Formulation and Shelf Life Evaluation of King Chilli Pickle

**Y. Prabhabati Devi, Khwairakpam Bembem,
Ingudam Bhupenchandra, Y. Jamuna Devi**

ABSTRACT

Pickling has been used throughout to conserve perishables and add to their savour. King chilli is a highly perishable crop and deteriorates quickly if not properly handled and processed. To improve the shelf life and assure availability year round, five differently treated king chilli pickles were made with the objectives to assess the treatment with best sensory acceptability and shelf life. Treatments varied in the concentration of salt, mustard oil, addition of vinegar and acetic acid. Shelf-life study for differently treated pickles stored in sterilized glass bottle was done for a period of 12 months in order to evaluate the change in color, flavor, texture and visual appearance of fungus. After critically observing periodically, T_5 (Vinegar cured king chilli + 8 % salt + spice + 35 % Mustard oil and store in sterilized glass bottle) sample was found to be the best treatment as compared to the other treatments. It has been observed that there was no change in color, texture, taste, aroma and no fungal growth up to the 12th month of storage without any deterioration in quality parameters.

Keywords King chilli, Post-harvest, Pickling, Shelf-life.

Y. Prabhabati Devi*
CAR-KVK,Chandel, ICAR-RC for NEH Region, Manipur Center 795001, Imphal, India

Khwairakpam Bembem
ICAR-Central Institute of Post-Harvest Engineering and Technology, Ludhiana 141004, India

Ingudam Bhupenchandra
ICAR-KVK, Tamenglong, ICAR-RC for NEH Region, Manipur Center 795001, India

Y. Jamuna Devi
Standard College, Kongba, Imphal East, Manipur 795001, India
Email; prabhayumnam@rediffmail.com
*Corresponding author

INTRODUCTION

King chilli (*Capsicum chinense*), is one of the hottest chillies in the world, grown widely in Manipur. It is known as U-Morok in Manipur and termed as ghost pepper, ghost chilli, Naga Jolokia, Bihjolokia and Bhoot Jolokiainin different parts of the north eastern states of India. It is widely used, fresh dried or pickled in many cuisines to add spiciness and for its distinct pungent flavor (Kuna *et al.* 2018). King chilli has high content of capsaicin (3-5%) and is gaining importance for its varied use in food, spices and medicine (Roy 2017). King chilli is famous for its heat content which is measured by Scoville Heat Units (SHU). The Scoville Heat Unit (SHU) value is a unit of heat/ pungency measurement, fluctuated between 272897 (0.27 million) to 1037305 (1.0 million) for king chilli (Gaur *et al*. 2016). It measures 60 to 85 mm (2.4 to 3.3 inches) long and 25 to 30 mm (1.0 to 1.2 inches) wide with a red, orange and chocolate color (Kuna *et al.* 2018). King chilli is highly priced compared
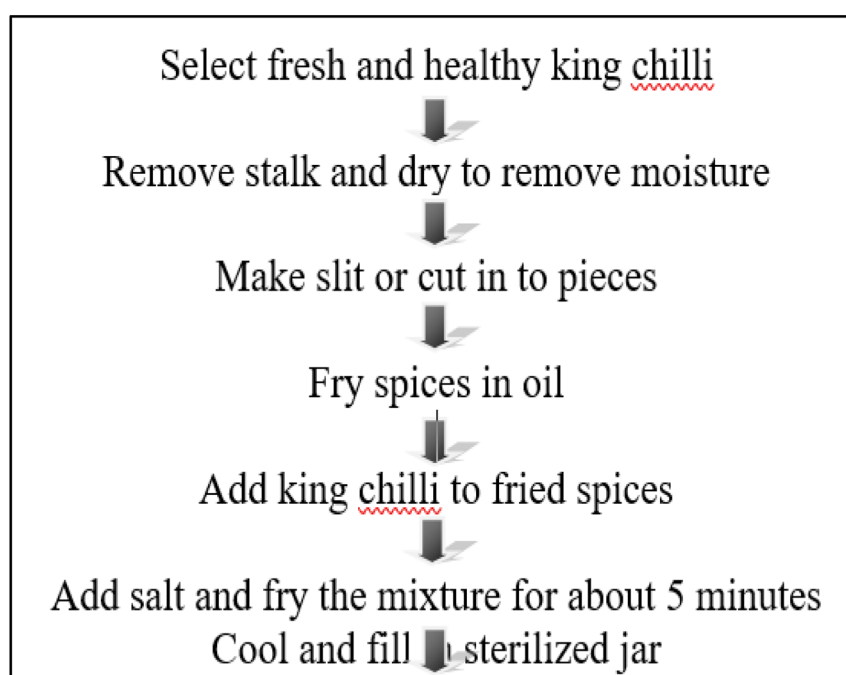
Fig. 1. Flow sheet for the preparation of king chilli pickle.

