

## Development of Diversified Technology for Jujube (*Ziziphus jujuba* L) Processing and Preservation

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**Abstracts:** This study reported on processing of value added products from Jujube and BAU kul (Bangladesh Agricultural University kul). Fresh Jujube and BAU kul were analyzed for moisture, total sugar, total soluble solids, protein, fat, acidity ascorbic and ash contents. The total sugar, ash and ascorbic were lower in BAU kul than Jujube. The formulations of jam, jelly, chutney, pickles were finalized and products were processed from pulp/juice of Jujube and BAU kul. The products were analyzed for moisture, total sugar, acidity pH and ascorbic acid contents. The chemical analysis of products showed that all the products have acceptable composition jujube and BAU kul may be exploited for development of various foods products jam, jelly and pickle. The sensory evaluation results showed that all the processed products are acceptable to the test panelists.

**Key words:** Jujube • Processing • Preservation • BAU Kul • Pickle • Jam

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### INTRODUCTION

The jujube (*Ziziphus jujuba* L. ), belonged to the family Rhamnaceae that consists of 45 genera and 550 species, is widely distributed in tropical and subtropical climates in the world [1]. The jujube (*Zizyphus mauritiana* Lamk) locally known as 'kul' is a popular fruit in Bangladesh [2]. It is gaining popularity with the growers because of its higher yield, good return and suitability for the arid and semi-arid regions of Bangladesh where as most of the other fruit crops can not be grown either due to lack of proper irrigation facilities or adverse climatic and soil condition [3]. Ber is a cross pollinated crop and generally propagated by seeds. As such variability exists among these genotypes. Improved varieties are multiplied by vegetative propagation and are mostly cultivated in Satkhira, Rajshahi and Comilla [4]. The ber is a highly nutritive fruit it is also a good source of vitamins and minerals. The physiological and biochemical characteristics are the qualitative indexes of any fruit for fresh consumption. Little information about its export is still unknown though it has a great export potential [5].

Among the main constituents of this fruit, carbohydrate and organic acids contribute a great deal to the food value of the fruit [6]. The objective this study was to develop the products of a jujube by value addition and evaluate these products depending upon the physical-chemical and sensory characteristics.

### MATERIALS AND METHODS

**Processing of Jam and Jelly:** Selected jujubes and BUA kul were weighed and washed thoroughly in cold water. Cut the washed fruits with a stainless steel knife into small pieces. Extracted pulp (Fig. 1) from fruit was adjusted the pH by addition of citric acid or sodium hydroxide. Strained the mass through a course cloth to separate the extract, took one more extract and mix them. Kept the mixed extract in deep a container and after settling, carefully decant the extract. The pectin was mixed in 3 proportions 0.5, 1.0 and 1.5% with sugar thoroughly. The martial was cooked the mixed juice till its TSS reached 65% (tested by refractometer). The cooking temperature maintained at 104-105°C. Added Citric Acid and KMS and cooled. The finished products poured into clear dry sterilized glass jars.

