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Analysis of traditional mango pickling recipes of Watala and Allied Villages of Barnala, District Bhimber Azad Jammu and Kashmir Pakistan and its commercial perspectives

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Abstract

Mango is an important indigenous fruit of Watala area of Barnala, District Bhimber Azad Jammu and Kashmir. Indigenous communities' utilizemangoas ethnomedicines, fruit and condiments (pickle, sauce and juice. Organic mango pickle is prepared using different traditional recipes in the area. In this research, optimization of various recipes was conducted to recommend the best recipe for pickle production at domestic and commercial scale. Five indigenous mango pickling recipes: Watala Mango Pickle (WMP), Sweet Mango Pickle (SMP), Vinegar Mango Pickle (VMP), Chili-Spicy Mango Pickle (CMP) and Namkeen (Salty) Mango Pickle (NMP) were testified. On basis of ethnomedicinal survey and physio-chemical properties, fat mango (called mota aam) was selected for experimental trial. In the analysis, parameters like pH, acidity, and moisture, ascorbic acid content, reducing sugar content, total sugar content and browning of color were studied in triplicate. After different time intervals (0, 30, 60, 90 days) color, consistency, flavour, aroma, texture and acceptability were evaluated to determine organoleptic quality of pickle. Results obtained through 9-point hedonic scale(HPS)proved that recipe WMP was the best one because of lower pH(2.46), less moisture content (50.16),higher acidity (4.21), elegant aroma, less sugar content (6.10), high phenetic texture (with least browning effect: 0.341) and good flavour.Itwas found that with increase of storage period organoleptic properties like color, consistency, flavour, aroma, texture, taste and overall acceptability improved but coloration became brownish/faded.The experimental analysis recommended WMP as the best pickle recipe whileCMP and SMP ranked second and third recipes, respectively. The recipe has potential of commercial production of pickle to meet local and national requirements. This will assist indigenous people to achieve sustainable livelihood for as per united nation's SGDs.

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Introduction

Mango (*Mangifera indica* L.) known as king of fruits and it belongs to family Anacardiaceae. On world level, its grown in more than 100 countries; particularly tropical areas are favorable for its cultivation. Its annual yield is 25 million tons around the globe while Pakistan has 8.5% share in it (FAO, 2002). In Pakistan, mango crop is cultivated on an area of 167.5 thousand hectares with annual fruit production of 1732 thousand tones (Balal *et al.*, 2011; Rashad *et al.*, 2012; Ishtiaq *et al.,* 2012.

Mango fruit as raw and ripened is used in different traditional ethnomedicinal (TEM) recipes in various cultures of world to cure aliments like as asthma, cough, diarrhoea, dysentery, Leucorrhoea, Jaundice, pains and malaria (Agoha, 1981; Ploetz *et al.*, 1990; Madunagu *et al.*, 1990).Mango fruits have rich nutritive sources because it contains vitamins A and C; carbohydrates, Calcium (Ca), sugars, fat, protein, dietary fibersand Phosphorus (Mukherjee, 1997; Amin *et al.*, 2008). Its fruit has been used to produce other by-products like juice, jelly, squashes, syrups, nectars, jams, sauces and pickles (Ploetz *et al.*, 1990; Rakhi and Swarnendu, 2018) which are being exported by many countries as commercial products to earn revenue budget (Tharanathan, *et al.*, 2009; Ghafoor, *et al.,* 2010; Solís-Fuentes *et al.*, 2011).

Pickle is one of mango fruit's product and pickling is also one of methodsfor preservation of various foods inherited by human. Pickle has been used in human culture since very old times of history 2000 B.C. originating back to Mesopotamians era and later it was introduced in sub-continent (India and Pakistan) region (Bowen and Ralph,2003). Mango pickle has been used in preparing different dishes in domestic life. Mango pickles assist in digestion and cure of flatulence because pickle contains beneficial bacteria which counterfeits harmful intestinal microbes (Akbudak *et al.*, 2007) and it also act as appetizer (Monika *et al.,* 2016). In old civilizations, man has been using drying, salt additives and oil therapy as preservative techniques for preservation of fruits, meat and vegetables which are hitherto in practice today (Ratti, 2001).

