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Developing and Evaluating Techniques of Guava Jam Processing

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Abstract
Fresh ripened guavas were gathered from farmer's field and were weighed, sorted, washed, peeled before crushing and sieving to pulp for preparation of guava jam product. Microbial properties (bacteria, yeast and mould) were studied for the products prepared. Microbial examination revealed that the product is safe to consume in the stay of 4 months.
Keywords: guava, jam, microbial properties

1. Introduction

Guava (Psidium guajava L.) is a member of the large Myrtaceae or Myrtle family, native to Central America and the southern part of Mexico (Somogyi et al. 1996). It is the fourth most important fruit next to mango, banana and citrus in Inia. India is the major world producer of guava (Jagtianiet al. 1998). It has been in cultivation in India since early 17th century and gradually became a crop of commercial importance. Guava is quite hardy, prolific bearer and highly remunerative even without much care. It is widely grown all over the tropics and sub-tropics(FAO, 1983).

In Ethiopia guava is widely cultivated and consumed as fresh and/or juice. It is very common to see guava in a street at the time of fruition.

Jam and jelly are made from fruits and they are being made since long in different forms (Jain and Asati, 2004). The production methods were easy but these products were made in conventional manner in many homes. Guava is seasonal and hence at ample time mankind had found out various ways to preserve them for consumption during off-season jam &jelly. High acidity and high sugar content (68-72%) of guava fruit prevents mould growth after opening the jar. The fruit has 83% moisture and is an excellent source of ascorbic acid and pectin but has low energy (66 cal/100g) and protein content (1%) (Bose et al., 1999). The fruit is rich in minerals like phosphorous (23-37 mg/100g), calcium (14-30 mg/100g), iron (0.6-1.4 mg/100g) as well as vitamins like niacin, pathotenic acid, thiamine, riboflavin, vitamin A (Bose et al., 1999).

Guava has natural antioxidants that can defend human body from certain diseases the main are: vitamins, carotenoids and phenolics (Thaipong et al., 2006) and those phenolic compounds and high content of vitamin C (ascorbic acid) in guava have the ability to scavenge free radicals. The anti-oxidant virtue in guavas is believed to help reduce the risk of cancers of the stomach, esophagus, larynx, oral cavity and pancreas.

The vitamin C in guava makes absorption of vitamin E much more effective in reducing the oxidation of the Low-density lipoproteins (LDL) bad cholesterol and increasing the High-density lipoproteins (HDL) good cholesterol. The fibers in guavas promote digestion and ease bowel movements. The high content of vitamin A in guava plays an important role in maintaining the quality and health of eyesight, skin, teeth, bones and the mucus membranes.

2. STATEMENT OF THE PROBLEM

2.1. Demand and Supply

Postharvest loss in developing countries is higher than industrialized countries. The post harvest losses of fresh fruits and vegetables including tomatoes are estimated to be 5 to 25% in developed and 20 to 50% in developing countries (Kedar etal 1985). 20-25% of guava fruit damaged and spoiled before it reaches the consumer (Yadav, 1997)

2.2. Fruit harvesting

Yellow skin color and firm guavas must used for processing but soft, over-ripe or moldy and fallen to ground fruit should be avoided. With proper storage at room temperature half yellow partly green fruit can harvested and utilized (R. A. Hamilton and H. Seagrave-Smith 1959).

2.3. Marketing demand

At the pick season guava fruits are spread in every corner of the country and hence the demand is very low. And Ethiopia is a thirteen months sun shine so; the fruits that are revealed in streets to be sold are prone for spoilage and damage.

3. Objectives

3.1. General objectives

- To develop guava Jam and jelly, and to evaluate microbial load and sensory properties of the product; thereby minimizing postharvest losses.

