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Evaluation of qualitative attributes of papaya leather

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■ **ABSTRACT :** India is major producer of papaya after Brazil and Indonesia. Papaya contains the digestive enzyme papain and valuable for aiding digestion. The antioxidant nutrients found in papaya including vitamin-C, vitamin-E and beta carotene. Papaya is easily digestible and prevents constipation. Fruit leather is ready to eat, semi- moist food with soft gel like texture obtained by dehydration of fruit purees into leathery sheets. Study of quality attributes like physio-chemical, sensory and microbiological properties of fruit leather resulted better and acceptable products. Experiments were conducted to investigate the effect of various sweeteners and packaging materials on physico-chemical, microbiological properties and sensory characteristics of fresh as well as stored papaya leather. The citric acid levels of 0.5 per cent, 0.75 per cent and 1.0 per cent were used for sweeteners as sugar, $sugar_{75}$+ $jaggery_{25}$, $sugar_{50}$+ $jaggery_{50}$, $sugar_{25}$+ $jaggery_{75}$ and jaggery. After preparation of papaya leather, the finished products were packed in two packaging material *viz.*, LDPE and HDPE and stored at room temperature for quality evaluation at 15 days interval upto 90 days. The study revealed that the moisture content increased with citric acid levels in case of all different sweeteners. The values of moisture content were found to have decrease after 15, 30, 45, 60 and 90 days of storage. The data showed that the samples packed in LDPE more decreases as compared to HDPE. The TSS was found to be higher for fresh samples prepared by sugar as sweeteners at all levels of citric acid. TSS of samples packed in HDPE were found to be higher than LDPE at the same level of citric acid. pH of samples after 90 days of storage periods prepared by sugar as a sweeteners were found to be lower than that of $sugar_{75}$+ $jaggery_{25}$, $sugar_{50}$+ $jaggery_{50}$, $sugar_{25}$+ $jaggery_{75}$ and jaggery at all levels of citric acid. Data obtained for browning index after 15, 30, 45, 60, 75 and 90 days of storage indicated that in case of all samples, the values increased for all different sweeteners. The study revealed that vitamin-C content of fresh papaya leather sample decreased with increase in citric acid levels in case of all sweeteners. In microbiological studies, the yeast and mold count and total plate count were found safe for consumption after 90 days of storage. Samples prepared by sugar as a sweeteners exhibited the highest overall sensory scores 7.64 and 7.60 for samples packed in HDPE and LDPE, respectively after 90 days of storage periods at the level of 0.75 per cent citric acid. It concluded that sugar as sweeteners gave better products after 90 days of storage followed by others at the level of 0.75 per cent citric acid. The HDPE was found suitable packaging material for storage of papaya leather.

■ **KEY WORDS :** Papaya, Sweetener, Physico-chemical, Microbiological, Sensory

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India is the second largest producer of fruits and vegetables. About 25-30 per cent produce are wasted due to in adequate facilities of processing, preservation, storage, handling and transportation (Kumar *et al.*, 2010). During the year 2013-14, India's papaya production was 5639.3 thousand metric tonnes (National

Horticulture Board, 2013-14). Papaya is an important source of vitamin- C in the diet of rural population (De arriola *et al.*,1980). Papaya has been described as an excellent source of pro vitamin- A and ascorbic acid (Wenkam and Miller, 1965). The pH of papaya ranges between 5.0 to 5.51 and acidity as 0.12 per cent (Ahmad and Chaudhary, 1995).

The papaya at colour turning stage can be stored at temperatures as low as 7°C for less than 14 days and it will be ripen normally (Thompson and Lee, 1971). Chan *et al.*,1979 observed several changes within the papaya during its development. Sucrose rapidly decreased, glucose and fructose increased correspondingly after 135 days of fruit development. Papain concentration in papaya flesh decreases with ripening. An and Paull, 1990 determined the optimum temperature for fruit ripening in between 22.5 and 27.5°C, with the fruit taking 10-18 days to reach full skin yellowing from the colour brake stage.

