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# Utilization of Overripe Discardable Fruits of Pineapple and Banana for Preparing Value - Added Products

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**Abstract:** ***A study was done to utilize over ripe discardable fruits of pineapple and banana for jam preparation. Three over ripe perishable varieties of banana: Palayankodan, Njalipoovan and Karpooravalli and a Vazhakulam pineapple variety was used for jam preparation. Pineapple and banana were mixed in the ratios of 100: 0, 75: 25, 50: 50, 25: 75 and 0: 100 respectively. This combination was maintained same for all banana varieties. In total there were 13 treatments prepared for this experiment. After jam preparation, various quality parameters were analysed for all treatments that included physical, chemical and sensory properties of jam. The sensory properties were evaluated by a sensory panel. The results indicated an overall consumer acceptance for pineapple: banana treatments with combination ratio of 50: 50 (Palayankodan); 75: 25 (Njalipoovan) and 75: 25 (Karpooravalli). The same treatment combinations were further utilized for sugar - free jam preparation by replacing sugar with sucralose and sorbitol. The quality characteristic of both sugar and sugar - free jams were comparable, however, higher consumer preference was for sugar included jams. The overall consumer acceptance was higher for 75: 25 (Njalipoovan) in sugar - free jam category. Conclusively, over ripe discarded fruits can be efficiently used for making value - added products like jam.***

**Keywords:** Perishable, Jam, Physicochemical, Sensory parameters, Sugar - free jam

## 1. Introduction

Fruits occupy a significant proportion and position in human diet. Pineapple (*Ananas comosus* L. Merr) and Banana (*Musa sp.)* are two important tropical fruits of Kerala, cultivated widely all over the state. The annual production of banana and pineapple in Kerala are 5.3 lakh tonnes and 0.75 lakh tonnes respectively (Agricultural Statistics 2013 - 14, Govt. of Kerala).

Although the production is massive, high postharvest losses have been observed in these fruit crops due to their high perishability and mishandling. The fruits are known to possess high nutritional value and sugar level with appreciable flavour. The market value of these fruits is also reduced due to the glut during the harvesting time. Hence, value addition through processing would be the only effective tool for economic utilization of these fruits.

Jam is a product made by boiling fruit pulp with sufficient quantity of sugar to a reasonably thick consistency, firm enough to hold the fruit tissues in position. Desrosier and Desrosier (1978) defined jam as a semisolid food made from not less than 45% (by w/w) fruit and 55% (by w/w) sugar. This substrate is concentrated to 65% or above soluble solids. Patel and Naik (2013) prepared blended jam using banana cv. Grand Naine and pineapple cv. Queen and observed that jam prepared from banana: pineapple 25: 75 as well as 50: 50 proportions were equally best.

High sugar content of jam may cause diabetic problems. Kerala is the diabetic capital of India with a prevalence of diabetes as high as 20%, double the national average of 8% (Mohan *et al.*, 2007). Several studies from different parts of Kerala support the high prevalence of diabetes. The chances of diabetes can be reduced by using diabetic friendly low - calorie jam. Sugar free or diabetic friendly jam can be prepared by replacing artificial sugar in the optimum quality jam with non - calorie sweeteners (like sucralose, sorbitol, etc.). The growing concern with health and the higher incidence of obesity, metabolic syndrome and diabetes has resulted in an increase in interest for foods with reduced lipids and sugar (Ogden *et al*., 2006; Dabelea *et al*., 2007). With increased consumer interest in reducing sugar intake, food products made with sweeteners rather than sugar become more popular (Pinheiro *et al*., 2005).

Determining the best sweetener for a product requires several sensory tests. These sweeteners, in addition to being safe, meeting current law, must be compatible with the food and present the greatest similarity to the characteristic flavour of the sucrose - based product (Fernandes *et al*., 2001). Furthermore, it is desirable that the sweetener have a low calorie density and commercial viability (Malik *et al*., 2002). According to Cardello *et al*. (1999), the replacement of sucrose by alternative sweeteners can produce changes in the perception of bitter and sweet tastes.

