Original Research Article

DevelopmentandstandardizationofWoodapple(*Limoniaacidissima*Linn)Sauce

Abstract

Common name for Wood apple (*Limoniaacidissima*Linn), is Bael, is a native toIndia. Development and standardization of Sauce, its acceptability and storage stability werestudied in this study. To analyze the physic- chemical properties of developed product fourvariations of wood apple sauce of containing different levels of pulp (70, 80, 90 and 95percent) were prepared and compared with control tomato sauce. Organoleptic evaluation forofcontrol sample were 8.40, 8.59, 8.79, 8.56, 8.26 and 8.60 for appearance, texture, colour,flavour, taste and overall acceptability respectively.Itwas followed by WA (wood apple70%)whichscored7.80forappearance,7.90fortexture,8.00forcolour,8.15foraroma, 7.50fortasteand8.35foroverallacceptability.Phosphorous(90mg/100g),zinc(0.501mg/100g),copper(0.245mg/100g)andmanganese(0.286mg/100g)contentwereobserved in sauce prepared with 70% wood apple. Best accepted sauce powder WA-1 wasstored at room temperature and refrigerated temperature in polythene pouches of 8 gauges forstorage period of 3 months.There was a non significantdifference with respect to pH ofsauce stored for a period of three months under ambient conditions. Significant decrease intitrable acidity of sauce was observed from initial (6.07%) to final (6.02%) stored for a periodof three months. organoleptic evaluation of sauce stored under both ambient and refrigeratedconditions were decreased as the duration increases Moulds population of sauce at initial daywas found to be 1.33 X 10^4 CFU, 3.67 X 10^4 CFU on 30^{th}day, 6.67 X 10^4 CFU on 60^{th} dayand8.33X10^4CFUon90^{th} dayofstorage.

Keywords:Woodapple, sensoryevaluation, chemicalevaluation,storagestudiessauce

Introduction:

Many underutilized fruits and vegetables are rich in micronutrients and couldsignificantly contribute to nutritional security if eaten as a part of daily diet. Common namefor Woodapple (*Limoniaacidissima*Linn) is Bael. India is the native place for wood appleandisalsocultivatedinBangladesh,PakistanandSriLanka(Bakshi*etal*.,2001).Fruitis,5

to 12.5 cm wide, shape is oval to round , woody, amazingly hard rind whichis difficult tocrack, greyish-white, scurfy rind about six mm thick, pulp brown, mealy, odorous, resinous,astringent, acid or sweetish, with numerous small, white seeds scattered through it. Two typesof wood apples are available, one with small, acidic fruits and large, sweet fruits (*Morton andJulia*1987).

Fig:1Woodapplefruit.

Allpartsof theplantsareprescribedinindigenoussystem ofmedicineforthetreatmentofvariousailments.Leaves,barks,rootsandfruitpulpareallusedagainst snakebite (Yusuf, 1994). In India, fruit is used as a liver and cardiac tonic, in diarrhea anddysentery,an effective treatmentforhiccup,sore throatand gum diseases.The pulpispoultice onto bites and stings of venomous insects (*Kirtikar and Basu, 1993*). In English theycallitas Curdfruit,Elephantapple,Monkeyfruit,Wood-apple.

Fruits of wood apple are refrigerant, stimulant, astringent, aphrodisiac, diuretic, cardiotonic,tonic to liver and lungs, cures cough, hiccup and good for asthma, constipation, tumours,opthalmia andleucorrhoea(*Jadejaetal.,2005*).

Objectivesofthepresentstudyare

1. DevelopmentandstandardizationofSauce,itsacceptabilityandstoragestability.
2. To analyzethe physico-chemicalpropertiesofdeveloped product.

Materialand Methods:

From the local market wood apples were collected during the season and they werestored in deep freezer for the further study. For the preparation of products ingredients wereprocuredfromlocalmarket.

Fig2:woodapllesauce

Wood apple sauce (WA): Four variations of wood apple sauce of containing different levelsof pulp (70, 80, 90 and 95per cent) were prepared and compared with control tomato sauce asindicatedintable 1andmethodusedinthepreparationofsauceisgiveninFig3.