Aruna *et al*. (1999) studied the physico-chemical and microbiological quality of papaya fruit bar (Thandra) which was stored at room temperature (25-45°C) for 9 months. The products stored for 6 months were found superior from the textural and odour points of view and with minimum physico- chemical changes. Babalola *et at*. (2002) evaluate the effect of cold temperature storage on the quality attributes of pawpaw and guava leathers. pawpaw leather was significantly higher than guava leather in calorific content, water activity, pH and total mold count throught the duration of storage. Sreemathi *et al*. (2008) obtained a decreasing trend in pH, total sugar and ascorbic acid as well as increasing trend in TSS, acidity and reducing sugar during storage of blended fruit pulp of sapota - papaya 50:50 at room temperature for three months.

Organoleptic qualities of pawpaw (cv. co-2) leather and pawpaw - mango (cv. NEELUM) blended leather (60 : 40) in comparison with plain mango leather were evaluated and the blended leather was superior in most of the quality attributes with no evidence of microbial contamination upto 8 months storage.The products are generally remaining shelf stable and can be stored safely for longer time at room temperature in any type of flexible laminates pouches, PET jar or glass jar. The production of fruit bars after tremendous advantages owing to simplicity and lower production cost besides consumer appeal (Kumar *et al.,* 2003). Azeredo *et al.* (2006) conducted study to produce mango leathers with no preservation and without sugar addition and evaluated their acceptance and storage stability. The mango leathers were packed in polypropylene buckets and stored at room temperature.The product was well accepted and microbiologically stable for at least 6 months without the need for chemical preservation. Fruit leather or bar is ready to eat, semi- moist food with soft gel like texture obtained by dehydration of fruit purees into leathery sheets (Ramesh Kumar *et al*., 2007). The effect of air temperature (50, 60, 70 and 80°C) and sample thickness (1.8, 2.7 and 3.6 mm) on drying kinetics of strawberry fruit leather was investigated and mathematical modelling was performed using three thin layer drying models. The value of activation energy were obtained 35.57, 33.14 and 30.46 KJ mol^{-1} for 1.8, 2.7 and 3.6 mm sample thickness, respectively (Lee and Nsien, 2008). Plain and spiced tomato leathers were prepared using 2 per cent corn flour, acetic acid and 0.7 per cent salt. Leathers were stored well without any deterioration upto three months of storage (Jayalakhsmi and Karthiga,2009). Kumar *et al*. (2010) prepared blended papaya leather by mixing 20, 40, 60 and 80 per cent of guava pulp with that of papaya pulp while plain papaya leather and/or guava leather served as control. The product proposed by mixing 60 per cent papaya with that of 40 per cent guava pulp significantly resulted in a better overall rating for sensory property and without impairing the nutritional and textural quality of the product. Prinkajain (2010) reported that guava and papaya pulp was preserved in airtight glass containers by addition of potassium meta bisulphate @ 2.5 g/kg of pulp. After two months of storage, the guava pulp was found best inorganoleptic characters and qualitative characters for the preparation of mixed fruit leather. Singh *et al*. (2015) investigated the effect of citric acid levels and packaging materials on physico-chemical and sensory quality of fresh and stored papaya leather. The moisture content increased with citric acid levels. The TSS, Vitamin-C decreased with increased in the levels of citric acid. The organoleptic score of leather samples in glass jar at 0.75 per cent citric acid level was found to be higher followed by samples packed in PET Jars. Kumar *et al*. (2015) investigated the effect of sugar and jaggery on the quality characteristics of papaya leather. The quality parameters were done for fresh as well as stored papaya leather for 60 days of storage under room temperature.The acidity

and moisture content decreased with decreased in the level of papaya ratio and acidity values after 60 days of storage. Overall acceptability score for papaya leather prepared with sugar and jaggery ratio sample T_1 (papaya pulp + sugar 650 g) 7.1 in glass jar and the minimum score T_1 6.8 in PET jar at room temperature.

Hunter colour parameter (L, a, b) of grape juice during briling, cooking and of pestil samples (1.53 mm) during drying were investigated and colour changes ocured during grape juice boiling. The hunter a-value changed during hot air or sun drying (Keya *et al.*, 2002). Osmotic dehydration in hot air drying of pineapple cubes by using sucrose solution in able to improve the quality like colour, aroma, texture, appearance as well as overall acceptability. osmotic and infrared drying were reduced the water activity which prevents the microbial growth. The logarithmic model sufficiently described the drying behaviour of blanched pineapple silver. The fick's diffusion model was suitable for experimental results (Kumar and Shukla, 2017).