This study deals with the utilization of overripe discardable fruits of pineapple and banana for jam preparation and their physical, chemical and sensory analysis to select ideal proportion of pulp mix for optimum quality jam preparation. Preparation of diabetic friendly low - calorie jam and comparison of physicochemical as well as sensory properties of low - calorie jam with normal jam was also done.

## 2. Materials and Methods

The present study was conducted at Pineapple Research Station (PRS), Vazhakulam, Kerala, India. Overripe fruits of pineapple and banana and other ingredients required for this study were procured from Vazhakulam and Ernakulam wholesale market of Kerala. Fruits were picked at much ripened stage without any pathological damage. Three over ripe perishable varieties of banana popular in Kerala: *Palayankodan*, *Njalipoovan* and *Karpooravalli* along with Vazhakulam pineapple (*Mauritius* var.) were used for jam preparation. Two kinds *viz*. normal and diabetic friendly low calorie jams were prepared. Normal jam contains standard materials like sugar, citric acid and pectin powder. Low - calorie jam contains malto - dextrin, sorbitol and sucralose in addition to citric acid and pectin.

Pineapple fruits were peeled carefully with clean sharp knife, cut into four halves; central fibrous portion was removed and pulped in a blender. Clear fruit pulp was obtained by squeezing the fruit pulp through muslin cloth. Banana fruits were peeled by hand and cut into small pieces after removing central portion. Pulp was prepared by homogenizing the fruit pieces in blender. Blending ratio of pineapple and banana pulp was given in Table 1. Combination was maintained same for all banana varieties.
Jams were prepared as per the procedure adopted in PRS, Vazhakulam (Lal *et al*., 1986). End point was determined using refractometer method, drop test or sheet test. After the preparation, jam poured in to sterilized bottle in hot condition. After cooling, mouth was closed and bottles were kept under ambient condition. In diabetic friendly jam sucralose and sorbitol was used as sweeteners instead of sugar. Malto - dextrin was addedto get bulkiness. In total there were 13 combinations prepared for this experiment.

The prepared jams were tested for physicochemical parameters *viz*. titratable acidity (% Citric acid using titration), total soluble solids (TSS, °Brix, using Digital refractometerHI 96801), ascorbic acid (mg/100g, using titration), moisture (%, using oven dry method) and ash content (%, using muffle furnace) according to the procedure described by AOAC (1998) and Ranganna (1986). Sensory analysis of fresh jam samples were conducted by nine untrained panellists using blind test. The sensory evaluation for colour, texture, taste and overall acceptability were done in order to determine consumer acceptability. These parameters were evaluated based on 9 point hedonic scale (Amerine *et. al*., 1965). The scale ranged from 1 – dislike extremely to 9 – like extremely. Statistical analysis was done using Microsoft Excel – 08.

Based on physicochemical and sensory parameters, best 3 samples from each banana variety were selected. The same treatment combinations were further utilized for sugar - free jam preparation by replacing sugar with sucralose and sorbitol. The quality characteristic of both sugar and sugar - free jams were compared.

## 3. Results and Discussion

**Titratable Acidity**
The mean values of titratable acidity (% citric acid) of jam (Table 2) were found almost similar in all samples. It was maximum in $J_1$ (Pineapple jam) and minimum in $J_3$ (Pineapple: *Palayankodan*, 50: 50) and $J_{11}$ (Pineapple: *Karpooravalli*, 50: 50). All other samples have same titratable acidity. These findings were almost in accordance with results obtained by Patel and Naik (2013). Values (Table 4) of $D_2$ (Pineapple: *Njalipoovan*, 75: 25) and $D_3$ (Pineapple: *Karpooravalli*, 75: 25) werefound equal. These values were somewhat in accordance with the observations of Muhammad *et al*. (2009) in diet apple jam, Correa *et al*. (2011) in guava jam. Same proportion of normal and diabetic friendly jam possessed same acidity values.

