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RESEARCH ARTICLE

ANTIMICROBIAL EVALUATION OF JAMS MADE FROM INDIGENOUS FRUIT PEELS

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Abstract

Fruit peels are a problem to the processing industries and pollution monitoring agencies. The fruit peels are rich in nutrients and contain many phytochemicals; they can be efficiently used as drugs or as food supplements. The present study was carried out with the objective of preparing jams from peels from fruits like orange, pineapple, pomegranate and banana and to assess the antimicrobial properties. Fruit peel pectin was extracted from four different indigenous fruits like pineapple **(***Ananas comosus* L.*)*, orange **(***Citrus sinensis* L.), pomegranate **(***Punica granatum* L.**)** and banana **(***Musa balbisiana* Colla**)** and processed to make jams. Total soluble solids, acidity, pH, and moisture were analyzed by the standard methods of AOAC. Sensory evaluation was conducted using a five point hedonic scale. The antimicrobial potency of the peel jams was studied using disk inhibition method. Results indicated that the mean Brix was 68.5, pH ranged from 4.4 – 5.9, this would hinder microbial growth and maintain keeping quality of Jams. Pineapple peel jam was most acceptable by the panel. Pomegranate peel jam should highest antimicrobial activity against Shigella. Utilization of fruit peels will improve the nutritional status, broaden the food base, raise standards of living and provide opportunities for income generation.

Introduction

Waste generated from food industries is a source of an untapped energy which is mostly dumped inland fills whereby it releases greenhouse gases into an atmosphere. It is very difficult to treat and recycle food waste due to its composition. Food industry produces large volumes of wastes, both solids and liquid, resulting from the production, preparation and consumption of food. These wastes lead to increasing waste disposal and can pose severe pollution problems and represent a loss of valuable biomass and nutrients (Vasso and Winfried, 2007). Waste utilization in fruits and vegetable processing industries is the one of the important and challengeable job around the world. It is anticipated that the discarded fruits as well as weight materials could be utilized for further industrial purposes (Atul, 2010). Considering the challenges in the area of food industry, efforts are to be made to optimize processing technologies to minimize the amount of waste.

Processing of fruits produces two types of waste - a solid waste of peel/skin, seeds, stones and a liquid waste of juice and washes waters. In some fruits the discarded portion can be very high (e.g. mango 30-50%, banana 20%, pineapple 40-50% and orange 30-50%). Fruit peels are rich in health-promoting flavonoids and aroma compounds (Paranthaman, 2009).

Possible products that can be considered from fruit waste are as candied peel, oils, pectin, reformed fruit pieces, enzymes, wine and vinegar (Singh, 2007). Each of the above uses for fruit waste requires: a good knowledge of the potential market for products and of the quality standards required, a careful assessment of the economics of production, a certain amount of additional production knowledge, a certain amount of additional capital investment in equipment, a fairly large amount of waste to make utilisation worthwhile. Besides, it finds numerous applications in pharmaceutical preparations, pastes and cosmetics. All these combined efforts of fruit waste minimization during the production process, environmentally friendly preservation of the fruit peel, and utilization of fruit waste by-products would substantially reduce the amount of fruit waste, as well as boost the environmental aspect of fruit processing industry (Pap, 2004).

Fruit peel waste are highly perishable and seasonal, is a problem to the processing industries and pollution monitoring agencies. There is always an increased attention in bringing useful products from waste materials and fruit wastes are no exceptions (Apsara and Pushpalatha, 2002). The fruit peels are rich in nutrients and contain many phytochemicals; they can be efficiently used as drugs or as food supplements too. Since there is an increase in the number of antibiotic resistance pathogens, there is always a search of an alternative drug that is regarded as safe. Fruit peels if proved to have antibacterial activity; they can be also used in same food industry which generates large peel wastes as a food preservative (Kumar et al., 2011). Thus the present study was carried out with the objective of producing jams from peels of indigenous fruits like orange, pineapple, pomegranate and banana and to assess the sensory, physiochemical and antimicrobial properties.