Therefore, the study was undertaken to study the effect of various sweeteners and packaging materials on qualitative attributes of papaya leather.

METHODOLOGY

Fresh, uniform sizes and fully ripened papaya of Pusa delicious variety were used in the experiment. papaya free from diseases and insets infections were selected for the investigation. The fully ripened papaya was washed with fresh water, peeled and deseeded after that pulping in done by while electric juicer for 10 min. Papaya leather was prepared by adopting the procedure reported by Srivastava and Kumar, 1994. Sugar and citric acid (0.5%) were mixed with juice and boiling is done with continuous stirring for 5 minutes, after that smearing stainless steel trays with mustard oil and mixture is poured into the stainless steel trays. After spreading the mixture into trays, the trays were then placed in the hot air oven at 45°C for 48 hours. The trays were taken out from the hot air oven, cooled and leather was cut into rectangular shape (3.5 x 3.5 x 0.5cm) and packed into LDPE and HDPE at ambient temperature. After prepared papaya leather using sugar as a sweetener with citric acid level of 0.5 per cent above process isagain done for the preparation of papaya leather using sugar as a sweetener with 0.75 per cent and 1.0 per cent citric acid level, respectively. Same procedure was adopted to produce papaya leather using $sugar_{25}$+ $Jaggery_{75}$, $Sugar_{50}$ + $Jaggery_{50}$, $Sugar_{75}$+ $Jaggery_{25}$ and jaggery as a sweeteners with 0.5 per cent, 0.75 per cent and 1.0 per cent citric acid level, respectively.

The digital pH meter was used to determine the pH of the samples. Refractometer is used to measure substances dissolved in water and certain oils. The refractometer works using the principle of light refraction through liquids. Digital spectrophotometer, a compact instrument was used for the analysis of optical density of solution. Digital colony counter is designed for quick and accurate counting of bacterial and molds colonies in petridishes. Hunter colour parameters (L, a, b) of fresh and stored papaya leathers were investigated by using CIE colour space system. Weighing of sample for analysis of moisture content, fat content, ash content, acidity etc was carried out with the help of electronic balance. Samples were served to the panellist and they were asked to rate the acceptability of the product through the sense of organs. Different attributes *viz.*, colour, flavour, texture and taste were rated on the basis of hedonic scale, ranging from 1(extremely dislike/most undesirable) to 9 (extremely like/ most desirable), Renganna, 2001.

RESULTS AND DISCUSSION

The study was undertaken to investigate the effect of various sweeteners and packaging materials on qualitative attributes of papaya leather. The citric acid levels of 0.5 per cent, o.75 per cent and 1.0 per cent were used for sugar, $sugar_{75}$ + $jaggery_{25}$, $sugar_{50}$+ $jaggery_{50}$, $sugar_{25}$ + $jaggery_{75}$ and jaggery as sweeteners. Several physico-chemical parameters (moisture content, TSS, pH, browning index, vitamin-C and ash content), sensory parameters (colour, taste, flavour, texture and overall acceptability) and microbial studies (yeast and mold count and total plate count) were investigated for fresh and stored papaya leather. papaya leather were packed in two packaging materials *viz.*, LDPE and HDPE. Products were stored for quality evaluation after 15, 30, 45, 60, 75 and 90 days under room temperature.

The study revealed that the final moisture content of fresh papaya leather sample prepared with 0.5, 0.75 and 1.0 per cent citric acid levels were found in increasing order for all the samples by different sweeteners. Result showed that the samples prepared with the sugar as a sweeteners had moisture content of 18.61, 18.66, and