The current research was focused on optimization of traditional mango pickling recipes of Watala National Park (WNP) and allied villages of Barnala, District Bhimber of Azad Jammu and Kashmir (AJK). Bhimber one of ten Districts of AJK is situated on latitude: 32-48 to 33-34 and longitude: 73.55 to 74-45 and it has area of 1,516 Km^2 and population of the District is 0.420 million (Nabeela, 2009; (Ishtiaq *et al.,* 2012; 2016).WNP is historic place because maternal family of famous Sikh ruler "Mahraja Hari Singh" belonged to this area. WNP which contains many small mango units culminating into one large mango garden called 'Garden of Princess' "Raani ka Bagh" that might be wife of king of the regime. The area has rich cultural and biodiversity diversity as in this region various ethnic groups are residing since long ago. Major ethnic casts are: Jaat, Mirza, Jarral, Rajpoot, Janjua, Mughals and Butt/Kashmiris (Ishtiaq *et al.*, 2012; 2016; Mubashar, *et al.,* 2017). The communities of the area speak many local languages such as "Gojri, Kashmiri, Punjabi, Saraikee, Paareey, Urdu, Arabic and English" that might be differing in dialects due to amalgam of various cultures (Ishtiaq *et al.*, 2012). WNP and allied villages have dynamic plant biodiversity and many mango trees are prevalently grown because this area is known as the best soil for mango cultivation. There are huge number of mango trees cultivated in "Raani ka Bagh" that dates back to 18th century and hitherto these trees give handsome yield of mango fruits that is natural source of frutis of indigenous people as well as commercial perspectives to earn cash/livelihood (Ishtiaq *et al.,* 2013; 2016). These mango trees are now present in wild area and farmers/owners did not supplement these trees with chemcial fertilizers, hence these mango fruits are considered as organic mango fruit (OMF). Their taste, shape and aroma is natural and local people of area prefer to prepare different products such as pickle, sauce (chatnees), juices, jelly and Jams using folklore approaches (Ishtiaq *et al.*, 2012). Pickle is one the key products of WNP mango fruits and people of the area and allied villagesprefer it because they consider it "organic

mango pickles" (OMP) with natural taste, aroma and nutrition.

Procedure of making pickles is called "pickling" and it is conducted at low pH, using brine soln. spices and other acidic products which enhances the bio-preservation of food contents more than two years without refrigeration (Tamang, 1998; Krishnan *et al.,* 2004; Tamang, 2010).Different types of mango pickles (MPs) are being prepared and marketed in the country such as salty pickle, oily pickle, sweet pickle (Akbudak *et al.*, 2007). Each type of MPs is different in taste, nutrition and aroma depending its constituents and ingredients. Many commercial brands of MPs are being prepared by different companies and marketed nationally and internationally. The pickling reduces the post-harvest losses and also stabilizes the prices in markets (Sultana *et al.,* 2014).

In this analysis, five commonly occurring mango varieties Gola mango (GM), Mota mango (MM), Peela mango (PM), Sandoori mango (SM) and Ajwainee mango (AM) in WNP were chose for initial trials and through EB method one best variety was selected.The key objectives of this research work was to (i) to collect ethnomedicinal and phytogeographic information about mango varieties of WNP, and select best variety for pickling,(ii)to enlist and optimize indigenous recipes of organic mango pickling (OMP)used by communities of WNP and allied areas, (iii) to introspect the impact of cultural variation on OMPs production and health benefits imparted on the societies in conjunction with its commercial perspectives.

Materials and methods

Ethnobotanical information collection

Ethnobotanical (EB) information about the occurrence, phytogeography, indigenous uses of mango varieties being grown in Watala National Park (WNP) and allied villages were collected by using questionnaire format. It consisted of open-ended and close-ended interviews method and data from both genders covering all ethnic groupsof the area were collected (Ishtiaq *et al.,* 2012; 2016). The data was tabulated in matrix form and analyzed using different micro statistical tools. This approach was used selection of the best indigenous mango variety of WNP for optimization pickling recipes.