3.2. Specific objectives

- To develop guava jam
- To determine microbial load
- To evaluate sensory property

4. METHODS AND MATERIALS

4.1. Raw materials

Materials of guava, lemon and apple were obtained from farmers' orchard. Sugar was purchased from market

4.2. Fruit pulp extraction for guava juice

Guava fruits of local variety were purchased from farmers. The fruits were sorted based on the assessment of colour, ripeness, shape, size or microbiological damage. Only those that were not bruised or rotten were reserved for further processing. The selected fruits were weighed, washed with tap water and cut using stainless steel knives. Sliced guava fruits were introduced into well cleaned pulping machines for further processing of guava juice and the pulp filtered using stainless steel sieve and it was heated for 30 minutes in medium heat and bottled tightly.

4.3. Guava jam process

Fresh fruits were washed in water and after removing their skin; they were cut or sliced in small pieces. These pieces were boiled with water. Appropriate quantity of sugar was mixed with the pulp. When the temperature is around 60^0C; citric acid was added. This mixture was then stirred for a while, cooled and then packed in bottles.

The process flow chart is as under:

Ripe firm fruit
↓
Washing, peeling and slicing of fruits
↓
Pulping (remove seed and core)
↓
Addition of sugar
(Add sugar if necessary)
↓
Boiling (with continuous stirring)
↓
Judging the end point by further cooking up to
105^0c or 68-70% TSS or by sheet test
↓
Filling hot in to sterilized bottles
↓
Cooling
↓
Waxing
↓
Capping
↓
Storage at ambient temperature

5. Result and discussion

5.1. Microbiological characteristics

Hygiene status of food commodities can be fairly judged by the abundance of microorganisms associated with them. The degree of contamination of fruit products largely depends on the initial load, source and kinds of microorganisms related to the fruits and care taken during collection, processing and product handling (Jay, 1991).

The microbial load of the product was determined by checking the fungal and bacterial growth in the

developed product for safety of the consumers. No fungal and bacterial infestation was detected in any of the processed guava products. As indicated in the table only APC at 37^0c/48hrs $4x10^2$ cfu/g for guava with out-lemon juice and $2.3x10^3$ with lemon juice which are smaller than Freeze-dried concentrate powder had an Aerobic plate count (APC) of 5.3 $x10^5$ cfu/g and the spray-dried concentrate powder with 9.7 x 10^4 cfu/g(CHETAN A. CHOPDA and DIANE M. BARRETT) but the rest is below 1x101 and shigella and salmonella are not isolated for both samples.

Yeast, coliform, E.coli, staphylococcus spp. and mold counts were relatively low in both samples and did not pose any threat to the safety.

The findings of mould count, Yeast count, staphylococcus are smaller than from that of dried fish (Y.A. Barat etal., 2015). And Salmonella and Shigella spp. of this research are safer than the three dried fish samples of Aghghala, Bandar-torkman and Gomishan (Y.A. Barat etal., 2015) which accounts like

properties	Aghghala	Bandar-torkman	Gomishan
Salmonella	0.8×10^1	0	$2x10^1$
Shegella	$7x10^1$	$0.4x10^1$	$1.2x10^2$

Similar results were reported in foam-mat dried mango (Kadam et al. 2010). Therefore, the value added products prepared from guava in this study may be judged safe as far as national and international standards of micro-bial safety are concerned (Kadam et al. 2005; Kadam et al. 2009). The bacteria load from the total plate count was also lower than the maximum recommended levels of 1.0 x 10^5cfu/ml (MBS…).
Results from the microbiological analysis of guava fruit jam are summarized below

Table 1 guava jam with lemon juice

Method reference	Parameters(testes) guava jam with lemon juice	Results	Quality control(p/f)
NMLK,NO.98,1997	Mould count at 22^0c/5-7day	$<1x10^1$ cfu/g	P
NMLK,NO.98,1997	Yeast count at 22^0c/5-7days	$<1x10^1$ cfu/g	P
NMLK,NO.98,1997	APC at 37^0c/48hrs	$2.3x10^3$ cfu/g	P
NMLK,NO.86,2006	Coliform count	$<1x10^1$ cfu/g	P
NMLK,NO.44,2004	Fecal coliform count	$<1x10^1$ cfu/g	P
NMLK,NO.125,2005	E.coli count	$<1x10^1$ cfu/g	P
NMLK,NO.125,2005	Staphylococcus spp.	$<1x10^1$ cfu/g	P
NMLK,NO.98,1997	Salmonella	Not isolated/25g	P
NMLK,NO.98,1997	Shigella spp.	Not isolated/25g	P
NMLK,NO.98,1997	External appearance of sample container	Normal	
NMLK,NO.98,1997	Visual appearance of sample opening	Normal	