**Ascorbic Acid**
The mean values of ascorbic acid (mg/100g) of jam (Table 2) were found highest in $J_1$ (Pineapple jam) and $J_{10}$ (Pineapple: *Karpooravalli*, 75: 25) and lowest in $J_5$ (*Palayankodan* jam) and $J_9$ (*Njalipoovan* jam). Samples with same proportion of fruit pulp gave very close values. Processing may decrease the ascorbic acid content. This kind of observations were also recorded by Patel and Naik (2013), Sakir *et al*. (2008) in apple and pear mixed fruit jam and Sawant *et al*. (2009) in kokam - pineapple blended jam. Values (Table 4) of samples $D_1$ (Pineapple: *Palayankodan*, 50: 50) and $D_2$ (Pineapple: *Njalipoovan*, 75: 25) were equal and less than sample $D_3$ (Pineapple: *Karpooravalli*, 75: 25). These results were more or less similar with study of Muhammad *et al*. (2009) in diet apple jam. Values of samples $D_1$ and $D_3$ were similar as that of same proportion of normal jam, while value of $D_2$ was less.

**Total Soluble Solids (TSS)**
Mean TSS content (Table 2) of prepared jam was found to be maximum in $J_1$ (Pineapple jam) and minimum in $J_4$ (Pineapple: *Palayankodan*, 25: 75). Higher TSS content values were obtained by Singh *et al*. (2009) in mixed jams of pineapple and papaya (70.5°Brix) as well as in mixed jams of papaya and orange (72.5°Brix). The TSS content is responsible for a higher or lower acceptance of the product, and jams with TSS content between 65 and 70°Brix had a good sensory acceptance according to several authors (Lago *et al*., 2006; Damiani *et al*., 2008). TSS (Table 4) of prepared sugar - free jam was highest in $D_3$ (Pineapple: *Karpooravalli*, 75: 25) and lowest in $D_2$ (Pineapple: *Njalipoovan*, 75: 25). The values were approximately similar with the findings of Youssef and Mousa (2012) in Baladi rose petals jam. But findings of Muhammad *et al*. (2009) in diet apple jam, Correa *et al*. (2011) in guava jam were less compared to these values. These values were less compared to same proportion of normal jam.

**Moisture**
The mean moisture content (Table 2) ranged from 9.52% (Pineapple jam) to 18.50% (Pineapple: *Palayankodan*, 25: 75) which were comparatively less compared to values observed by Viana *et al*. (2012) in mixed jams of papaya (25.99% to 29.93%). It is important to note that moisture content is directly related to the conservation of product in storage, and jams with lower moisture content have a longer

shelf - life. According to Eke and Owuno (2013), jackfruit jam had higher moisture content than pineapple jam and there was a significant difference in moisture between the pineapple and jackfruit jam. Moisture content (Table 4) of sugar - free jam showed almost similar range of values with normal jam of same proportion. It was highest in $D_2$ (Pineapple: *Njalipoovan*, 75: 25) and lowest in $D_3$ (Pineapple: *Karpooravalli*, 75: 25). These values were not in accordance with the observations of Muhammad *et al*. (2009) in diet apple jam, Correa *et al*. (2011) in guava jam, while approximately equal to the findings of Youssef and Mousa (2012) in Baladi rose petals jam. Values of same proportion of normal and sugar - free jam was given in Figure 1.

**Ash Content**

Ash content (Table 2) gives an indication of minerals present in a particular food sample and it is very important in many biochemical reactions which aid physiological functioning of major metabolic processes in the body. The mean values ranged from 0.45% to 0.69%. The lowest value was found in case of pineapple jam while highest value for *Karpooravalli* jam. Lower ash content is due to increased activities of microorganism utilizing the minerals for growth (Ashaye *et al*., 2006). Ash content (Table 4) values of sugar - free jam was in the same range as of normal jam samples. The values ranged from 0.51 to 0.62%. Sample $D_3$ (Pineapple: *Karpooravalli*, 75: 25) showed higher value and $D_2$ (Pineapple: *Njalipoovan*, 75: 25) showed lower value. Findings of Correa *et al*. (2011) in guava jam was similar with these values.