18.70 at storages of 15 days (LDPE) for citric acid levels of 0.5, 0.75 and 1.0 per cent, respectively. The similar trends were also obtained for other samples prepared by different sweeteners. The value of moisture content for all samples were prepared by different sweeteners packed in LDPE and HDPE were found to be decreased after 15, 30, 45, 75 and 90 days. The result showed that the total soluble solid decreased with increase in the level of citric acid for all five sweeteners. The fresh sample prepared by sugar as a sweetener had total soluble solid values as 64.38, 64.36 and 64.32°Brix for citric acid level of 0.5, 0.75 and 1.0 per cent. The reason for decreased in total soluble solids with increase citric acid level may be attributed to the final moisture content of fresh samples as these two parameters have inversion correlation. It was also shown that in all cases of sweeteners, the total soluble solids was found to be decrease in 90 days of storage period. Similar pattern of increasing trend was reported by (Gayathri and Uthira, 2008). TSS of sample packed in HDPE were found to be more increasing as compared to samples packed in LDPE after 90 days of storage period in case of all sweeteners at same levels of citric acids. The pH of samples as fresh prepared by sugar as a sweetener were found to be 3.87, 3.84 and 3.81 at citric acid levels of 0.5, 0.75 and 1.0 per cent, respectively. Results revealed that the pH of samples decreased after 15, 30, 45, 60, 75 and 90 days of storage period in case of all samples prepared by different sweeteners. similar pattern of decreasing trend was reported by (Siva Kumar *et al.*, 2005), reason behind that the decreases pH is due to increasesacidity. The decrease was more pronounced in case of samples packed in HDPE as compared to LDPE. Browning index of samples decreased with increase in citric acid level in case of all sweeteners. The samples prepared by sugar as a sweetener has browning index of 0.054, 0.052 and 0.049 at citric acid level of 0.5, 0.75 and 1.0 per cent, respectively at the time of storage in HDPE. The value of browning index increased during 90 days storage period. This increase on non enzymatic browning might be due to decrease in sulpher dioxide (Mir and Nath, 1993). The increase in browning index was found highest for samples packed in HDPE as compared to LDPE. Results revealed that vitamin-C content of fresh leather samples decreased with increased in citric acid level for all sweeteners. The sample prepared by sugar as a sweetener had vitamin-C content as 59.70, 58.30 and 57. 40 mg/100g at 0.5, 0.75 and 1.0 per cent citric acid levels. Reason of decrease in acidity as loss of vitamin-C occurs due to participation in non enzymatic browning reaction with organic acids (Srivastava and Kumar, 1994). ANOVA were generated for all physico-chemical parameters which were significant at 5 per cent level. Study revealed that as microbial growth (TPC values) increases with increase of storage period irrespective of storage periods. The yeast or mold count and total plate count were found safe for consumption after 90 days of storage. The highest microbial growth was observed as 1.110×10^5cfu/ml in case of sample prepared by jaggery as a sweetener and packed in LDPE after 90 days of storage which is safe for consumption as reported by (Sarvanakumar and manimeglai, 2002). Sensory parameters of papaya leather just after preparation and after 30, 60 and 90 days of storage period were evaluated on 9 point scale of hedonic rating test method. Study revealed that the fresh samples of jaggery as a sweetener exhibited better sensory score for colour, flavour and overall quality attributes.Sensory scores decreased rapidly in case of samples prepared by jaggery as a sweetener than those of sugar $sugar_{75}$ + $jaggery_{25}$, $sugar_{50}$ + $jaggery_{50,}$ $sugar_{25}$ + $jaggery_{75}$ as a sweetener at the citric acid level of 0.5, 0.75 and 1.0 per

Table 1 : Effect of sugar sweetener, levels of citric acid and packaging materials on sensory attributes of papaya leather after 90 days of storage

Sensory attributes	Sensory score					
	$PSC_{0.5}$		$PSC_{0.75}$		$PSC_{1.0}$	
	LDPE	HDPE	LDPE	HDPE	LDPE	HDPE
Colour	7.40	7.75	7.80	7.90	7.25	7.30
Flavour	7.20	7.30	7.75	7.80	7.35	7.45
Taste	7.45	7.50	7.45	7.50	7.00	7.15
Texture	7.35	7.30	7.40	7.35	7.45	7.50
Overall acceptability	7.35	7.46	7.60	7.64	7.26	7.35

Ps = Papaya sugar; $C_{0.5}$ = 0.5% citric acid level; $C_{0.75}$ = 0.75% citric acid level; $C_{1.0}$ = 1.0% citric acid level