2. MATERIALS AND METHODS

2.1. *Formulation of Jams from Fruit Peel*

Fruit peel pectin was extracted from four different indigenous fruits like pineapple **(***Ananas comosus* L.*)*, orange **(***Citrus sinensis* L.), pomegranate **(***Punica granatum* L.**)** and banana **(***Musa balbisiana* Colla**)** and processed to make jams. Ripe fruits were selected from local market and cleaned. Peels were removed from the fruit, soaked overnight in clean water and ground using grinder with the soaked water. Ground peels were cooked with sugar in a high flame. When sugar dissolved completely, citric acid was added and stirred. The jam is ready when bubbles form at the sides of the vessels. The hot jam was poured in clean, dry, wide-mouthed jars or bottles and cooled well. Total soluble solids, acidity, pH, and moisture were analyzed by the standard methods of AOAC (1990).

2.2. *Total Soluble Solids*

The jam was weighed into the tarred beaker to the nearest 0.01 mg, a suitable quantity (up to 40 gm.) of the sample and added 100 – 150 ml of distilled water. The contents were heated with the beaker to boiling and allowed to boil gently for 2- 3 minutes, stirring with a glass rod. The contents were cooled and mixed thoroughly. After 20 minutes weighed to the nearest 0.01gm, then filter through a fluted filter paper or a Buchner funnels into a dry vessel. The filtrate was used for the determination of direct reading of the soluble solids content on the refract meter (Ranganna 1986).

2.3. *Titratable acidity*

About 1 g of the sample was taken, diluted to 20ml with distilled water titrate with 0.1 N NaOH using 0.3 phenolphthalein for each 100ml of the solution to pink end point persisting for 30 seconds (AOAC, 2000). The report acidity was as ml.0.1 N NaOH per 100g. Titrable acidity can be calculated as in Equation

$$T_a = \frac{B \text{ x } 0.1\ 0.064\ 100}{W}$$

Where, Ta is titrable acidity; B is reading burette; W is weight of sample

2.4. *pH value*

the pH value of the sample was measured with a digital glass electrode pH meter (CD 175 E) at room temperature, which was calibrated prior to sample pH measurement using buffer solutions of pH value 4.0 and 7.0 (Ranganna 1986)..

2.5. *Moisture*

The gravimetric method by AOAC (2000) was used for this analysis. Exactly 2ml of the sample was measured each into 2 previously weighed moisture crucible. The crucibles and samples were allowed to dry in a hot air electric oven at 105ºc for 2 hours at the end of the time; the crucibles were carefully removed and kept to cool in a desiccator. The crucibles and the samples were re-weighed and put back into the oven for further drying; cooling and weighting were done respectively until a constant was obtained.

$$\text{Percentage moisture } M = \frac{W_2 - W_3}{W_2 - W_1}$$

M = Moisture content
W_1 = Weight of empty containers
W_2 = Weight of container and sample before drying
W_3 = Weight of the container and sample after drying

2.6. ***Sensory Evaluation of the Jams***
Sensory evaluation was conducted by thirty panel members using a five point hedonic scale to evaluate the oroleptic properties like appearance, color, taste, texture, flavour and acceptability of fruit peel jams.

2.7. ***Assessment of antimicrobial activity***
The antimicrobial potency of the orange peel jam, pineapple peel jam, pomegranate peel jam and banana peel jam was studied using disk inhibition method. In disk inhibition zone method, the Mueller-Hinton agar medium was inoculated with freshly prepared cells of each bacteria and fungi to yield a lawn of growth. After solidification of the agar, a number of sterilized disks were dipped into the solvents (negative controls) 100% pure jam (100mg/ml) is placed on the plates. After incubation at 37˚C for 24 h, the antimicrobial activity was measured as diameter of the inhibition zone formed around the disk. At the same time, a comparison antibiotic control test was made using commercial disks, streptomycin and Amphotericin. Interpretation of inhibition zones of test cultures was adopted from Johnson and Case (1995). Diameter zone of inhibition of 10 or less indicates test product being resistant to test organism, diameter zone of inhibition of 11 to 15 indicates test product being intermediate resistance to test organism, diameter zone of inhibition of 16 or more indicates test product being susceptible resistance to test organism.