**Colour**

Colour acceptability of jam (Table 3) was found highest in $J_1$ (Pineapple jam) and$J_{10}$ (Pineapple: *Karpooravalli*, 75: 25) due to the maximum concentration of pineapple pulp that have golden yellowish colour and lowest in $J_4$ (Pineapple: *Palayankodan*, 25: 75) which was at par with $J_{13}$ (*Karpooravalli* jam) and $J_9$ (*Njalipoovan* jam). Colour is one of the most important parameter that determines the acceptability at first sight. The observations were similar to the findings of Patel and Naik (2013) in pineapple and banana jam, Priya *et al*. (2010) in mixed fruit jam and Relekar *et al*. (2010) in sapota jam. Colour acceptability score (Table 5) was highest in $D_2$ (Pineapple: *Njalipoovan*, 75: 25) followed by $D_3$ (Pineapple: *Karpooravalli*, 75: 25) and $D_1$ (Pineapple: *Palayankodan*, 50: 50). The values were almost similar with values obtained for same proportion of normal jam except in $D_3$. These observations were comparatively less with the findings of Youssef and Mousa (2012) in Baladi rose petals jam, Muhammad *et al*. (2009) in diet apple jam.

**Texture**

Texture acceptability of prepared jam was found highest in $J_3$ (Pineapple: *Palayankodan*, 50: 50) which was at par with $J_8$ (Pineapple: *Njalipoovan*, 25: 75) and lowest in $J_{13}$ (*Karpooravalli* jam) which was at par with $J_5$ (*Palayankodan* jam) and$J_{12}$ (Pineapple: *Karpooravalli*, 25: 75). The texture of jam samples depend upon the blending effect of both fruits which in turn responsible for the gelling and firming of softened finished product. The observations were similar to the findings of Patel and Naik (2013) in pineapple and banana jam, Priya *et al*. (2010) in mixed fruit jam and Relekar *et al*. (2010) in sapota jam. Texture acceptability was highest in $D_1$ (Pineapple: *Palayankodan*, 50: 50) and lowest in $D_3$ (Pineapple: *Karpooravalli*, 75: 25). These observations were comparatively less with the findings of Youssef and Mousa (2012) in Baladi rose petals jam, Muhammad *et al*. (2009) in diet apple jam. Texture scores were slightly less compared to scores of normal jam.

**Taste**

Taste acceptability was maximum for $J_{10}$ (Pineapple: *Karpooravalli*, 75: 25) which was at par with $J_1$ (Pineapple jam) and lowest in $J_4$ (Pineapple: *Palayankodan*, 25: 75). These observations were somewhat similar with the findings of Patel and Naik (2013) in pineapple and banana jam, Shakir *et al*. (2008) in apple and pear mixed fruit jam. Taste score (Table 5) was highest in $D_2$ (Pineapple: *Njalipoovan*, 75: 25) and lowest in $D_1$ (Pineapple: *Palayankodan*, 50: 50). The observations were comparatively less with the findings of Youssef and Mousa (2012) in Baladi rose petals jam, Muhammad *et al*. (2009) in diet apple jam. Taste scores were in accordance with normal jam scores except in $D_3$.

**Overall Acceptability**

The overall acceptability score was highest in $J_{10}$ (Pineapple: *Karpooravalli*, 75: 25) followed by $J_1$ (Pineapple jam) and lowest in $J_{13}$ (*Karpooravalli* jam). The observations were similar to the findings of Patel and Naik (2013) in pineapple and banana jam, Priya *et al*. (2010) in mixed fruit jam and Relekar *et al*. (2010) in sapota jam. Score of diabetic friendly jam was comparatively less than same proportion of normal jam. The value was higher for $D_2$ (Pineapple: *Njalipoovan*, 75: 25) and lower for $D_1$ (Pineapple: *Palayankodan*, 50: 50). The decrease in acceptability may be due to the replacement of sucrose with other sweeteners. These observations were comparatively less with the findings of Youssef and Mousa (2012) in Baladi rose petals jam, Muhammad *et al*. (2009) in diet apple jam. Comparison of sensory score of 75: 25 (Pineapple: *Kapooravalli*) normal and sugar - free jam was given in Fig.2.