Sample collection for pickling

Mature but unripe mango fruit of five indigenous mango varieties was collected from different gardens of Watala District Bhimber, AJK in triplicate form and tagged. All the fruit was washed, shadow dried and cut into small slices. Then it was processed for picklingaccording to the selected folklore recipes in triplicate. All ingredients like sugar, salt, spices, pepper, chilies were purchased from local marketbearing standard trade mark companies.

Recipes and protocols to prepare pickles

Unripe mature green mango fruit of fivelocal varieties was collected and initially processed as described above. The fruit were thoroughly cleaned, washed in water and were dried by wiping with muslin cloth. Fruits were cut into small pieces of about 1 x 0.75 x 0.5 cm size. Five indigenous recipes of mango pickling *viz*: Watala Mango Pickle (WMP), Sweet Mango Pickle (SMP), Vinegar Mango Pickle (VMP), Chili-Spicy Mango Pickle (CMP) and Namkeen (Salty) Mango Pickle (NMP) were documented by EB method and each was applied in triplicate to optimize and recommend the best one. All supplementary spices like coriandrum, chilies, caraway seeds, carom seeds, aniseed, black pepper and clove were grinded coarsely. In case of sweet pickle, sugar (refined quality) was also added along with spices.

Sliced fruit were filled into bottles and capped tightly. In case of oil pickle, previously heated and cooled mustard oil was poured into bottles to cover the pickle completely. Bottles were kept in sun for a week and were shaken at least two to three times daily. Pickle prepared by using different recipes were analyzed at 0, 30, 60 and 90 days for their physicochemical composition and organoleptic properties. The results were analyzed statistically by completely randomized design and using ANOVA

using SPSS (version 26). The various indigenous pickling recipes used in the analysis for the preparation of mango pickle are outlined in Table 1.

Results and discussion

There is strong correlation between mango and man's history. Mango has been used by human for different purposes during his life times. Through ethnobotanical (EB) analysis it was found that mango plant's parts have been used in various ethnomedicinal therapeutics to cure aliments.

Table 1. Indigenous Recipes for Traditional Mango Pickle (TPM) preparation from Watala National Park (WNP) and Allied Villages of District Bhimber Azad Jammu and Kashmir, Pakistan.

Names of Ingredients used in Pickle Making	Names of Indigenous Pickle Recipes of Mango				
	WMP	SMP	VMP	CMP	NMK
Unripe Mango Pieces	1.5 Kg	1.5 Kg	1.5 Kg	1.5 Kg	1.5 Kg
Turmeric (adrak)	20 g	-	20 g	20 g	20 g
Mustard seed	75 g	75 g	75 g	75 g	75 g
Ani seed	25 g	25 g	25 g	-	25 g
Nigella (black seeds)	10 g	-	10 g	10 g	10 g
Black pepper (powder)	20 g	-	20 g	20 g	20 g
Fenugreek seed	25 g	25 g	25 g	25 g	25 g
Red chilies (powder)	50 g	-	50 g	50 g	50 g
Cumin seed	15 g	15 g	15 g	15 g	15 g
Fennel seed	20 g	20 g	20 g	20 g	-
Clove powder	05 g	-	05 g	05 g	05 g
Salt	200 g	200 g	200 g	200 g	200 g
Cardamom	15 g	15 g	15 g	15 g	15 g
Asafoetida (Heeng)	05 g	-	-	-	05 g
Sugar	-	500 g	-	-	-
Mustard oil	300 ml	-	100 ml	500 ml	-

Key: Watala Mango Pickle=WMP; Sweet Mango Pickle=SMP; Vinegar Mango Pickle =VMP; Chili-Spicy Mango Pickle=CMP; Namkeen (Salty) Mango Pickle=NMP.