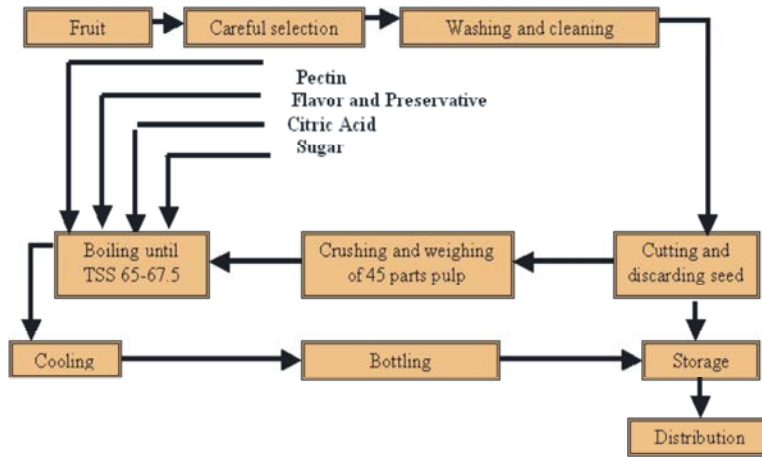


Fig. 1: Process Flow-chart for Jam manufacture

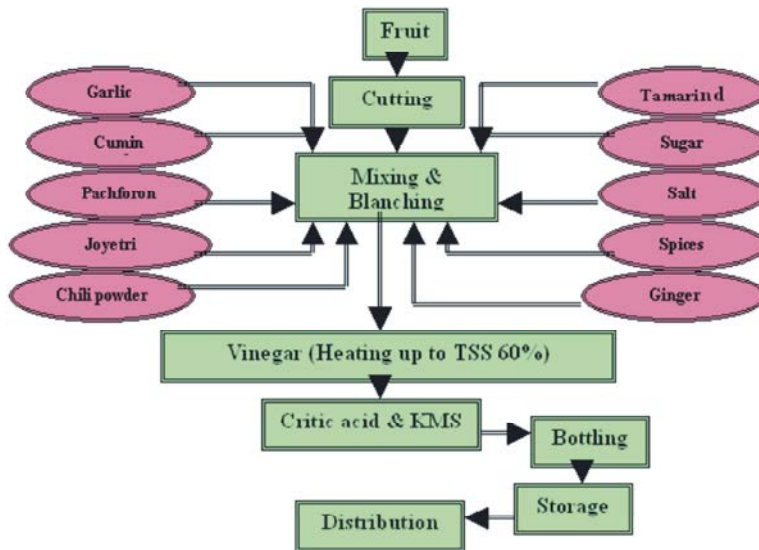


Fig. 2: Process Flow-chart for pickle manufacture

**Processing of Pickle:** Selected fresh jujubes were weighed and washed them thoroughly in cold water. Cut the washed fruits with a stainless steel knife into small pieces. The pieces were mixed with tamarind, sugar, salt, spices, Ginger, Garlic, Cumin Powder, Pachforon, Joyetri & Joyfal, Postodana, Chilli powder. The mustard oil was heated to boiling and the pulp mixture was added into it. After heating few minutes vinegar was added into it. The heating was continued until the mixture became brown in colour and TSS reached 60%. After that citric acid and KMS were added at three different proportions in the finished products. Finally the soft brown mass was filled hot in glass jars and immediately capped. The process flow diagram for manufacturing of pickle is shown in Fig 2.

**Chemical Analysis:** The fresh fruit of jujube and BAU kul as well as their products were analyzed. The total soluble solids (TSS) and total solids were determined with a hand refractometer [7]. vitamin C was determined by using 2,6-dichlorophenolindophenol [8], acidity was determined titrimetrically with the visual acid-base method [9], the pH was determined with a digital pH meter [10] and the moisture content and the dry matters were measured by oven drying method [11]. Sugar was determined by Lane and Eynon [12] method. Ash and fat contents of the fresh fruit were determined by method of AOAC [13].

**Sensory Analysis:** The 10 semi-trained panelists from Department of Food Technology and Rural Industries BAU Mymensingh were selected for sensory evaluation. The prepared sample of jam jelly and pickle were

evaluated for color, flavor, texture and overall acceptability according to the methods described by Meligaared *et al.* [14]. 9-point Hedonic Scale Test permitted the comparative evaluation of formulations with regard to the aspects clour flavor texture and overall acceptability. The scale ranged from 1-dislike extremely to 9-extremely like.

**Statistical Analysis:** The results were analyzed by ANOVA - Analysis of Variance (5% limit of significance) and by comparative analysis of means separated by DMR test for finding possible significant differences between the samples.