## 4. Conclusion

From the observations of the study it was possible to prepare value added products like jam successfully from overripe discardable fruits of pineapple and banana. All three banana varieties *viz. Palayankodan*, *Njalipoovan* and *Karpooravalli* used in this study were almost similarly effective and acceptable for jam preparation in combination with Vazhakulam pineapple. Three ideal proportions of pineapple and banana mix selected mainly based on their sensory parameters were 50: 50 (*Palayankodan*), 75: 25 (*Njalipoovan*) and 75: 25 (*Karpooravalli*). Preparation of sugar - free jam by replacing sugar with sucralose and sorbitol provided almost same intensity of sweetness with low - calorie. The overall consumer acceptance was higher for 75: 25 (*Karpooravalli*) in normal jam and 75: 25 (*Njalipoovan)* in sugar - free jam.

## References

[1] Agricultural Statistics 2013 - 2014., 2015. Department of Economics & Statistics, Govt of Kerala, Thiruvananthapuram.

[2] Amerine, M. A., Pangborn, R. M. and Roessles, E. B., 1965. Principles of sensory evaluation of foods. Academic Press, New York, pp: 349.

[3] AOAC, 1998. The Association of Analytical Chemists: Official methods for analysis. Washington, U. S. A.

[4] Ashaye, O. A., Taiwo, O. O. and Adegoke, G. O., 2006. Effect of local preservatives *Aframomum danielli* on the chemical and sensory properties of stored warakanshi. *African Journal of Agricultural Research* 1 (1): 10 - 16.

[5] Belitz, D - and Grosch W., 1999. Food chemistry, 2nd edition. Springer – Verag. Berlin German, p.987.

[6] Cardello, H. M. A. B., Silva, M. A. A. P. and Damasio, M. H., 1999. Measurement of the relative sweetness of stevia extract, aspartame and cyclamate/saccharin blend as compared to sucrose at different concentrations. *Plant Foods for Human Nutrition*, 54, 119 - 130.

[7] Correa, R. C. G., Sora, G. T. S., Haminiuk, C. I. W., Ambrosio - Ugri, M. C. B., Bergamasco, R. and Vieira, A. M. S., 2011. Physico - chemical and sensorial evaluation of guava jam made without added sugar. *Chemical Engineering Transactions, 24*, pp.505 - 510.

[8] Dabelea, D., Bell, R. A., D'Agostino Jr, R. B., Imperatore, G., Johansen, J. M., Linder, B., Liu, L. L., Loots, B., Marcovina, S., Mayer - Davis, E. J. and Pettitt, D. J., 2007. Incidence of diabetes in youth in the United States. *Jama*, *297* (24), pp.2716 - 2724.

[9] Damiani, C., Vilas Boas, E. V. B., Soares Junior, M. S., Caliari, M., Paula, M. L., Pereina, D. E. P. and Silva, A. G. M., 2008. Physical, sensory and microbiological analysis of mango jams formulated with different levels of peels in substitution to pulp. *Ciência Rural*, 38, 1418 - 1423.

[10] Dauthy, M. K., 1995. Fruit and vegetable processing. FAO Agricultural services bulletin No 119. FAO of United Nations, Rome, p.203.

[11] Desrosier, N. W. and Desrosier, J. N., 1978. The technology of food preservation.4th Edn. AVI Publishing Co. Inc. Westport, Connecticut.

[12] Eke - Ejiofor, J. and Owuno, F., 2013. Physico - chemical and sensory properties of jackfruit (Artocarpus heterophilus) jam. *International Journal of Nutrition and Food Sciences*. Vol.2, No.3, pp.149 - 152.

[13] Fernandes, L. M., Pereira, N. C., Mendes, E. S., Lima, O. C. M. L. and Costa. S. C., 2001. Clarification of aqueous extract of Stevia rebaudiana (Bert.) Bertoni using cactus, Cerus peruvianus. *Acta Scientiarum*, 23, 1369 - 1374.

[14] Jaiswal, S. G., Patel, M. and Naik, S. N., 2015. Physico - chemical properties of Syzygium cuminii (L.) Skeels jam and comparative antioxidant study with other fruit jams. *Indian Journal of Natural Products and Resources (IJNPR) [Formerly Natural Product Radiance (NPR) ]*, *6* (1), pp.9 - 15.

[15] Lago, E. S., Gomes, E. and Silva, R., 2006. Production of Jambolan (*Syzygiumcumini* Lamarck) Jelly: Processing, physical - chemical properties and sensory evaluation. *Ciência e Technologia de Alimentos*, 26, 847 - 852.