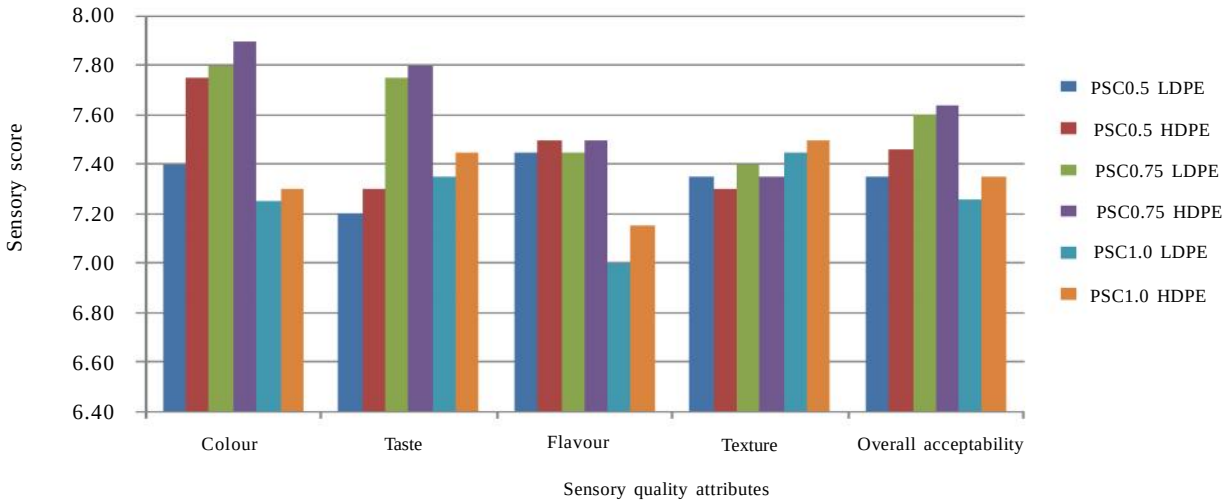

Fig. 1 : Effect of sugar as a sweetener, citric acid levels and packaging materials on sensory quality attributes of papaya leather after 90 days of storage

cent, respectively during storage.

Samples were prepared by sugar as a sweetener gave the highest overall sensory scores as 7.64 and 7.60 for samples packed in HDPE and LDPE, respectively after 90 days of storage periods at the level of 0.75 per cent citric acid. The HDPE was found to be better for packaging to papaya leather followed by LDPE. Table 1 shows the effect of sugar sweeteners, citric acid levels and packaging materials on sensory quality attributes of papaya leather after 90 days of storage at room temperature. Fig. 1 shows the effect of sugar as a sweetener, citric acid levels and packaging materials on sensory quality attributes of papaya leather after storage of 90 days.

Conclusion:

The effect of different sweeteners using various citric acid levels and packaging materials on qualitative attributes of papaya leather was found acceptable upto 90 days storage period. The moisture content values found to be decreased with increase of storage period. The TSS decreased with increase in citric acid levels. The TSS of samples packed in HDPE was found to be higher than samples packed in LDPE at the same level of citric acid. The pH and browning index of sample invariably decreased with increase in citric acid levels in case of all different sweeteners. Data obtained for pH after 15 to 90 days of storage indicate that in case of all samples, the value decreased for all sweeteners whereas the value increased for browning index. Decrease in vitamin- C was also recorded invariably in all samples which were prepared from all sweeteners after storage of 15 - 90 days. The loss was observed maximum in LDPE as compared to HDPE. In microbiological studies, the yeast and molds count and total plate count were found safe for consumption after 90 days of storage. Samples prepared by sugar as a sweetener exhibited the highest overall sensory scores of 7.64 and 7.60 for the sample packed in HDPE and LDPE, respectively after 90 days of storage at the level of 0.75 per cent citric acid. The HDPE was found suitable packaging material for storage of papaya leather.

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REFERENCES

Ahmad, R. and Chaudhary, A. (1995). *Osmotic dehydration of papaya*. Indian Food Packer, July-Agust : 5-9.

An, J.F. and Paull, R.E. (1990). Storage temperature and ethylene influence on ripening of papaya fruit. *J. American Society of Hort. Sci.*, **115** : 949 - 953.

Aruna, K. , Vimela, V. , Dhanalakshmi, K. and Reddy, Vnodini

(1995). Physico-chemical changes during storage of papaya fruit. *J. Food Sci. & Technol.*, (Mysor) **36** (5): 428-433.