### RESULTS AND DISCUSSION

Results presented in Table (1) show the physico-chemical characteristics of jujube and BAU kul fruits. Results indicated that the moisture content of fruits are 83% for jujube and 86 % for BUA kul, total solids (TS) 17% and 12% for jujube and BUA kul respectively. Total soluble solids TSS (°brix) for jujube and BUA kul were 8.1 and 11%, respectively. Results regarding total sugars were 6% for jujube and 8.7 % for BUA ku; proteins for both fruits were 1.6 and 0.8% respectively. Fat content of jujube was 0.2 and for BAU kul was 0.1% and ash content for both fruits wer 0.7 and 1.35% respectively. BAU kul variety fruit had higher values of pH (4.5) and jujube had 2.5%.The Jujube fruit had more acidity value than BAU Kul. The BAU kul is a good source of ascorbic acid (65mg/100g) than jujube (40 mg/100g) These results

are in agreement with those previously reported [15-16].The both fruits were also analyzed for contents in pulp and juice little variation was in these two extraction it may due to extraction method Table 2 shows the results obtained for the physical-chemical characterization of jujube products. The results regarding jam shows that moisture range from 32.21 to 32.39%, TS ranged from 67.61-67.79 (°Brix), TSS 66%, acidity ranged from 1.58 to 1.61%, pH ranged from 3.12-3.13 and ascorbic acid varies from 2.71- 2.98 mg/100g. [17], analyzing guava sweet in paste form, yielded similar results to this study for the parameters pH, total soluble solids (°Brix). The total soluble solids of SF was 65.03°Brix, which is default value typically used by industries in the preparation of fruit jams added with sugar [18]. The value of total soluble solids found for sample was lower, which is consistent with that expected for diet and light products. The total acidity of the jam must not exceed 1% because from this value occurs syneresis (water formation in the product). The values of acidity found in both formulations are considered well below this limit, thus reducing the possibility of "defects" in these products. The results regarding jelly product of jujube shows that moisture range from 31.42 to 31.55 %, TS ranged from 68.28-68.58 (°Brix), TSS 67%, acidity ranged from 1.45 to 1.46 %, pH ranged from 3.09-3.10 and ascorbic acid varies from 2.95-3.05 mg/100g. Pickle is a fermented product of the fruits and vegetables in this study the pickle was also prepared from jujube fruit and evaluated the results in Table 2 shows that moisture range from 32.30 to 32.70 %, TS ranged from 70.10 to 70.28 (°Brix), TSS 66%, acidity

Table 1: Composition of fresh jujube fruits, pulp and juice

Products		Moisture %	TS (°Brix).	TSS (°Brix).	Total sugar %	Protein %	Fat %	Ash %	pH	Acidity %	Ascorbic acid mg/100g
Fresh	Jujube	83.0±4	17.0±2.0	8.1±1.01	6.0±0.9	1.6±0.2	0.2±.01	0.7±.01	2.50±.5	3.10±.07	40.0±3
	baukul	86.0±6	12.0±1.0	11.0±1.4	8.7±0.8	0.8±0.1	0.1±.01	1.35±.07	4.50±.7	0.44±.01	65.0±4
Pulp	Jujube	84.0±4	16.0±1.2	7.9±1.3	5.8±0.5	1.52±0.2	0.15±.02	0.8±.02	3.50±.6	4.3±.04	35.0±2
	baukul	86.6±5	11.4±1.1	9.5±1.3	8.2±0.7	0.7±0.1	0.1±.01	1.12±.04	5.50±.7	0.20±.01	53.0±4
Juice	Jujube	85.0±4	15.0±1.6	7.6±1.4	4.7±0.6	1.53±0.3	0.16±.03	0.7±.03	2.50±.4	3.35.03±	32.0±2
	baukul	87.3±6	10.5±1.02	9.0±1.6	7.8±0.7	0.6±0.1	0.1±.01	1.01±.02	4.50±.5	0.40±.4	42.0±4

Table 2: Composition of jujube products

S.No.	Content	Jam			Jelly			Pickle		
		Aa	Ab	Ac	Ba	Bb	Bc	Ca	Cb	Cc
1	Moisture (%)	32.21±2.0	32.36±2.0	32.39±2.0	31.55±2.0	31.42±2.0	31.72±2.0	32.30±2.0	32.70±2.0	32.60±2.0
2	TS (%)	67.79±3.0	67.64±3.0	67.61±3.0	68.45±3.0	68.58±4.0	68.28±4.0	70.28±4.0	71.25±4.0	72.10±4.0
3	TSS (%)	66±3.0	66±3.0	66±3.0	67±3.0	67±4.0	67±4.0	65±3.0	66±3.0	66±3.0
4	Acidity (%)	1.58±0.32	1.61±0.34	1.63±0.25	1.45±0.42	1.46±0.32	1.46±0.26	2.50±0.31	2.40±0.33	2.29±0.24
5	pH	3.12±0.43	3.13±0.44	3.12±0.46	3.09±0.51	3.10±0.45	3.10±0.38	3.10±0.37	3.07±0.42	3.08±0.46
6	Ascorbic acid (mg/100)	2.98±0.35	2.91±0.43	2.78±0.42	3.02±0.51	3.05±0.47	2.95±0.33	2.55±0.23	2.78±0.28	2.56±0.29