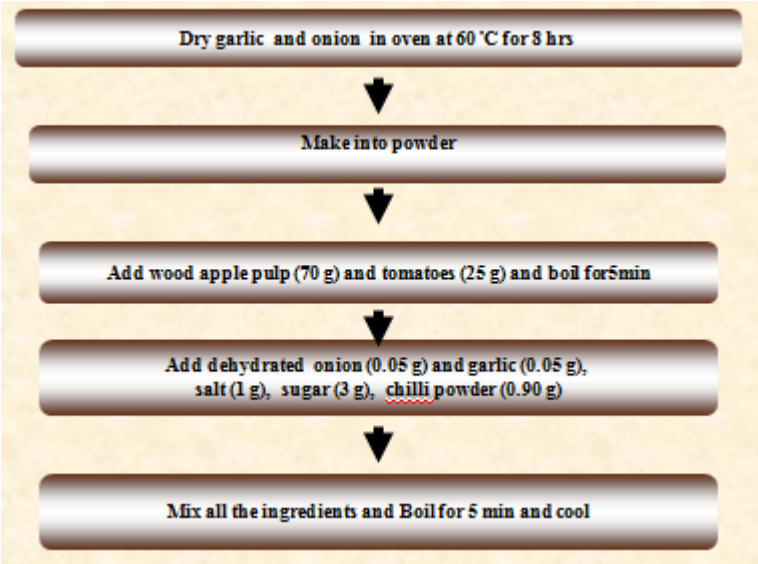

Fig. 3: Flowchartforthepreparation ofSauce

Table: 1Standardization ofvalueaddedWoodapplesauce

Sl.No.	Ingredients	Control	WS-1	WS-2	WA-3	AW-4
1.	Woodapple(g)	-	70	80	90	95
2.	Tomato(g)	95	25	15	5	-
3.	Chillipowder(g)	0.90	0.90	0.90	0.90	0.90
4.	Sugar (g)	3.00	3.00	3.00	3.00	3.00
5.	Salt(g)	1.00	1.00	1.00	1.00	1.00
6.	Onion(g)	0.05	0.05	0.05	0.05	0.05
7.	Garlic(g)	0.05	0.05	0.05	0.05	0.05
	Total	100	100	100	100	100

WA-Woodapplesauce

Nutrientsanalysisofthesauce(Anon,1980)

Nutrients namely moisture, protein,fat, ash, crude fibre, calcium, phosphorus, ironand zinc were analysed using standard AOAO method 2010. Carbohydrate content of saucewascomputedbydifferencemethod.Usinganalyticalgradechemicalsnutrientswereanalysed intriplicate.Results were expressedondryweightbasis.

RESULTSANDDISCUSSION

Organolepticevaluation ofSauce

Table2:OrganolepticevaluationofSauce(n=20)

Treatments	Appearance	Texture	Colour	Aroma	Taste	Overallacceptability
Control	8.40	8.59	8.79	8.56	8.26	8.60

A-1 (70%)	7.80	7.90	8.00	8.15	7.50	8.35
WA-2 (80%)	7.44	7.59	7.52	7.97	7.96	8.10
WA-3 (90%)	7.18	7.36	7.28	8.01	7.15	7.65
WA-4 (100%)	7.00	7.03	7.04	7.56	7.36	7.29
Fvalue	*	*	*	*	*	*
SEm±	0.15	0.18	0.24	0.22	0.19	0.17
CDat5%	0.43	0.50	0.66	0.62	0.53	0.48