[16] Lal, G., Siddappa, G. S. and Tandon, G. L.1986. Preservation of Fruits and Vegetables. ICAR publications, pp.192 - 193.

[17] Malik, A., Jeyarani, T. and Raghavan, B., 2002. A comparison of artificial sweeteners stability in a lime - lemon flavoured carbonated beverage. *Journal of FoodQuality*, 25, 75 - 82.

[18] Mohan, V., Sandeep, S., Deepa, R., Shah, B. and Varghese, C., 2007. Epidemiology of type 2 diabetes: Indian scenario. *Indian journal of medical research*, *125* (3), p.217.

[19] Muhammad, A., Durrani, Y., Ayub, M., Zeb, A. and Ullah, J., 2009. Organoleptic evaluation of diet apple jam from apple grown in Swat valley. *Sarhad J. Agri*.25 (1), 81 - 86.

[20] Mulla, A. M., 2007. Standardization of mixed fruit jam technology based on sapota [Manikara achras (Mill.) Fosberg] fruits. Unpublished M. Sc. thesis submitted to N. A. U., Navsari.

[21] Ogden, C. L., Carroll, M. D., Curtin, L. R., Mcdowell, M. A., Tabak, C. J. and Flegal, K. M., 2006. Prevalence of overweight and obesity in the United States, 1994 - 2004. *Journal of the American Medical Association*, 295, 1549 - 1555.

[22] Patel, N. V. and Naik, A. G., 2013. Studies on standardization of pulp proportion for banana - pineapple blended jam during storage. *International Journal of Processing and Post Harvest Technology*, *4* (2), pp.63 - 69.

[23] Pinheiro, M. V. S., Oliveira, M. N., Penna, A. L. B. and Tamime, A. Y., 2005. The effect of different sweeteners in low - calorie yogurts - a review. *International Journal of Dairy Technology*, 58, 193 - 199.

[24] Priya, B., Shankar, R. and Murari., 2010. Optimization of process for mixed fruit jam using sweeteners. *Beverage and Food World*, 37 (7): 56 - 58.

[25] Ranganna, S., 1986. Handbook of Analysis and Quality Control for Fruit and Vegetable Products. Tata Mac Graw Hill Publishing Company Ltd., New Delhi.

[26] Relekar, P. P., 2010. Value added products of sapota *(Manilkara achras (Mill) Fosberg) cv* Kalipatti (Doctoral dissertation, Navsari Agricultural University, Navsari).

[27] Sawant, A. A., Kad, V. P. and Thakor, N. J., 2009. Preparation of kokum - pineapple blended jam. *Beverage and Food World*, 36 (12): 28 - 30.

[28] Shakir, I., Durrani, Y., Hussain, I., Mabood Qazi, I. and, Zch, A., 2008. Physicochemicalanalysis of apple and pear mixed fruit jam prepared from varieties grown in Azad Jammu and Kashmir. *Pakistan J. of Nutri.7* (1): 177 - 180.

[29] Viana, E. S., Jesus, J. L., Cardoso, R., Andrade, M. V. S. and Sacramento, C. K., 2014. Physicochemical and sensory characterization of banana and araçá - boi jam. *Food and Nutrition Sciences*, 5, 733 - 741.

[30] Viana, E. S., Jesus, J. L., Reis, R. C., Fonseca, M. D. and Sacramento, C. K., 2012. Physicochemical and sensorial characterization of papaya and Araçá Boi jelly. Revista Brasileira de Fruticultura, 34, 1154 - 1164.

[31] Youssef, H. M. K. E. and Mousa, R. M. A., 2012. Nutritional assessment of low - calorie Baladi rose petals jam. *Food and Public Health*, 2 (6), 197 - 201.