Table 3: Composition of BAUKul products

S.No.	Content	Jam			Jelly			Pickle		
		Aa	Ab	Ac	Ba	Bb	Bc	Ca	Cb	Cc
1	Moisture (%)	32.50±2.0	32.40±2.0	32.50±2.0	29.90±2.0	30.10±2.0	30.20±1.0	32.20±2.0	32.35±2.0	32.50±2.0
2	TS (%)	67.50±3.0	67.50±3.0	67.50±3.0	67.50±3.0	67.50±3.0	67.50±3.0	55.30±3.0	55.25±3.0	55.10±3.0
3	TSS (%)	66±4.0	66±4.0	66±4.0.0	67±4.0	67±4.0	67±4.0	50±2.0	50±2.0	50±2.0
4	Acidity (%)	1.58±0.5	1.50±0.5	1.50±0.5	1.60±0.4	1.40±0.3.0	1.40±0.3	2.50±0.3	2.40±.6	2.40±0.3
5	pH	3.05±0.5	3.00±0.4	3.10±0.5	3.09±0.8	3.10±0.6	3.10±0.4	3.10±0.5	3.07±0.5	3.08±0.4
6	Ascorbic acid (mg/100)	2.50±0.4	2.50±0.4	2.60±.4	3.02±0.4	3.05±.4	2.95±0.3	2.55±0.3	2.78±0.4	2.56±0.5

Table 4: Sensory evolution of jujube products

Storage period	Jam			Jelly			Pickle			Remarks
	Aa	Ab	Ac	Ba	Bb	Bc	Ca	Cb	Cc	
Clour	6.67 <sup>a</sup>	6.33 <sup>a</sup>	7.00 <sup>a</sup>	6.67 <sup>a</sup>	6.33 <sup>a</sup>	7.00 <sup>a</sup>	7.30 <sup>a</sup>	6.31 <sup>a</sup>	7.10 <sup>a</sup>	Good
Flavor	6.33 <sup>b</sup>	7.00 <sup>ab</sup>	7.33 <sup>a</sup>	6.33 <sup>b</sup>	7.00 <sup>ab</sup>	7.33 <sup>a</sup>	7.20 <sup>a</sup>	6.30 <sup>a</sup>	7.30 <sup>a</sup>	Good
Texture	6.67 <sup>a</sup>	6.33 <sup>a</sup>	7.00 <sup>a</sup>	6.67 <sup>a</sup>	6.33 <sup>a</sup>	7.00 <sup>a</sup>	6.32 <sup>a</sup>	7.00 <sup>a</sup>	6.67 <sup>a</sup>	Good
Overall acceptability	7.00 <sup>b</sup>	6.00 <sup>a</sup>	8.00 <sup>c</sup>	7.00 <sup>b</sup>	6.00 <sup>a</sup>	8.00 <sup>c</sup>	6.00 <sup>b</sup>	7.30 <sup>a</sup>	7.31 <sup>a</sup>	Good