2.8 ***Statistical Analysis***
All the experiments were done in triplicates. The data obtained were statistically analyzed using SPSS Version 17; Chicago, Inc. Sensory evaluation was analyzed using one-way ANOVA followed by Duncan's Multiple Range Test. The type I error rate was a P value of <0.05, was considered statistically significant for all statistical tests conducted.

3. RESULTS AND DISCUSSIONS

3.1 ***Physicochemical Properties of fruit peel jams***
The physicochemical properties of the fruit peel jams are presented in Table 1. Physicochemical characteristics indicate that the highest Brix was observed in orange peel jam (85) and the lowest was in pomegranate peel jam (57). The sugar (Brix) present in jam comprises natural and added sugar and is an important preservative. The proportion of sugar to fruit varies according to the type of fruit and its ripeness, but a rough starting point is equal weight of each (Eke-Ejiofor and Owuno, (2013).

Orange peel jam had the highest (0.47%) and pomegranate and banana peel jam had the lowest (0.16%) value for acidity. The highest and the lowest pH values were recorded in banana peel jam (5.94) and pomegranate peel jam (4.48) respectively. Variation in acidity among different fruits might be due to the activity of citric acid glyoxalase during ripening process which leads to the degradation of citric acid (Rathore et al., 2007).Moisture content was found to be highest in pineapple peel jam (62.6%) and lowest in banana peel jam (31.9%). Moisture has a great impact on the shelf life of products. The Brix value of 68.5 + 0.71 and pH 3.44 in the jam conforms to values recommended for jam to hinder microbial growth and maintain keeping quality (Aina and Adesina 1999).

Table 1 Physicochemical characters of Fruit Peel Jams

Sample	Total Soluble Solids (ºBrix)	Acidity (%)	pH	Moisture (%)
Pineapple Peel Jam	77 ±2.3	0.25±0.2	4.91±0.1	62.6±0.8
Orange Peel Jam	75±3.4	0.47±0.1	5.64±0	32.25±0
Pomegranate Peel Jam	65±0.2	0.16±0.2	4.48±0	43.23±0.6
Banana Peel Jam	57±0.9	0.16±0.2	5.94±0	31.9±0

Table 2Antimicrobial Activity of Fruit Peel Jams

Organism	Fruit Peel Jams				Control
	Pineapple	Orange	Pomegranate	Banana	
	Zone of Inhibition (mm)				
Escherichia coli	6 ±0	6±0	6±0	6±0	24±0.1
Staphylococcus aureus	6±0	6±0	6±0	6±0	24±0
Salmonella typhi	6±0	6±0	6±0	6±0	16±0
Shigella	6±0	6±0	**12**±0.2	6±0	24±0
Candida albicans	6±0	6±0	6±0	6±0	20±0.3