Table 2. Ethnomedicinal Uses of Different Mango Plant Parts to Cure Diseases by Indigenous People of Watala National Park (WNP) and Allied Villages, Barnala of District Bhimber Azad Kashmir, Pakistan.

Respondents (R:1-10)	Respondents Parameters				Folklore Phytotherapeutics of WNP		
	Age	*Gender*	*Education*	*Profession*	*Disease*	*Plant Part Used*	*Mode of Use with Recipe*
R1	45	M	Matric	Shopkeeper	Indigestion	Fruit	Pickle is used for better digestion
R2	55	M	Illiterate	Farmer	Cough	Inflorescence	Inflorescence is crushed and with sugar (ghor) is used
R3	48	F	Primary	Labour	Dysentery	Seed Kernel	Seed Kernel is dried, crushed and used with honey
R4	57	M	Illiterate	Farmer	Leucorrhoea	Leaf	Extract of leaf used with lemon juice +sugar
R5	78	F	Illiterate	Farmer	Jaundice	Root	Decoction of root is used
R6	65	F	Illiterate	Farmer	Asthma	Peel of Fruit	Peel fruit is dried, crushed and used with cow butter
R7	66	M	Illiterate	Farmer	Pains	Fruit pulp	Fruit pulp as admixture with cow Ghee (butter) taken
R8	34	M	Intermediate	Teacher	Malaria	Leaf, bark	Leaf and bark are burnt as repellent of mosquito
R9	83	M	Illiterate	Farmer	Vitality	Fruit ripened	Fruit ripened mixed with milk and used as admixture
R10	75	F	Illiterate	Farmer	Flatulence	Raw Fruit	Green fruit dried, crushed and powder used with hot water

The interview survey in field and homes was conducted, and it was known that indigenous people of WNP and allied villages use mango fruit and other plant parts for curing different diseases which is presented in tabular form (Table 2). The mango pickle is used to cure indigestion and flatulence by local people (Table 2) and it also used as ethnoveterinary medicine to cure stomach disorders of livestock by village people and similar findings has been reported from Samahni area of District Bhimber AJK (Ishtiaq *et al.,* 2008).

Table 3. Effect of Storage Period and Different Indigenous Recipes on pH of Mango Pickles Made from *Watala National Park and Allied Villages Mangoes, District Bhimber Azad Jammu and Kashmir, Pakistan.*

Storage Period (Days)	Names of Mango Pickles (based on recipes name)					Mean
	WMP	SMP	VMP	CMP	NMP	
0	3.20	3.66	3.01	3.80	2.95	3.12
30	2.40	3.35	2.60	2.50	2.75	2.72
60	2.25	3.25	2.36	2.35	2.00	2.44
90	2.00	4.05	2.10	2.13	2.50	2.55
Mean	2.46	3.57	2.51	2.69	2.55	

Table 4. Effect of Storage Period and Indigenous Recipes on Acidity (% age) of Different Pickles Made from Mangos of Watala National Park, District Bhimber Azad Jammu and Kashmir, Pakistan.

Storage Period (Days)	Names of Mango Pickles (based on recipes name)					Mean
	WMP	SMP	VMP	CMP	NMP	
0	2.8	3.5	2.66	2.65	2.8	2.88
30	4.3	3.7	3.08	3.19	3.1	3.47
60	4.8	4.5	3.35	3.3	3.5	3.89
90	4.95	4.75	3.1	3.9	3.9	4.12
Mean	4.21	4.11	3.04	3.26	3.32	

CD at 5%, Recipes: 0.19, Storage period: 0.19, *Recipes x Storage* period: NS.

Key: Watala Mango Pickle=WMP; Sweet Mango Pickle=SMP; Vinegar Mango Pickle =VMP; Chili-Spicy Mango Pickle=CMP; Namkeen (Salty) Mango Pickle=NMP.