i.e. APC=Aerobic bacteria plate count, AAPC=Anaerobic bacteria plate count, P= pass, F= fail, Tmc= too many to count, cfu = colony forming units and In the counts $<1x10^1$ is the standard reporting format for plates from all dilution of the sample has no colonies

Table 2 guava jam without lemon juice

Method reference	Parameters(testes) without lemon juice	Results	Quality control(p/f)
NMLK,NO.98,1997	Mould count at 22^0c/5-7day	$<1x10^1$ cfu/g	P
NMLK,NO.98,1997	Yeast count at 22^0c/5-7days	$<1x10^1$ cfu/g	P
NMLK,NO.98,1997	APC at 37^0c/48hrs	$4x10^2$ cfu/g	P
NMLK,NO.86,2006	Coliform count	$<1x10^1$ cfu/g	P
NMLK,NO.44,2004	Fecal coliform count	$<1x10^1$ cfu/g	P
NMLK,NO.125,2005	E.coli count	$<1x10^1$ cfu/g	P
NMLK,NO.125,2005	Staphylococcus spp.	$<1x10^1$ cfu/g	P
NMLK,NO.98,1997	Salmonella	Not isolated/25g	P
NMLK,NO.98,1997	Shigella spp.	Not isolated/25g	P
NMLK,NO.98,1997	External appearance of sample container	Normal	
NMLK,NO.98,1997	Visual appearance of sample opening	Normal	

i.e. APC=Aerobic bacteria plate count, AAPC=Anaerobic bacteria plate count, P= pass, F= fail, Tmc= too many to count, cfu = colony forming units and In the counts $<1x10^1$ is the standard reporting format for plates from all dilution of the sample has no colonies

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
10	5	440	88	30420
10	5	2340	468	1048820

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	361000	1	361000	0.668989	0.437085	5.317655
Within Groups	4316960	8	539620			
Total	4677960	9				

From this Fcrit (5.32) is higher than Pvalue(0.44) which means there is no significance difference between guava Jam with lemon juice and without lemon juice.

5.2. Sensory evaluation

Sensory property is reported as the indicative and quality parameters for the guava jam and jelly products (Hayeset al., 1998) of the samples were measured to quantify the extent of the color difference between guava product and fresh one.

Five trend panelists were used to made pretest. A five point hedonic scale was used to determine the organoleptic attributes and acceptability of the complementary foods. The number "5" represented 'like very much, '1' represented 'dislike very much'. The observations and suggestions made by the trend panelists were used to improve on the preparation of the guava jam and jelly.

A total of 20 mothers were selected for the sensory evaluation. They were selected randomly from the mothers who have guava farm. These mothers voluntarily accepted to participate after thorough detailed discussion session and interview.

Descriptive Statistics

	N	Range	Minimum	Maximum	Mean		Std. Deviation	Variance	Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic	Statistic	Std. Error
jam color	40	2	3	5	3.78	.110	.698	.487	-.848	.733
jam smell	40	3	2	5	3.57	.123	.781	.610	-.253	.733
jam taste	40	3	2	5	3.57	.118	.747	.558	-.251	.733
jam overall acceptance	40	2	3	5	3.83	.087	.549	.302	.159	.733
Valid N (listwise)	40									

The higher score mean of the sensory property is overall acceptance(3.83) while lowest are jam smell and taste (3.57)