Azeredo, H.M.C., Birto, E.S. , Moneira, G.E.G., Farias, V.L. and Bruno, L.M. (2006). Effect of drying and storage time on the physico-chemical properties of mango leathers. *Internat. J. Food Sci. & Technol*., **41** (6): 635-638.

Babalola, S.O. , Ashaye, O.A. , Babalola, A.O. and Aina, J.O. (2002). Effect of cold temperature storage on the quality attributes of pawpaw and guava leathers. *African J. Biotechnol.*, **1** (2): 61-63.

Chan, H.T. , Hibbard, K.L. , Goo, T. and Akamine, E.K. (1979). Sugar composition of papaya during fruit development. *Hort. Sci*., **14** : 140-141.

De ariola, M.C., Calzada, J.F., Menehu, J.E., Rolz, C., Gracia, R. and De cabrrera, S. (1980). *Papaya. In tropical and subtropical fruits : composition nutritive value*, Properties and Uses. westport corn. , 316-340pp.

Gayathri and Uthira, L. (2008). *Preparation and evaluation of protein mango-papaya blended fruit bar*. Sept-2008, 156-157.

Jayalakhsmi, N. and Karthiga, K. (2009). *Processing and evaluation of tomato leathers*. Beverage and Food World. Feb. 40-42.

Keya, S. Markan, M. and Markan, A. (2002). Effect of convntretion and drying processes on colour change of grape juice and leather. *J. Food Engg.*, **54** (1): 75-80.

Kumar, R., Patil, R.T. and Mondel, G. (2010). Development and evaluation of blended papaya leather. *Aeta Horticulture.* **851** : 565-570.

Kumar, Santur and Shukla, R.M. (2017). Different pre-treatment and storage stability of dehydrated pineapple slices. *Internat. J. Agric. Sci. & Res.,***7**(2) : 12.

Kumar, Sarvesh, Kumar, Vishal and Chandra Prakash (2015). Effect of sugar and jaggery on quality characteristics of papaya leather and shelf-life stability at room temperature. *South Asian J. Food Technol. Environ.*, **1**(1): 79-85.

Kumar, S.R., Barkaran, R. and Balaswamy, M. (2003). Medical value of under utilized fruits, *Krishanworld*, **30** : 51-52.

Lee, G. and Nsien, F. (2008). Thin layer drying kinetics of strawberry fruit leather. *Transaction of the ASABE.*, **51** (5): 1699-1705.

Mir, M.A. and Nath, N. (1993). Storage changes in fortified mango bars. *J. Food Sci. Technol*, **30** : 279-282.

Prinkajain (2010). Effect of preserved guava and papaya pulp on the quality of mixed fruit leather, *Research on Crops.* **11** (2): 373-374.

Renganna, S. (2001). *Handbook of analysis and quality control of fruit and vegetable products.* Republished by Tata MCG raw Hil Publishing Company Limited, New Delhi, India.

Sarvanakumar and G. Manimeglai (2002). Storage stability of 50y milk whey based jack fruit blended RTS beverage. Research Institute, Tamil Nadu Agricultural University, Madurai. Processed Food Industry. pp. 33-34.

Shiv Kumar P.K., Malathi, D., Nallakurumban, B. and Kalaiselvan, A. (2005). Studies on storage stability of guava bar in different packaging materials. Beverage and Food World. Nov. 80-81pp.

Singh, Ankit, Singh, Jaivir, Chauhan, Neelesh, Vivek Kumar and Kumar, Dinesh (2015). Effect of different citric acid levels and packaging materials in quality of sugar based papaya leather. *South Asian J. Food Technol. Environ.*, **1**(1): 75-78.

Sreemathi, M., Sankaranaryanan, R. and Balasubramanan, S. (2008). Sapota - papaya bar. *Modern Agric. J.*, **95** (1/6): 170-173.

Srivastava, R.P. and Kumar, S. (1994). *Fruits and vegetables preservation* (principles and facts). International Book Distributing Company, Charbagh, Lucknow (U.P.) India.

Thompson, A.K. and Lee, G.R. (1971). Facturs affection the storage behaviour of papaya fruit. *J. Hort. Sci.*, **46** : 511-516.

Wenkam, N.S. and Miller, C.D. (1965). *Hawaii Agricultural Research Station*, Bulletin 135.