to other chilies and are highly demanded seasonal crop but they are highly perishable and deteriorate quickly. The shelf-life of this crop is limited to 3–5 days as a result of which considerable post-harvest losses are incurred (Rongsennungla *et al*. 2012). To extend the post-harvest shelf-life, it can be pickled and value added. Pickling has been used throughout to conserve foods and add to their savour (Davison 2018). Processing and preservation of vegetable by pickling reduce post-harvest losses, assure availability and control price fluctuation. Pickles are good appetizers consumed by all age group of people. Pickles contain large number of lactobacilli bacteria which are important for the digestion of grains and vegetables which have usual beneficial probiotics properties used by the body (Shahzorand Wen 2015). The process of pickle production is carried out under optimal condition. For pickling proper concentration of salt is very important for better shelf-life and also to reduce the infestation of mold, yeast and bacteria (Xiong *et al*. 2016). If salt concentration is less, the product gets slimy, soft and holds lots of water. Texture is also one of the most important sensorial qualitative characteristics of pickle and its effects on products acceptance is crucial (Sadeghizadeh *et al.* 2018). King chilli pickle is one of the most popular pickles prepared by women in Manipur. There is good scope to produce king chilli pickle by fermentation on commercial scale. But the quality and shelf-life of this pickle are of question. Introspecting the backdrop

Table 1. .Different treatments for pickling king chilli.

Sample	Treatment
T_1	King chilli + 3.5 % salt + spice + 15 % Mustard oil
T_2	King chilli + 5 % salt + spice + 20 % Mustard oil
T_3	King chilli + 6 % salt + spice + 25% Mustard oil + 10%
T_4	King chilli + 7% salt + spice + 30 % Mustard oil + 1.5 % Acetic acid
T_5	Vinegar cured king chilli + 18 % salt + spice + 35 % Mustard oil

Table 2. Formulation of king chilli pickle.

Ingredients	T_1	T_2	T_3	T_4	T_5
King chilli	1 kg	1 kg	1 kg	1 kg	1 kg
Mustard oil	150 ml	200 ml	250 ml	300 ml	350 ml
Salt	35g	50 g	60 g	70 g	80 g
Chilli powder	10 g	20 g	30 g	40 g	50 g
Jira powder	10 g	20 g	20 g	20 g	20 g
White mustard seed powder	10 g	20 g	20 g	20 g	20 g
Corriander powder	10 g	10 g	10 g	10 g	10 g
Turmeric powder	10 g	10 g	10 g	10 g	10 g
Vinegar	-	-	100 ml	-	1 lt
Acetic acid	-	-	-	15 ml	-

of this rationale, the study was undertaken to prepare king-chilli pickle by using different proportions of ingredients in order to assess the sensorial quality and shelf-life of king chilli pickles.

MATERIALS AND METHODS

Collection of study materials

Matured, firm and good quality king-chillies were collected from Imphal market of Manipur. Established brands of red chilli powder, turmeric powder, cumin seed powder, white mustard seed powder for spices, salt and mustard oil, vinegar and acetic acid were purchased from local market.

Preparation of pickle

King chillies were thoroughly washed with tap water to remove dust and dirt. Chillies were destalked and dried to remove surface moisture. Chillies were uniformly cut in to pieces for the spices to easily mix. Five different treatments were given for the pickle preparation varying in salt, mustard oil and vinegar

proportions as given in Table 1. Spice mix was deep fried in mustard oil. King chilli pieces were added to the spice mix and fried for another 5 minutes followed by the addition of salt in low flame. Flowsheet for the preparation of king chilli pickle is shown in Fig. 1. For treatment T_3 and T_4, vinegar and acetic acid respectively, were added justs before removing from fire and in case of T_5, king chilli was cured in vinegar overnight and vinegar water was drained before pickling. Formulation for king chilli pickle is given in Table 2.

Sensory evaluation

Sensory evaluation was carried out for all the differently treated pickles. 30 semi-trained panelists evaluated the sensory attributes of pickles. Panelists were familiar with product sensory evaluation; most having trained on pickle preparation. The attributes evaluated were color, aroma, taste, texture, appearance and overall acceptability. For each sample, panelists scored their liking of these characteristics using the nine point Hedonic scale as described by

Table 3. Mean sensory score of king chilli pickle.