The people of area use seed kernel paste with honey to treat dysentery and diarrhoea in their folklore therapeutics and it corroborates with previous work of Agoha, (1981) and Ploetz *et al.*, (1990). Leaf extract and root decoction is commonly used as traditional therapy to cure leucorrhoea and jaundice and these findings are in coincidence with past ethnomedicinal work on mango tree (Ploetz *et al.*, 1990; Ishtiaq *et al.,* 2012; 2016). EB data profiling depicted that mango fruit and pickle is prevalently used to as vital nutritive tonic because it contains many vitamins and minerals (Amin *et al.*, 2008). EB studies conducted on five indigenous mango varieties proved that mota mango (MM) variety was most appropriate for pickling and local people prefer its pickles.

Table 5. Effect of Different Indigenous Pickle Recipes and Storage Period on Moisture Content of Pickles Made from Mangoes of Watala National Park, District Bhimber Azad Kashmir, and Pakistan.

Storage Period (Days)	Names of Mango Pickles (based on recipes name)					Mean
	WMP	SMP	VMP	CMP	NMP	
0	59.55	68.50	76.50	75.10	77.20	57.67
25	51.40	60.15	65.24	66.50	68.50	50.32
50	46.51	55.54	60.19	65.65	62.25	46.92
75	43.21	53.36	61.14	55.88	58.80	43.80
Mean	50.16	59.38	65.76	65.78	66.68	

CD at 5%, Recipes: 0.08, Storage period: 0.09, Recipes x Storage period: 0.16

Key**:** Watala Mango Pickle=WMP; Sweet Mango Pickle=SMP; Vinegar Mango Pickle =VMP; Chili-Spicy Mango Pickle=CMP; Namkeen (Salty) Mango Pickle=NMP.

Pickle formation is very old custom being promulgated in several of country and particularly the communities of WNP had gained this wealth of traditional knowledge and mango pickling recipes from their forefathers through oral mode of transference (Ishtiaq *et al.,* 2012; Mehmood *et al.,* 2011). The pickle is part and parcel of life of indigenous rural communities of WNP and other allied villages of District Bhimber AJK. Local people of WNP and allied areas not only prepare pickles using various recipes for their own use but also they sell out in markets to earn revenue for their livelihood.

Table 6. Effect of Different Indigenous Pickle Recipes and Storage Period on Browning of Mango Pickles Made from Mangoes of Watala National Park, District Bhimber Azad Kashmir, Pakistan (OD at 440 nm).

Storage Period (Days)	Names of Mango Pickles (based on recipes name)					Mean
	WMP	SMP	VMP	CMP	NMP	
0	0.224	0.312	0.285	0.240	0.310	0.27
25	0.305	0.403	0.320	0.429	0.450	0.38
50	0.375	0.482	0.350	0.486	0.525	0.44
75	0.462	0.570	0.420	0.526	0.550	0.50
Mean	0.341	0.441	0.343	0.420	0.457	

CD at 5%, Recipes: 0.039, Storage period: 0.039, Recipes x Storage period: NS.

Key: Watala Mango Pickle=WMP; Sweet Mango Pickle=SMP; Vinegar Mango Pickle =VMP; Chili-Spicy Mango Pickle=CMP; Namkeen (Salty) Mango Pickle=NMP.

In this analysis, five mango pickling recipes *viz.* Watala Mango Pickle (WMP), Sweet Mango Pickle (SMP), Vinegar Mango Pickle (VMP), Chili-Spicy Mango Pickle (CMP) and Namkeen (Salty) Mango Pickle (NMP) were documented from local people and standardized for preparation of mangopickle from mota mango (MM) variety. During the analysis, it was found that out of these recipes, WMP was found the bestrecipe and EB analysis also favored this finding.All of therecipes were found to be organoleptic acceptable after two and three months of storage (Table 10) and it was found that pH value of mango pickles decreased significantly with the increase in storage period irrespective of pickle type and it was found that WMP recipe was the best in the pH analysis, which assist in stability and aroma maintenance (Table 4). This finding; decrease in pH can be attributed to increase in acidity that might be due to breakage of cellulosic and other carbohydrates into mono and di-saccharides that is correlated with previous work of Ranganna, (2002)and Muhammad (2016).