6. Conclusions and recommendations

This finding revealed that guava can be processed in to different value added products thereby increased the shelf life and extends its availability from seasonal to throughout the year. Since value addition and product diversification is an important in the present to combat micronutrient deficiencies which are called hidden hunger. More diversified products from guava like guava jam, guava nectar and jelly have much importance as a method of preservation and post harvest loss prevention. The developed products were retained original fruit flavor and safe for consumption. Development of such nutritional products using pilot scale facilities will not only reduce the postharvest losses but also impart value to less appreciated fruits. Therefore, manufacturing of such products will provide opportunity for employment generation in the rural masses by way of setting small scale processing unit. But finally I want to recommend that since this product is new in our country to practice by farmers it may have to work intensively in the adoption of the products to the society.

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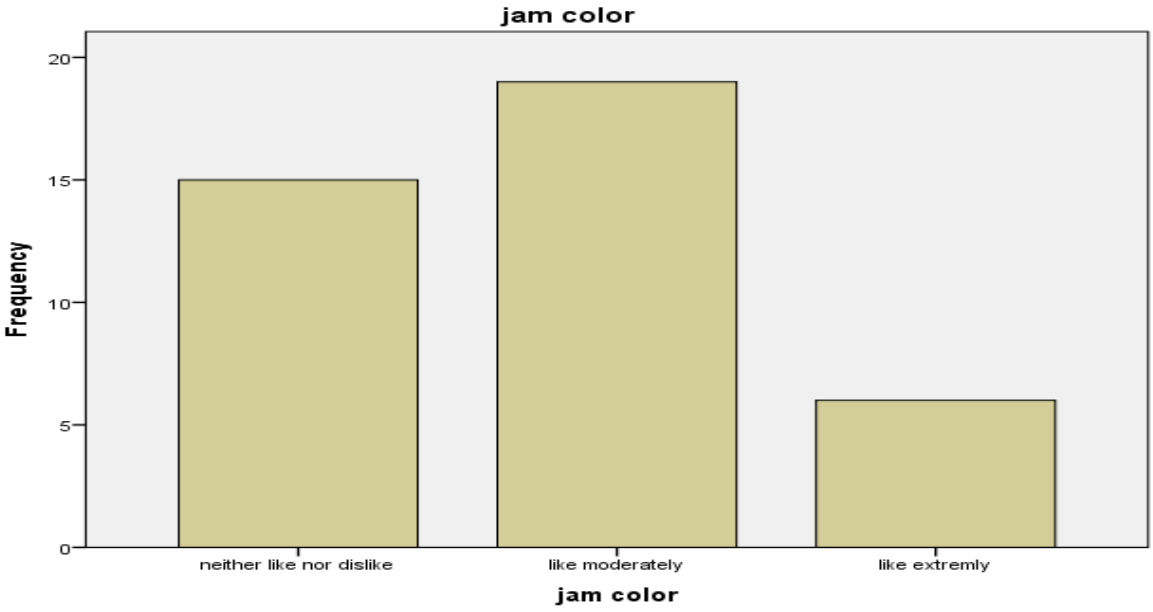
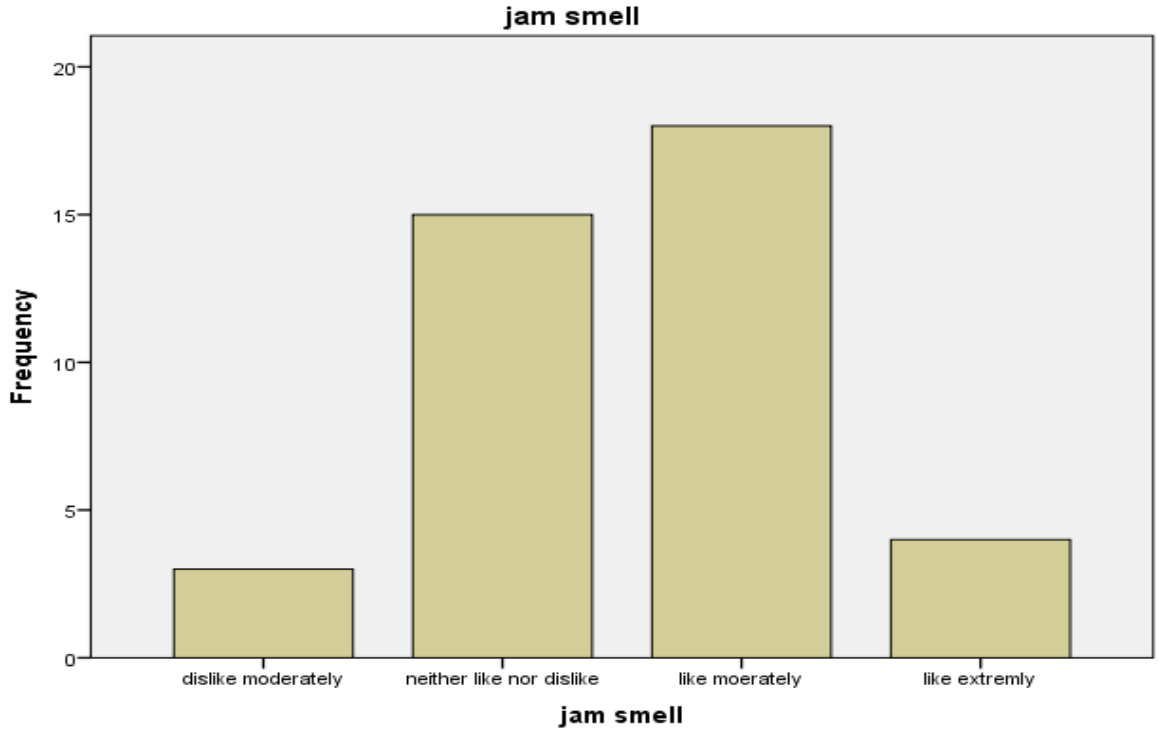
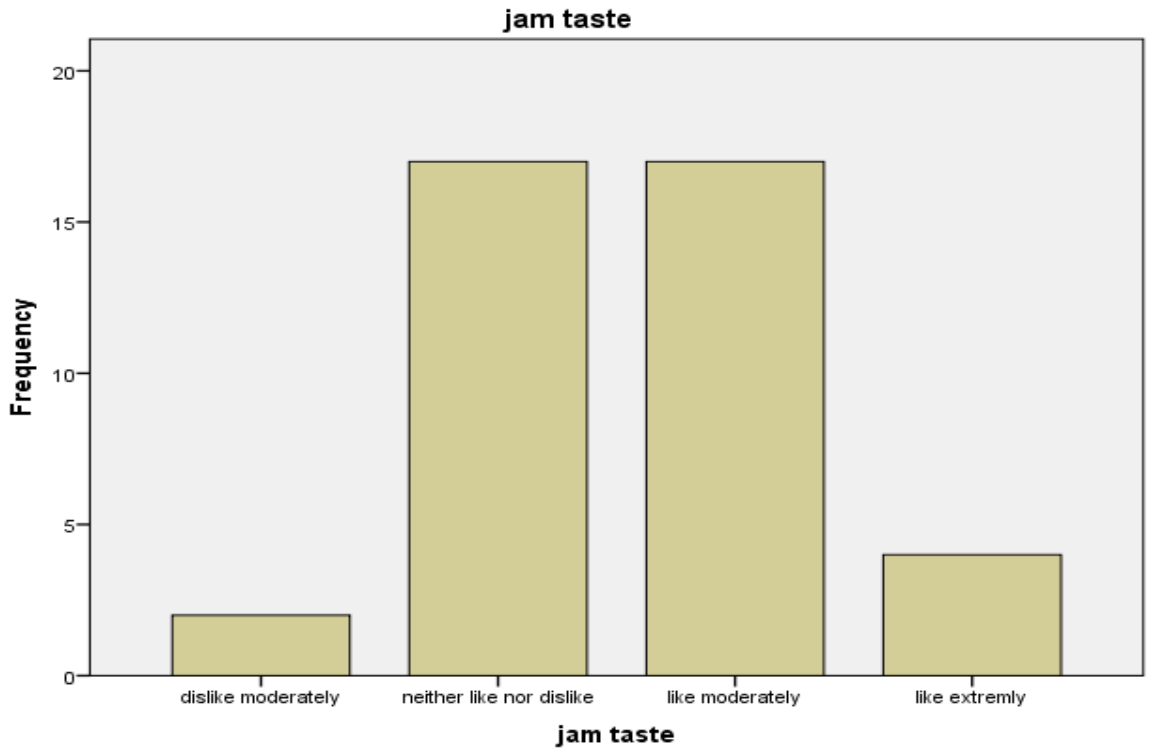
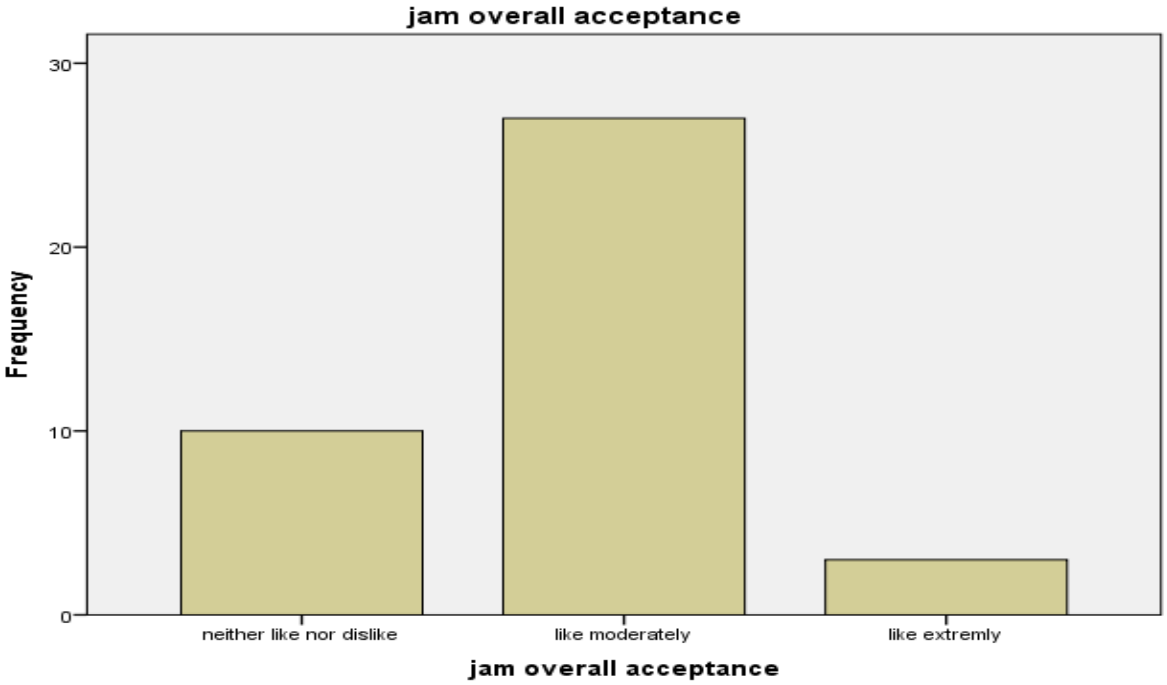
9. Annexure

Bar graph of the sensory property




jam smell
Frequency
20
15
10
5
0
dislike moderately
neither like nor dislike
like moerately
like extremly
jam smell


jam taste
Frequency
20
15
10
5
0
dislike moderately
neither like nor dislike
like moderately
like extremly
jam taste


jam overall acceptance
Frequency
30
20
10
0
neither like nor dislike
like moderately
like extremly
jam overall acceptance