Fig 1. Sensory Evaluation of Fruit Peel Jams

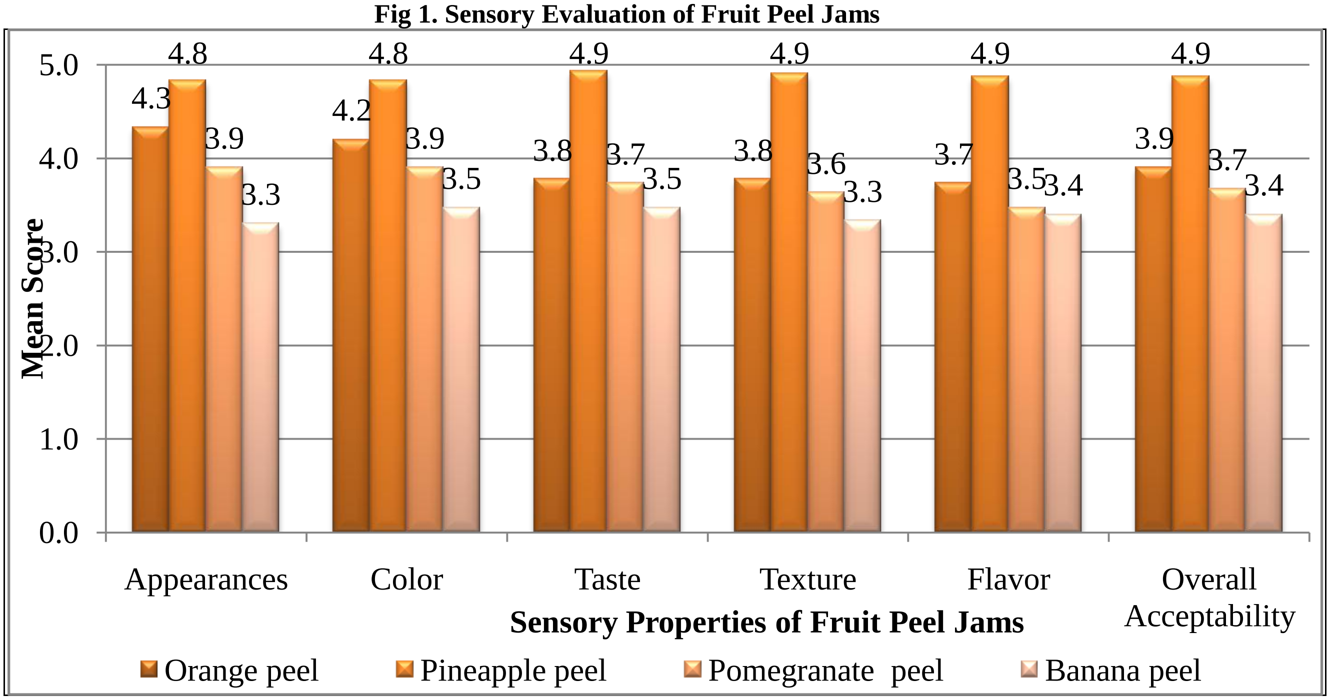
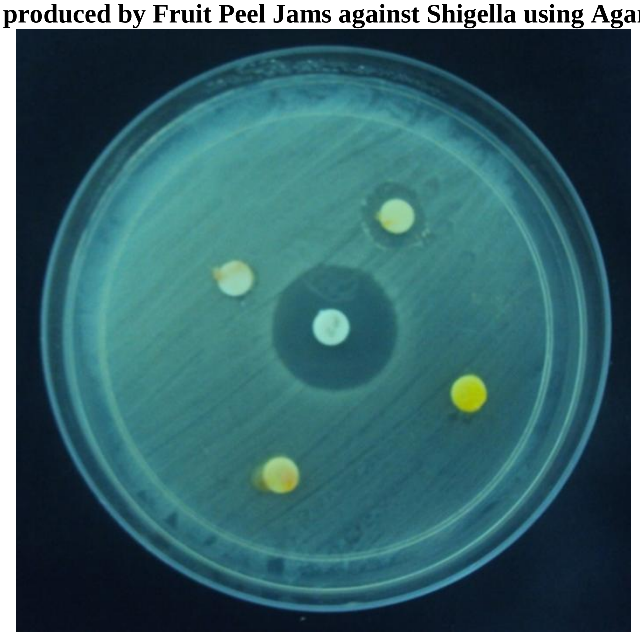


Fig 2. Zone of inhibition produced by Fruit Peel Jams against Shigella using Agar Well Diffusion method