Table 7. Effect of different Indigenous Pickle Recipes and Storage Period on Ascorbic Acid Content (mg/100g) of mango pickle of Mango Pickles Made from Mangoes of Watala National Park, District Bhimber Azad Kashmir, Pakistan.

Storage Period (Days	Names of Mango Pickles (based on recipes name)					Mean
	WMP	SMP	VMP	CMP	NMP	
0	43.51	25.50	29.61	24.05	24.05	24.24
30	25.62	15.45	19.40	20.26	20.26	17.10
60	18.40	12.12	16.51	12.41	12.41	11.94
90	18.40	12.12	16.51	12.41	12.41	11.94
Mean	26.48	16.29	20.50	17.28	17.28	

CD at 5%, Recipes: 0.38, Storage period: 0.38, Recipes x Storage period: 0.76

Key: Watala Mango Pickle=WMP; Sweet Mango Pickle=SMP; Vinegar Mango Pickle =VMP; Chili-Spicy Mango Pickle=CMP; Namkeen (Salty) Mango Pickle=NMP.

In the analysis, reduction in pH for different pickles is attributed to lactic acid formation and fermentation activityincreases the acidity level in pickles and it was found highest in WMP (4.21%) followed by SMP (4.11 %) and all results are shown in Table 5. These results are corroborative to previous research conducted on several foods by other workers (Gupta, 1998) and pickles rise of acidity was reported by Panwar (1996) and Sharma (2002). It was found that SMP has second rank in acidity value after 90 days shelfing and it might be due to higher amount of sugar. Flemming (1982) concluded that increased concentration of reactive sugarcan increase acidity because of increase in lactic acid fermentation process and similar results were obtained by Bansett (1992) in bottled carrot pickle recipes. Another rationale of increase in acidity withincrease in storage periodis due to lactobacilli bacteria, present in pickles which causes fermentation converts sugar into lactic acid (Srivastva *et al.,* 2002; Rekha, 2004).

Table 8. Effect of different Indigenous Pickle Recipes and Storage Period on Total Sugar Content (%) of Mango Pickle Made from Mangoes of Watala National Park, District Bhimber Azad Kashmir, and Pakistan.

Storage Period (Days	Names of Mango Pickles (based on recipes name)					Mean
	WMP	SMP	VMP	CMP	NMP	
0	5.20	12.10	6.55	5.30	6.25	4.66
30	5.95	13.67	7.15	5.45	6.20	4.95
60	6.50	14.46	6.55	6.50	6.60	5.23
90	6.76	16.10	7.50	8.05	8.80	6.22
Mean	6.10	14.08	6.93	6.32	6.96	

CD at 5%, Recipes: 0.19, Storage period: 0.19, *Recipes x Storage period: NS*

Key: Watala Mango Pickle=WMP; Sweet Mango Pickle=SMP; Vinegar Mango Pickle =VMP; Chili-Spicy Mango Pickle=CMP; Namkeen (Salty) Mango Pickle=NMP.

In the analysis, WMP showed the least moisture content (50.16) followed by SMP (59.38). NMP showed the highest level of moisture content (66.68) and it was due to not use of oil and only salt and water is used in it (Table 6). This type of mango pickle can be easily attacked by pickle spoiling mycoflora (Khan*et al.,* 2005) which causes huge loss to pickles and it is loss time and wealth. These findings coincide with past work of Bacon, (1958) and Khan, *et al.,* (2005).

With passage of time all mango pickles showed considerably decrease in moisture content throughout the storage period. Kalra and Tandon (1983) concluded that the reduction in moisture content was due to addition of more salt and sugar, which causesosmosis. So the spicy pickle showed considerable decrease in moisture content and sweet pickle also showed maximum reduction in moisture content and similar result were obtained by Narayana (1986) in sweet turnip pickle.

Table 9. Effect of Different Indigenous Pickle Recipes and Storage Period on Reducing Sugar Content (%) of Mango Pickle Made from Mangoes of Watala National Park, District Bhimber Azad Kashmir, and Pakistan.

