that sample T_1 has highest concentration of fructose (13.58) followed by the sample T_3 (6.68) and the lowest value was obtained by sample T_2 (0.78). Similar, findings was observed by (Giulio, 2006).

Table 3: Analysis of sugar profile of jelly.

Parameter	Treatment (g/100g)			
	T_1	T_2	T_3	CD
Fructose	13.58a	0.78b	6.69b,c	6.75
Glucose	23.30	0.36	17.17	S
Sucrose	27.10a	17.85b	36.95c	0.01
Maltose	0.00	0.00	6.25	-

As evident from the result of ANOVA shows that F calculated value (13.89425) is more than the F tabulated value (6.944) at 5% level of significant. Therefore, the difference exists a significant between different jelly samples. It was further analysed that the difference between the mean value of T_1-T_2 (12.80) and T_1-T_3 (6.87) was more than the CD. Value (6.75). Therefore, the difference was significant. The difference between the mean value of T_2-T_3 (5.91) was less than the CD. Value (6.75). Therefore, the difference was non- significant.

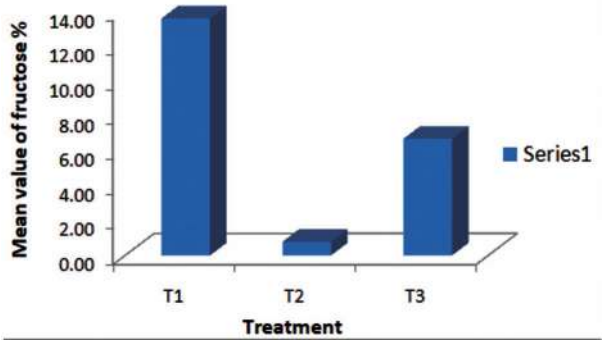


Fig. 9: Graph depicting average percentage of Fructose in different jelly samples.

Glucose in different sample of jelly, in triplicate that the mean value of glucose (g/100g) was found to be 0.36 to 23.30 for different sample (Fig. 10). The mean value indicate that sample T_1 has highest concentration of Glucose (23.30) followed by the sample T_3 (17.17) and the lowest value was obtained by sample T_2 (0.36).

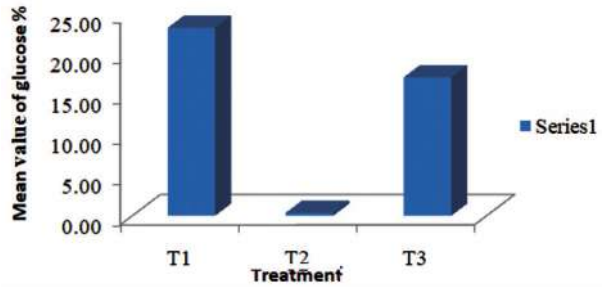


Fig. 10: Graph depicting average percentage of Glucose in different jelly samples.

Sucrose in different sample of Jelly, in triplicate that the mean value of sucrose (g/100g) was found to be 17.85 to 36.95 for different sample (Fig. 11). The mean value indicate that sample T_3 has highest concentration of sucrose (36.95) followed by the sample T_1 (27.10) and the lowest value was obtained by sample T_2 (17.85).It was further analysed that the difference between the mean value of T_1-T_2 (9.25), T_1-T_3 (9.85) and T_2-T_3 (19.10) was more than the CD. Value (0.01). Therefore, the difference was significant.

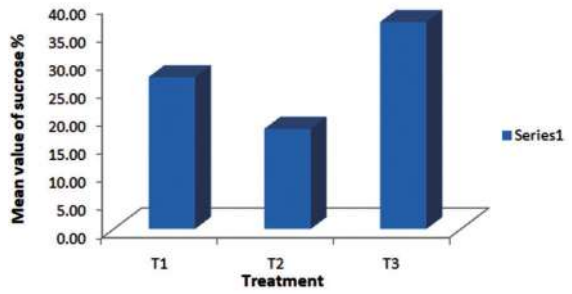


Fig. 11: Graph depicting average percentage of sucrose in different jelly samples.

Maltose in different sample of jelly, in triplicate, that the mean value of Maltose (g/100g) was found to be 0.00 to 6.25 for different sample (Fig. 12). The mean value indicate that sample T_3 has only the concentration of Maltose (6.25) followed by the sample T_1 and T_2 (0.00).

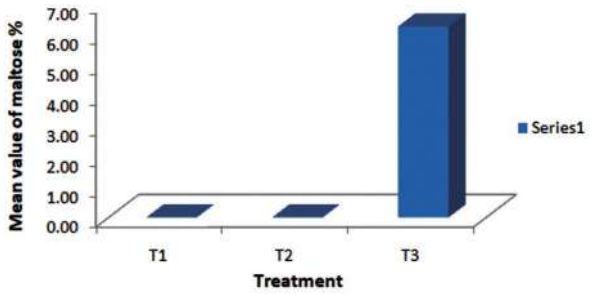


Fig. 12: Graph depicting average percentage of maltose in different jelly samples.

Conclusion

In this study, three samples of honey, jam and jelly were investigated for sugar contents by using the instrument HPLC. Sucrose was found to be in high amount in the product of jam and jelly and this sugar contain a large amount of fructose (50%). So, intake of this sugar is harmful to our body because fructose is metabolized only by liver that means a large amount of VLD is produced along with fat. Also,it cannot be controlled by brain as brain resists leptin (a protein for energy intake regulation and to check the efficacy of metabolism). In honey, glucose was found to be in high amount and this sugar level was above the limit of FSSAI. Excess consumption of glucose causes cardiovascular diseases so this honey is not good for human health.

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