**Table 1:** Proportion of pulp used for jam ($J_n$) preparation

| Sample | Blending Ratio (Pineapple: Banana) in Percentage | | | |
|---|---|---|---|---|
| | Pineapple | Banana Varities | | |
| | | *Palayankodan* | *Njalipoovan* | *Karpooravalli* |
| $J_1$ | 100 | - | - | - |
| $J_2$ | 75 | 25 | - | - |
| $J_3$ | 50 | 50 | - | - |
| $J_4$ | 25 | 75 | - | - |
| $J_5$ | - | 100 | - | - |
| $J_6$ | 75 | - | 25 | - |
| $J_7$ | 50 | - | 50 | - |
| $J_8$ | 25 | - | 75 | - |
| $J_9$ | - | - | 100 | - |
| $J_{10}$ | 75 | - | - | 25 |
| $J_{11}$ | 50 | - | - | 50 |
| $J_{12}$ | 25 | - | - | 75 |
| $J_{13}$ | - | - | - | 100 |

**Table 2:** Physicochemical Analysis of Jam

| Sample | Acidity | Ascorbic acid | TSS | Moisture | Ash |
|---|---|---|---|---|---|
| $J_1$ | 0.63 | 24.24 | 82.4 | 9.52 | 0.45 |
| $J_2$ | 0.56 | 21.21 | 77.4 | 12.95 | 0.51 |
| $J_3$ | 0.49 | 18.18 | 76.5 | 13.02 | 0.52 |
| $J_4$ | 0.56 | 18.18 | 71.3 | 18.50 | 0.57 |
| $J_5$ | 0.56 | 12.12 | 76.1 | 13.77 | 0.66 |
| $J_6$ | 0.56 | 21.21 | 80.3 | 10.27 | 0.53 |
| $J_7$ | 0.56 | 18.18 | 74.2 | 15.16 | 0.54 |
| $J_8$ | 0.56 | 15.15 | 72.6 | 17.01 | 0.56 |
| $J_9$ | 0.56 | 12.12 | 73.2 | 16.91 | 0.67 |
| $J_{10}$ | 0.56 | 24.24 | 81.7 | 9.88 | 0.55 |
| $J_{11}$ | 0.49 | 21.21 | 77.9 | 11.29 | 0.58 |
| $J_{12}$ | 0.56 | 18.18 | 80.1 | 10.91 | 0.59 |
| $J_{13}$ | 0.56 | 15.15 | 76.7 | 13.24 | 0.69 |

**Table 3:** Sensory score (hedonic scale – 1 - 9) for Jam

| Sample | Colour | Texture | Taste | Overall Acceptability |
|---|---|---|---|---|
| $J_1$ | 8.2 | 6.5 | 7.5 | 7.7 |
| $J_2$ | 6.2 | 6.5 | 6.5 | 6.7 |
| $J_3$ | 5.5 | 7.2 | 6.5 | 6.8 |
| $J_4$ | 4.3 | 5.6 | 5.2 | 5.4 |
| $J_5$ | 5.2 | 5.3 | 6.2 | 5.8 |
| $J_6$ | 7.0 | 6.2 | 6.5 | 7.1 |
| $J_7$ | 5.0 | 5.6 | 5.6 | 5.5 |
| $J_8$ | 5.8 | 7.0 | 6.5 | 7.0 |
| $J_9$ | 4.7 | 5.6 | 5.8 | 5.5 |
| $J_{10}$ | 8.2 | 6.6 | 7.6 | 8.0 |
| $J_{11}$ | 6.4 | 6.5 | 7.0 | 6.7 |
| $J_{12}$ | 5.6 | 5.4 | 5.7 | 5.8 |
| $J_{13}$ | 4.4 | 5.2 | 5.5 | 5.3 |

**Table 4:** Physicochemical Analysis of Diabetic Friendly Low - calorie Jam

| Sample | Acidity | Ascorbic Acid | TSS | Moisture | Ash |
|---|---|---|---|---|---|
| $D_1$ | 0.49 | 18.18 | 73.4 | 16.07 | 0.58 |
| $D_2$ | 0.56 | 18.18 | 69.8 | 19.85 | 0.51 |
| $D_3$ | 0.56 | 24.24 | 78.9 | 10.52 | 0.62 |

**Table 5:** Sensory Score (hedonic scale – 1 - 9) for Diabetic Friendly Low - calorie Jam

| Sample | Colour | Texture | Taste | Overall Acceptability |
|---|---|---|---|---|
| $D_1$ | 5.3 | 6.3 | 6.0 | 6.0 |
| $D_2$ | 7.3 | 6.0 | 6.7 | 6.7 |
| $D_3$ | 5.5 | 5.5 | 6.0 | 6.3 |