Sample code	Color	Aroma	Sensory attributes Appearance	Texture	Taste	Overall acceptability
S_1	7.3[d]	7.1[c]	7.1[d]	6.8[d]	7.4[cd]	7.2[cd]
S_2	7.5[cd]	7.8[b]	7.4[bc]	7.1[bc]	7.6[cd]	7.4[c]
S_3	7.9[bc]	7.5[bc]	7.8[b]	7.2[bc]	7.8[c]	7.5[c]
S_4	8.0[b]	7.7[b]	8.1[a]	7.5[b]	8.2[b]	8.0[b]
S_5	8.3[a]	8.2[a]	8.2[a]	7.8[a]	8.5[a]	8.4[a]
Mean	7.8	7.66	7.72	7.28	7.9	7.7
LSD (0.05)	0.44	0.36	0.57	0.61	0.47	0.48

Values in the same column followed by different letters are significantly different at $p < 0.01$ according to Duncan's multiple-range test r separation of means.

709

Table 4. Visual observation of fungus growth developed in king chilli pickle at different storage period.

Storage period (Month)	Sample	Fungal growth	Storage period (Month)	Sample	Fungal growth
1month	S_1	No growth	6 month	S_1	Excessive growth
	S_2	No growth		S_2	Excessive growth
	S_3	No growth		S_3	No growth
	S_4	No growth		S_4	No growth
	S_5	No growth		S_5	No growth
2 month	S_1	Slightly growth	8 month	S_1	Excessive growth
	S_2	No growth		S_2	Excessive growth
	S_3	No. growth		S_3	No growth
	S_4	No. growth		$S_{4'}$	No growth
	S_5	No. growth		S_5	No growth
4 month	S_1	Excessive growth	10 month	S_1	Excessive growth
	S_2	Slightly growth		S_2	Excessive growth
	S_3	No growth		S_3	No growth
	S_4	No growth		S_4	No growth
	S_5	No growth		S_5	No growth
			12 month	S_1	Excessive growth
				S_2	Excessive growth
				S_3	Slightly growth
				S_4	No growth
				S_4	No growth

Joshi (2006). Average scores for each parameter is reported. The scores represented 1 = dislike extremely, 2 = dislike very much, 3 = dislike moderately, 4 = dislike slightly, 5 = neither like nor dislike, 6 = like slightly, 7 = like moderately, 8 = like very much and 9 = like extremely.

Shelf-life study

Shelf-life study for king chilli pickle stored in room temperature was conducted for a period of one year. Observations for any change in color, flavor, texture and appearance of fungus were done at the end of first and second month and at two months interval for the rest of the period.

Data analysis

Duncan's multiple range test (DMRT) at 5% level of significance was used for separation of mean. For execution of DMRT, three replicates for each treatment were recorded for all the sensory parameters. Pearson's coefficient correlation analysis between different mean sensory score of king chilli pickle was performed using SPSS version 22.

RESULTS AND DISCUSSION

Sensory evaluation

The mean sensory scores of pickled king chilli as evaluated by the testing panel are presented in Table 3. It is seen that T_5 scored the highest for color (8.3), aroma (8.2), taste (8.5), texture (7.8), appearance (8.2) and overall acceptability (8.4), while T_1 scored the lowest for all the attributes. It was observed that sensory scores improved with the increase in concentrations of salt and mustard oil.