*Significantat5percent

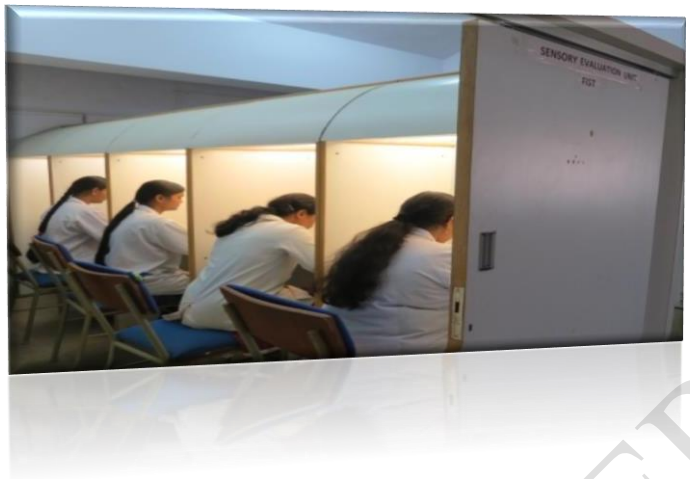

Fig.4: Organoleptic evaluationofwoodappleSauce

Table 2 and Fig 4 show the organoleptic evaluation of wood apple Sauce.Sensory scores ofcontrol sample were 8.40, 8.59, 8.79, 8.56, 8.26 and 8.60 for appearance, texture, colour,flavour, taste and overall acceptability respectively. It was followed by WA-1 (wood apple70%)whichscored7.80forappearance,7.90fortexture,8.00forcolour,8.15foraroma, 7.50 for taste and 8.35 for overall acceptability. The lowest score for appearance (7.00),texture (7.03), colour (7.04), flavour (7.56), taste (7.36) and overall acceptability (7.29) wasobserved by WA-4 (wood apple 100%). There was significant difference for appearance,flavour,tasteandoverallacceptabilitywasobserved.SimilarresultswereobservedbyJayashree *et al.*, 2012, organoleptic analysis showed thatginger sauce had the bestflavourand taste, with overall acceptability score of 8.0; the next was ginger-pepper sauce withacceptability score of 7.1, followed by ginger-nutmeg sauce with a score of 6.4. *Ginger-kokum*andginger-nutmeg-kokumsauceshada near-similaracceptabilityscoreof5.3.

According to El-sherif. (2013) significant differences were obtained among the tastesamples. Analysis of variance showed that tomato ketchup (T1) had the highest score forcolor, taste, odor, texture and overall acceptability compared to those of the other investigatedsamples.NosignificantdifferencewasobservedinthemeansoftasteforT2andT3compared to T4 which had the lowest mean of taste compared to the others. The color scoresof tamarind ketchup (T5) were lower than the other ketchup products. It could be stated thattomato ketchup (T1) and tomato ketchup supplemented with red Roselle extract had thehighest palatability compared to all other ketchup treatments while the mean score of T3, T4andT5waslowerthanT1andT2forthe overallacceptability.

1. **Macronutrientcomposition ofSauce**

Table3: Macronutrient compositionofdevelopedproducts(per100g)

Products	Moisture (g)	Protein (g)	Fat (g)	Total Ash(g)	Crude Fibre(g)	Carbohydrates (g)	Energy (g)
Sauce (70%)	69.2	5.085	1.08	1.75	3.97	18.90	106

Note:Forsauce,freshwoodappleisadded

2. **Micronutrientcomposition ofSauce**

Table4: Micronutrient compositionofdevelopedproducts(mgper100g)

Products	Calcium (mg)	Phosphorus (mg)	Iron (mg)	Zinc (mg)	Copper (mg)	Manganese (mg)
Sauce	217.00	90.00	0.46	0.50	0.25	0.29

Phosphorous(90mg/100g),zinc(0.501mg/100g),copper(0.245mg/100g)andmanganese (0.286mg/100g) content were observed in sauce prepared with 70% wood apple(Table-4).

Nutrient composition varies depending upon plant variety, agronomic practices, and stage ofcollection of fruits and climate and geological conditions of area from where seeds arecollected(Haq*etal*.,2012).

Calcium content was highest in treatment T2 (54.74mg) followed by T1 (53.59mg) and T3(53.38mg). Iron content was highest in treatment T2 (0.67mg) followed by T1 (0.66mg) andT3 (0.63mg).Phosphrous content was highest in treatment T2 (37.86mg) followed by T1(36.82mg)andT3(36.20mg)(Srivastav*etal*.,2014).