Table 5: Sensory evolution of BAUKul products

Storage period	Jam			Jelly			Pickle			Remarks
	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	B <sub>1</sub>	B <sub>2</sub>	B <sub>3</sub>	C1	C2	C3	
Color	6.33 <sup>a</sup>	7.00 <sup>a</sup>	6.67 <sup>a</sup>	6.33 <sup>a</sup>	7.00 <sup>a</sup>	7.33 <sup>a</sup>	6.33 <sup>a</sup>	7.0 <sup>a</sup>	7.0 <sup>a</sup>	Good
Flavor	6.33 <sup>b</sup>	7.00 <sup>ab</sup>	7.33 <sup>a</sup>	6.33 <sup>b</sup>	7.00 <sup>ab</sup>	7.33 <sup>a</sup>	7.00 <sup>a</sup>	6.33 <sup>a</sup>	7.0 <sup>a</sup>	Good
Texture	6.67 <sup>a</sup>	6.33 <sup>a</sup>	7.00 <sup>a</sup>	6.67 <sup>a</sup>	6.33 <sup>a</sup>	7.00 <sup>a</sup>	6.33 <sup>a</sup>	7.00 <sup>a</sup>	6.67 <sup>a</sup>	Good
Overall acceptability	7.00 <sup>b</sup>	6.00 <sup>a</sup>	8.00 <sup>c</sup>	7.00 <sup>b</sup>	6.00 <sup>a</sup>	8.00 <sup>c</sup>	6.00 <sup>b</sup>	7.30 <sup>a</sup>	7.31 <sup>a</sup>	Good

ranged from 2.29 to 2.50 %, pH ranged from 3.07-3.10 and ascorbic acid varies from 2.56- 2.78 mg/100g. Table 3 shows the results obtained for the physical-chemical characterization of BAU kul processed products. The results regarding jam shows that moisture range from 32.40to 32.50%, TS 67.50 (°Brix), TSS 67%, acidity ranged from 1.50 to 1.58%, pH ranged from 3.00-3.05 and ascorbic acid varies from 2.50-2.60 mg/100g. The results regarding jelly product of jujube shows that moisture range from 29.90 to 31.55 %, TS 67.50 (°Brix), TSS 67%, acidity ranged from 1.40 to 1.60 %, pH ranged from 3.09-3.10 and ascorbic acid varies from 3.02-3.05 mg/100g. Pickle was also prepared from BAU kul fruit and evaluated the results in Table 3 shows that moisture range from 32.20 to 32.50 %, TS ranged from 55.10 to 55.30 (°Brix), TSS 55%, acidity ranged from 2.40 to 2.50 %, pH ranged from 3.08-3.10 and ascorbic acid varies from 2.55- 2.78 mg/100g.

**Sensory Analysis:** Samples prepared from jujube were evaluated sensory attributes for colour, taste, texture and overall acceptability (Table 4). Colour is important sensor character on which the consumer preferences dependent. The maximum mean value for colour ranged from 6.33

to 7.00. The values of flavor ranged from 6.33 to 7.33. The value for texture ranged from 6.33 to 7.00. The value recorded for overall acceptability ranged from 6.00 to 8.00. The results regarding jelly from jujube shows that clour ranged from 6.33 to 7.33, flavor ranged from 6.33 to 7.33, texture ranged from 6.33 to 7.00 and overall acceptability ranged from 6.00 to 8.00. Pickle product was also evaluated for sensory characteristics the results shows that value for colour attribute ranged from 6.31 to 7.30, flavor ranged from 6.30 to 7.30, texture ranged from 6.32 to 7.00 and overall acceptability ranged from 6.00 to 7.31. Products prepared from BAU kul were also evaluated for sensory attributes results presented in Table 5 shows that colour value for jam product ranged from 6.33 to 7.00, flavor ranged from 6.33 to 7.33, texture ranged from 6.33 to 7.00 and overall acceptability ranged from 6.00 to 8.00. The results regarding jelly from jujube shows that clour ranged from 7.00 to 7.33, flavor ranged from, texture ranged from 6.33 to 7.33 and overall acceptability ranged from 6.00 to 8.00. Pickle product was also evaluated for sensory characteristics the results shows that value for colour attribute ranged from 6.33 to 7.00, flavor ranged from 6.33 to 7.00, texture ranged from 6.33 to 7.00 and overall acceptability ranged from 6.00 to 7.31.

## CONCLUSION

This work was initiated to characterize the product prepared from different varieties of the fruit from jujube and BAU Kul to establish the effect of the suitability for jam, jelly and pickle preparation. Physio chemical analysis shows that both fruits are good source of nutrients in summary, jujube may be exploited for development of various food products jam, jelly and pickle.

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