3.2 *Sensory Evaluation*

Sensory evaluation of fruit peel jam is presented in Figure 1, ANOVA indicates that there is a significant variation in the sensory attributes of fruit peel jams ($p<0.001$). The appearance, color, taste, texture, flavours and overall acceptability of pineapple jam was significantly higher compared to the other jams. The yellow colored shell of pineapple fruits was found to be relatively rich in carotenes and flavones, while the green leaves contained in addition to chlorophyll even larger concentrations of flavones, carotenes and xanthophylls than were found in the fruit flesh (Magistad, 1995). HRGC-MS analysis of flavour of fresh-cut pineapple fruit revealed the known prevalence of esters, with methyl 2-methylbutanoate, methyl 3-(methylthio)-propanoate, methyl butanoate, methyl hexanoate, ethyl hexanoate and ethyl 3-(methylthio)-propanoate, as well as 2,5-dimethyl-4-methoxy-3(2H)-furanone (mesifurane) and 2,5-dimethyl-4-hydroxy-3(2H)-furanone (furaneol) as major constituents (Elss et al., 2005).

Pineapple waste is a by-product of the pineapple processing industry and it consists of residual pulp, peel and skin. These wastes can cause environmental pollution problems if not utilized (Rajalakshmi et al., 2010). Pineapple is mainly valued for its pleasant taste and flavor. Pineapple fruit is a good source of Bromelain, a digestive enzyme with biological functions i.e., a non toxic compound have a number of potential therapeutic applications, including treatment of trauma, inflammation, autoimmune diseases, enhancement of immune response, and malignant disorders [Maurer, 2001; Orsini, 2006].

3.3 *Antimicrobial Activity of Fruit Peel Jams*

As seen in Table 2 and Figure 2, antimicrobial activity of jams reveals that the zone of inhibition produced by pomegranate (12mm) against Shigella exhibited an intermediate resistance (11-15mm) against the test organism.
Valeria and coworkers (2011) assessed in vitro antimicrobial activity of Aqueous Extracts from pomegranate peel (Punica granatum L.) against clinical isolates of Shigella and found that pomegranate peel showed highest inhibition against Shigella. Phytochemical analysis revealed the presence of active inhibitors in the peel including phenolics and flavonoids. The activity was related to the higher content (46%) of total phenolic compounds. Many other researchers also found that pomegranate peel extract proved to be the potent antibacterial agent against *Shigella flexneri*. The antibacterial activity of the pomegranate peel extracts might be due to the presence of various phytochemicals such as phenolic punicalagins, gallic acids, catechin, quercetin and retin (Janani and Estherlydia, 2013; Vijayanand and Hemapriya 2011)

4. CONCLUSION

Results indicate that overall acceptability of pineapple peel jam was significantly higher compared to the other fruit peel jams. Pomegranate peel jams exhibited antimicrobial activity against Shigella. Pomegranate peel extracts have great potential as antibacterial compounds against Shigella, and they can be used in the treatment of infectious diseases caused by resistant microbes. In conclusion, Indigenous fruits form a significant part of the diets and livelihoods of most rural people. In this country, processing and utilization of indigenous fruits at both household and commercial levels has been very limited. There are numerous ways of utilizing and processing indigenous fruits at household and industry level. Utilization of fruits will improve the nutritional status, broaden the food base, raise standards of living and provide opportunities for income generation.

5. REFERENCE

A.O.A.C (2000), Official method 942.15 Acidity (Titratable) of fruit products with AOAC official method 920. 17th Edition, Washington, DC.

Aina JO and AA Adesina (1999) Suitability of Frozen Indigenous Tropical Fruits for Jam Processing. Advances in Food Sciences, 2, 15 – 18

AOAC (1990). Association of Official Analytical Chemist Official Methods of Analysis. Washington, DC.

Apsara Madhav and P. B. Pushpalatha, (2002) Quality Degradation Of Jellies Prepared Using Pectin Extracted From Fruit Wastes Journal of Tropical Agriculture 40, 31-34

Atul Upadhyay, Jeevan P. Lama, Shinkichi Tawata, (2010) Utilization of Pineapple Waste: A Review, Journal of Food Science and Technology 6:10.