Storage Period (Days	Names of Mango Pickles (based on recipes name)					Mean
	WMP	SMP	VMP	CMP	NMP	
0	4.30	9.50	6.50	5.50	5.50	4.36
30	4.50	9.90	7.20	4.80	5.80	4.46
60	4.20	10.10	6.90	6.10	6.30	4.70
90	4.90	12.20	6.30	4.20	6.50	4.38
Mean	4.47	10.42	6.72	5.15	6.02	

CD at 5%, Recipes: 0.45, Storage period: 0.45, Recipes x Storage period: N.S. **Key:**Watala Mango Pickle=WMP; Sweet Mango Pickle=SMP; Vinegar Mango Pickle =VMP; Chili-Spicy Mango Pickle=CMP; Namkeen (Salty) Mango Pickle=NMP.

It was analysed that with increase in storage period, browning color of mangopickles increased continuously, irrespective of recipe used (Table 7).Minimum browning of coloration was found in WMP (0.341). Maximum browning was noticed in NMP followed by SMP.It might be due to the absence of a covering film of oilamong these recipes which resulted in formation of more fattyacid and increased peroxides value with the increased storageperiod. The obtained results were in concordance with thosefound by past researchers (Jiang, 2004; Qiang and Yaguang, 2007).

Table 10. Effect of Different Indigenous Recipes and Storage Period on Organoleptic Quality of Mango Pickle Made from Mangoes of Watala National Park, District Bhimber Azad Kashmir, and Pakistan.

Storage Period (Days	Names of Mango Pickles (based on recipes name)					Mean
	WMP	SMP	VMP	CMP	NMP	
Flavour						
0	6.55	5.5	5.99	5.75	5.8	5.91
30	7.10	6.2	5.90	6.65	6.45	6.46
60	7.50	6.55	6.55	7.25	7.15	7.00
90	8.25	7.15	7.25	7.10	7.10	7.37
Mean	7.35	6.35	6.42	6.68	6.62	
CD at 5%	Recipes = 0.35; Storage period = 0.36; Recipes x Storage period = N.S.					
Aroma						
0	7.77	5.25	6.10	5.25	6.55	6.18
30	7.95	6.70	6.45	6.90	6.85	6.97
60	8.42	6.55	6.90	7.55	7.55	7.39
90	8.55	8.00	7.78	8.35	8.45	8.22
Mean	8.17	6.62	6.80	7.01	7.35	
CD at 5%	Recipes = 0.32; Storage period = 0.32; Recipes x Storage period = N.S.					
Texture						
0	7.50	6.25	6.75	6.65	7.00	6.83
30	8.25	6.55	7.25	6.95	7.55	7.31
60	8.75	7.45	8.15	7.55	8.15	8.01
90	9.50	8.55	8.55	8.75	8.75	8.82
Mean	8.50	7.20	7.67	7.47	7.86	
CD at 5%	Recipes = 0.30; Storage period = 0.30; Recipes x Storage period = N.S.					
Colour						
0	8.55	7.25	6.99	7.15	6.92	7.37
30	8.75	7.75	7.55	7.55	7.45	7.81
60	9.15	8.25	7.95	7.95	7.95	8.25
90	9.75	8.95	8.74	8.45	8.55	8.88
Mean	9.05	8.05	7.80	7.77	7.7175	
CD at 5%	Recipes = 0.30; Storage period = 0.30; Recipes x Storage period = N.S.					
Consistency						
0	6.55	6.55	6.75	6.45	6.54	6.56
30	7.51	7.15	7.55	6.97	6.89	7.21
60	8.56	7.95	7.98	7.45	7.75	7.93
90	9.65	8.25	8.89	8.35	8.65	8.75
Mean	8.06	7.47	7.79	7.30	7.45	
CD at 5%	Recipes = 0.30; Storage period = 0.30; Recipes x Storage period = N.S.					
Taste						
0	9.55	9.46	7.44	7.56	6.95	8.19
30	10.25	9.95	7.55	8.75	7.68	8.83
60	11.55	10.25	7.98	9.25	8.74	9.55
90	13.75	11.95	10.15	11.65	12.55	12.01
Mean	11.27	10.40	8.28	9.30	8.98	
CD at 5%	Recipes = 0.30; Storage period = 0.30; Recipes x Storage period = N.S.					
Over all acceptance						
0	10.55	9.45	7.77	8.25	7.95	08.79
30	11.55	8.76	8.45	8.74	8.45	09.19
60	12.25	9.66	8.98	9.45	9.75	10.01
90	14.65	10.44	9.75	10.55	11.25	11.32
Mean	12.25	9.577	8.73	9.24	9.35	
CD at 5%	Recipes = 0.30; Storage period = 0.30; Recipes; Storage period = N.S.					