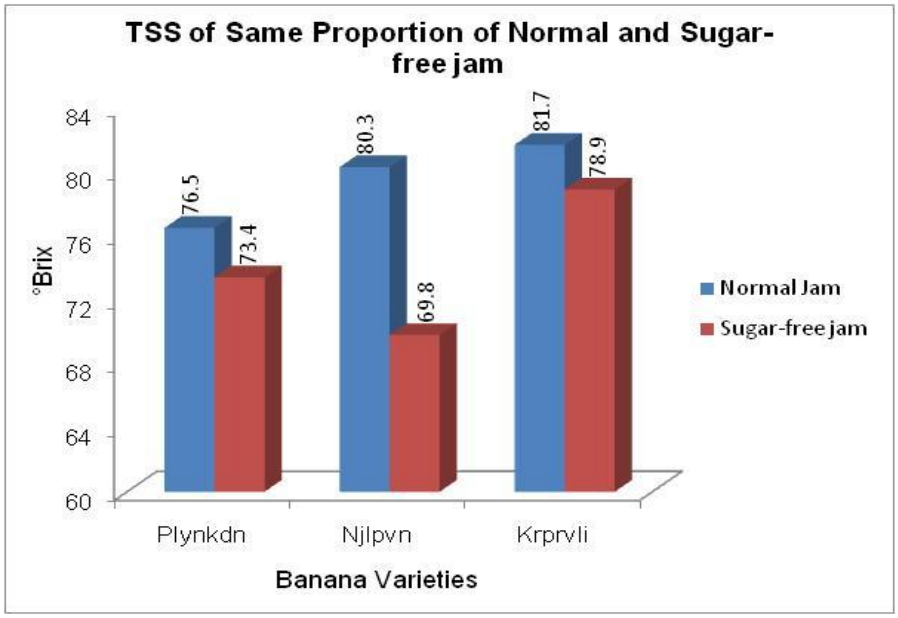


**Figure 1:** TSS content of Same Proportion of Normal and Sugar - free jam

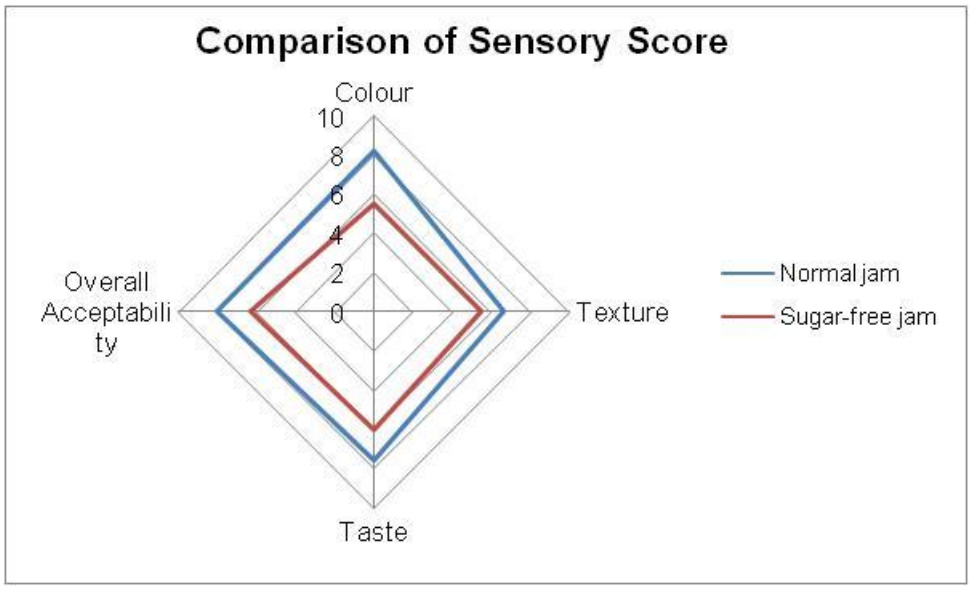


**Figure 2:** Comparison of sensory score of 75: 25 (*Karpooravalli*) normal and sugar - free jam