Eke-Ejiofor. J, Owuno. F. (2013) The Physico-Chemical and Sensory Properties of Jackfruit (Artocarpus Heterophilus) Jam. International Journal of Nutrition and Food Sciences. 2, 3, 149-152

Elss, S., Preston, C., Hertzig, C., Heckel, F., Richling, E. and Schreier, P. (2005). Aroma profiles of pineapple fruit (Ananas comosus [L.] Merr.) and pineapple products. LWT - Food Science and Technology. Volume 38, Issue 3. Pages 263-274.

Janani J and Estherlydia D (2013) Antimicrobial Activities Of Punica Granatum Extracts Against Oral Microorganisms Int.J.PharmTech Res VOL 5. Number 3, July-Sept.

Johnson, T. & Case, C. (1995). Laboratory Experiments in Microbiology. Brief Edition, 4th ed. Redwood City, CA: Benjamin/Cummings Publishing Co.

Kumar, K. Ashok Narayani, M. Subanthini, A. Jayakumar, M. (2011) Antimicrobial Activity and Phytochemical Analysis of Citrus Fruit Peels -Utilization of Fruit Waste International Journal of Engineering Science & Technology, 3, 6, 5414

Magistad, O. C. (1995). Carotene and Xanthophyll in Pineapples. Plant Physiology, vol. 10. 187-191.

Maurer, H.R. (2001) Bromelain: biochemistry, pharmacology and medical use. Cellular and Molecular Life Sciences, vol. 58, no. 9, p. 1234-1245.

Orsini, Roger A. (2006) Bromelain. Plastic and Reconstructive Surgery, vol. 118, no. 7, p. 1640-1644.

Pap N, Pongrácz E, Myllykoski L & Keiski R. (2004) Waste minimization and utilization in the food industry: Processing of arctic berries, and extraction of valuable compounds from juice- processing by- products. In: Pongrácz E. (ed.): Proceedings of the Waste Minimization and Resources Use Optimization Conference. June, University of Oulu, Finland. Oulu University Press: Oulu. 159-168.

Paranthaman,R., R. Vidyalakshmi, S. Murugesh and K. Singaravadivel (2009) Effects of Fungal Co-Culture for the Biosynthesis of Tannase and Gallic Acid from Grape Wastes under Solid State Fermentation Global Journal of Biotechnology & Biochemistry 4 (1): 29-36.

Rajalakshmi Madurai, Sheila John and Bhavani I.L.G. (2010) Study on preparation, nutrient analysis and shelf life of biovinegar and its formulations Biosciences Biotechnology Research Asia, Volume No. 7 Issue No.: 2

Ranganna S (1986) Handbook of Analysis and Quality Control for Fruit and Vegetable Products. 2nd ed. Tata McGraw Hill Publishing Company Ltd., New Delhi, India. p.12.

Rathore H.A., Masud T. Sammi S. and Soomro AH. (2007) Effect of storage on physiochemical composition and sensory properties of mango variety Dosehar. Pak.J. Nutrition 6, 143-148.

Singh M., (2007) Extraction of pectin from kinnow peels International Journal of Environmental Studies, 64, 3.

Valeria I. Ruiz Parra, Cristina Gaudioso, Marta Cecilia and Clara Silva, (2011). Evaluation of the Antimicrobial Activity of Aqueous Pomegranate (Punica granatum L.) Extract Against Shigella. Research Journal of Biological Sciences, 6: 205-212.

Vasso O, Winfried. R, (2007) Utilization of By-Products and Treatment of Waste in the Food Industry, Integrating Food Science and Engineering Knowledge Into the Food Chain, Vol. 3, Springer.

Vijayanand S and Hemapriya J (2011). In vitro antibacterial efficacy of peel and seed extracts of Punica granatum L. against selected bacterial strains. Int. J. Microbiolog. Res. 1(4):231-234.