3. **Shelflifestudy ofthedevelopedproducts**

Wood apple sauce mix was aseptically packed in HDPE polythene covers and sealed. Thesamples were kept at ambient and refrigerated conditions. Sauce stored product mix, wasevaluated for sensory attributes, pH, and acidity percentage and microbial load for a period ofthree months.

Table5:Effectofstorageconditiononsensorycharacteristicsofsauce

Temperature	Duration(days)	Appearance	Texture	Colour	Aroma	Taste	Overallacceptability
Ambient	Initial	7.80	7.90	8.00	8.15	7.50	8.35
	30days	7.05	7.20	7.50	7.60	6.85	7.65
	60days	6.25	6.35	6.55	6.65	6.20	6.90
	90days	6.00	6.10	6.45	6.25	5.75	6.45
Refrigerated	Initial	7.80	7.90	8.00	8.15	7.50	8.35
	30days	7.75	7.55	7.95	8.00	7.10	8.10

	60days	7.35	7.05	7.45	7.70	7.10	7.85
	90days	6.80	6.55	7.10	7.00	6.90	7.45
Temperature	**Fvalue**	**	**	**	**	**	**
	SEm±	0.08	0.08	0.10	0.09	0.11	0.09
	CD @5%	0.22	0.22	0.29	0.24	0.30	0.26
Duration	**Fvalue**	**	**	**	**	**	**
	SEM±	0.11	0.11	0.15	0.12	0.15	0.13
	CD @5%	0.31	0.31	0.41	0.33	0.43	0.36
Interaction	**Fvalue**	**	NS	NS	*	*	*
	SEM±	0.16	0.16	0.21	0.17	0.22	0.18
	CD @5%	0.44	0.43	0.57	0.47	0.60	0.51

*Significantat5percentlevel **Significant 1 per cent
levelNs-nonsignificant

Effect ofstorageonorganolepticevaluationofthedevelopedproducts

Best accepted product was selected for shelf life study. Environmental conditions may varythe sensory quality profile of products. In the present study, the effect of factors such astemperatureanddurationonwoodapple sauce wasstudiedforaperiodof3months.

Meansensoryscoresofsauce

Effect of storage on sensory scores of sauce is presented in Table-5. Best accepted saucepowder WA-1 was stored at room temperature and refrigerated temperature in polythenepouchesof8gaugesforstorageperiodof3months.

All the sensory attributes of sauce stored under both ambient and refrigerated conditions weredecreasedasthedurationincreases.Mean sensory scoresfor ambientconditionsampledecreased from 7.8 to 6, 7.9 to 6.1, 8 to 6.45, 8.15 to 6.25, 7.5 to 5.75and 8.35 to 6.45 forappearance, texture, flavour, taste and overall acceptability, respectively. Similarly in WA-1samples,meansensoryscoresdecreasedfrom7.8to6.8(appearance),7.9to6.55(texture),8 to 7.1(colour), 8.15 to 7(aroma), 7.5 to 6.9 (taste) and 8.35 to 7.45 (overall acceptability).There was a significant difference for all sensory attributes at five percent for texture andcolour.

Present results were inconformity with the study conducted by Gokoglu*et al*., (2009), toassess the organoleptic scores of both samples significantly decreased ($p< 0.05$) throughoutthe storage. Pomegranate sauce scores were significantly lowers ($p< 0.05$)forappearancethan those found in sunflower oil. in marinated anchovy the pomegranate sauce also produceddesirable tasteandflavour.

Table6:Effect ofstoringwoodapplesauceonpHcontentandtitrableacidity

	pH	**Titrableacidity**

Duration	Sauce	Sauce
Initial	3.45	6.07
Final(30thday)	3.47	6.02
Mean	3.46	6.04
F-value	NS	*
SEM±	0.060	0.012
CD at5%	0.245	0.045

*Significantat5percentlevel NSnon-significant

Effect of storage on pH and titrable acidity of wood apple products (Table 6). There was anon significant difference with respect to pH of sauce stored for a period of three monthsunder ambient conditions. Significant decrease in titrable acidity of sauce was observed frominitial(6.07%)tofinal(6.02%)storedforaperiodofthreemonths.