(Analysis Conducted According to Sukanya and Michael: 9-Hedonic Point Scale Year-2014).

In another study another parameter ascorbic acid content (AAC) was determined for all five recipes and it was found that WMP showed highest ascorbic acid content (26.48 mg/100g) and least amount of ascorbic acid was NMP (17.28 mg/100g) as shown in Table 8. These findings were in concordance with work of Zulueta *et al.,*(2010) where they have determined contents of ascorbic acid in different food contents. Further it was known that with passage shelfing days, AAC amount gradually and continuously decreases in all recipes of pickles and it might be due to leaching by process of osmosis triggered by inclusion of salts and sugars in pickles. The pickles with low moisture content depicted more amount of AAC and these results are in-line with past work of different researchers (Ghorai 1991; Premi *et a.l*, 2002; Zulueta *et al.*, 2010).

In pursuing of optimization of mango pickle recipes total sugar content (TSC) of all mango pickle samples determined and it was found that during increase in storage days TSC was increased gradually. The highest TSC was seen in SMP (14.08) that was due to external addition of sugar in the pickle and least was found in WMP (6.10) that is due to exclusion of sugar and supplementation with chilies and salts Table 9. Another cause of rise in TSC might be due to conversion of cellulose wall into mono-saccharide and di-saccharides (Aruna *et al.,* 1997; Gupta, 2008).

In analysis of pickle recipe optimization, reducing sugar content (RSC) was determined and it was seen that as pickle is getting old day by day, RSC was also increasing gradually (Table 10). It was found that highest RSC was found in SMP (10.42) that has addition of external source sugar. The least value of RSC (4.47) was seen in WMP because it has no addition of sugar and it has more quantity of chilies and salts which hinders and slows down the decomposition of cellulose and other starch contents of mango present in pickles. These studies are coincidence with previous workers (Nelson, 1994; Dinesh *et al.,* 2014). The organoleptic properties *viz.* taste, texture, flavour, aroma, color, consistency and overall acceptability were testified for all five mango pickle recipes which are collected from indigenous people using EB study. It was found that WMP showed the best values in all of organoleptic characteristics (Table 10). In this analysis, it was found that with passage of time over acceptability for all mango recipes were increased but WMP depicted the best results. It was found that texture, taste, consistency, aroma were improved with time elapse that might be due gradual degradation of starch and cellulosic contents of mango pickle. These types of findings were also found in another research on Qiang and Yaguang (2007) on another kind of fruit pickle.

Conclusion

Through this research it was concluded that indigenous mango varieties of WNP and allied villages are significant in life of rural communities. Mango plant and its fruit is hitherto being used as ethnomedicines by local people. There are different traditional mango varieties in WNP and documentation of ethnomedicinal and phytogeographic data about these mango trees is of dual importance; one it will assist in preservation of traditional culture of local ethnic communities and twice it will help to conserve the indigenous mango cultivars as bio-heritage of District Bhimber, AJK. The analysis recommends the Mota Mango (MM) as best variety for pickle making and during optimization procedure five recipes were tried and each gave its unique results but WMP: indigenous recipe of WNP was proven the best recipe of pickling. Further detailed research using technical phytochemical and nutraceutical approaches is required to classify and identify the best cultivar and to do more steps for its propagation and conservation.

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