Nutrient content of wood apple jam and fruit bar stored under ambient condition for a periodof3months.VitaminCcontentwassignificantreducedforstoring(11.1to50.0percentand 10.5to57.8percentrespectively).

Loss in Calcium was 15 percent and 12.5 percent Jam and Fruit Bar, respectively during thestorage of upto 90th day. phosphorus content also reduced for storage ofboth jam and fruitbar was observed upto 90 days. The reduction in phosphorus content of jam was 5.11 percentduring60thdayand8.80%during90th dayandinfruitbar5.81percentduring60thdayand 10.7 percent during 90th day of storage. loss of titrable acidity was also increased in both jamand fruit bar as the period of storage increased. No changes in TSS, pectin and ash value wasobserved in the prepared product during storage when compared to the initial observations.The percentage gain in total sugar contents (mg/100g of sample) was higher in jam followedby fruit bar recording 0.68 and 0.89% respectively. The reducing sugar content (mg/100g ofsample) was higher in jam followed by fruit bar recording 2.59 and 1.53 respectively. Withregards to microbial load content of jam and fruit bar, only acceptable amount was observedduring90dayofstorage(Vidhya andNarain.2010)

Microbialload ofSauce

Table-7indicates themicrobial load of sauce.Bestaccepted sauce powder WA-1(24g ofwood apple powder) incorporation was stored at room temperature in polythene pouches of 8gauges for storage period of 3 months.Microbial count was observed at initial day and at theintervalof30days.

Moulds population of sauce atinitial day was found to be 1.33 X 10^4 CFU, 3.67 X 10^4 CFUon30th day,6.67X10^4CFUon60th dayand8.33X10^4CFUon90th dayofstorage.

Table7: Effect ofstorageonmicrobialload ofsauce

Duration	Moulds(×10^4CFU)	Yeast(× 10^4CFU)
Initial	1.33	0.33
30thday	3.67	2.33
60thday	6.67	6.33

90th day	8.33	9.33
F-value	*	*
SEm±	0.83	0.73
CD at5%	2.34	3.96

Similarfindings were reported by Priyanka, (2014) Bacterial population of sauce atinitialday was found to be 73.33X10^{3}CFU/10 g and 105.33 X10^3 CFU, on 30th day was found andmouldswasfoundtobe3.66X10^{3}CFU/10gatinitialand7.00X10^{3}CFUon30th day.

The different extracts of *F. limonia*against various fungal and bacterial strains indicate thatthisplantishavingpotentantifungal effectsandantibacterialeffect.Theantimicrobialactivity of *F.limonia*wouldbedue tothepresenceof alkaloids,flavonoidsandthesecompounds are most probably soluble in organic polar solvent. (Jayashree and Londonkar,2014)

Naturalproductswithdualefficiencyasantimicrobialpropertiesandpreventinglipidoxidation have incredible potential for extending the shelf life of food products. Essential oilfrom the fruit pulp of *F. limonia*can be considered as a new and potential source of naturalantimicrobialagentandantioxidant(SenthilkumarandVenkatesalu,2013)

Conclusion

Excess production of wood apple in season leads to form glut in the market. To avoid scarcityin the off season and to reduce perish ability of wood apple, value added product sauce wasdeveloped. Sensory scores of control sample were highest wood apple 70%. Phosphorous,zinc, copper and manganese content were observed in sauce prepared with 70% wood apple.BestacceptedsaucepowderWA-1wasstoredatroomtemperatureandrefrigeratedtemperature in polythene pouches of 8 gauges for storage period of 3 months.There was anon significant difference with respect to pH of sauce stored for a period of three monthsunder ambient conditions.. All the sensory attributes of sauce stored under both ambient andrefrigeratedconditions were decreasedasthedurationincreases.

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