Fungal growth study

Visual observation for the growth of fungus in king chilli pickles stored at room temperature for a period of one year is shown in Table 3 and graphically presented in Fig. 2. Differently treated king chilli pickles were in good condition in the first month of storage. Fungal growth is undesirable in pickling and fermentation (Zhao and Ding 2008). From the table, it was found that slight growth of fungus started from the second months onwards in T_1 sample and for T_2 sample, it started from 4 months. Excessive growth of fungus also started from second month up to twelve
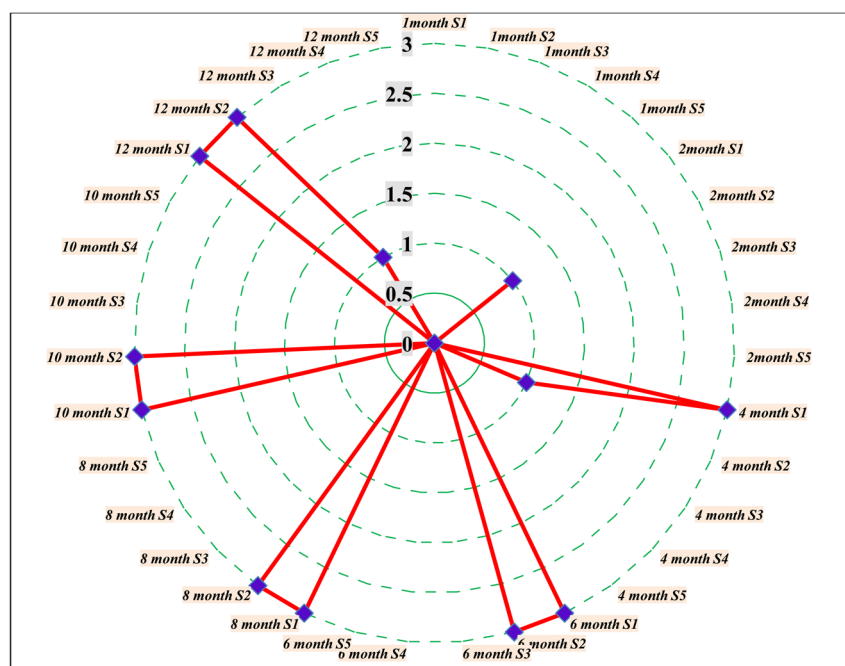
Fig. 2. Fungal growth developed at different storage period.

month in case of T_1, T_2 and T_3 sample which indicated that the pickle was completely spoiled. From Fig. 2, it was shown that assigning 0 score indicates no growth of fungus, 1 score indicates that there was slightly growth of fungus and 3 score indicates that there was excessive growth of fungus on the surface of pickles.

Shelf-life study

Observations for change in color, flavor and texture in king chilli pickles stored at room temperature (27-33°C) for a period of one year is given in Tables 4, 5 and graphically presented in Fig. 3. In the first month of storage, all the five samples of king chilli pickle were in good condition without any change in color, flavor and texture. The shelf-life of pickle is closely related with the growth of the fungus. In the second month of storage, slight fungal growth was seen in T_1 sample, by deteriorating with slight change in color and texture but no change were observed in the flavor of all the samples. In the fourth month, T_2 pickles also showed fungal growth on the surface of

the pickle rendering it not suitable for consumption, while T_3, T_4 and T_5 pickles showed no fungal growth, no change in color, flavor and texture. After sixth month of storage, T_3 sample showed slight change in color, flavor and texture although there was no fungal growth. Change in color and flavor on storage has also been reported in bell pepper based chutney (Sharma and Joshi 2014), tomato pickle mix (Rao *et al.* 2011) and stem amaranthus pickle (Shanta *et al.* 2014). This may be due to binding of pigment with the other spice components. Even after eight months of storage, T_4 and T_5 pickles were in good condition, showing no fungal growth and no change in other physical characteristics. On tenth month of storage, T_4 pickle showed slight change in the flavor, color and texture. However, no fungal growth was visually observed till the 12th month of storage in T_4 pickle. On storage of king chilli pickles for twelve months, it was observed that T_5 pickle had the best shelf-life and adjudged the best treatment with no change in the physical characteristics and no appearance of fungal growth. It was seen that with the appearance of fungus, texture of king chilli pickle softens. The

Table 5. Shelf life study of king chilli pickle.

Shelf life	Sample	Color	Flavor	Texture	Remark
1	S_1	No change	No off flavor	Firm	Good
	S_2	No change	No off flavor	Firm	Good
	S_3	No change	No off flavor	Firm	Good
	S_4	No change	No off flavor	Firm	Good
	S_5	No change	No off flavor	Firm	Good
2	S_1	Slight change	No off flavor	Slightly soft	Good
	S_2	No change	No off flavor	Firm	Good
	S_3	No change	No off flavor	Firm	Good
	S_4	No change	No off flavor	Firm	Good
	S_5	No change	No off flavor	Firm	Good
4	S_1	Change	Off flavor	Soft	Slightly spoiled
	S_2	Slight change	Slightly off flavor	Slightly soft	Fair
	S_3	No change	No off flavor	Firm	Good
	S_4	No change	No off flavor	Firm	Good
	S_5	No change	No off flavor	Firm	Good
6	S_1	Change	Off flavor	Extremely soft	Spoiled
	S_2	Change	Off flavor	Soft	Slightly spoiled
	S_3	Slightly change	Slightly off flavor	Slightly soft	Fair
	S_4	No change	No off flavor	Firm	Good
	S_5	No change	No off flavor	Firm	Good
8	S_1	Change	Off flavor	Extremely soft	Completely spoiled
	S_2	Change	Off flavor	Extremely soft	Spoiled
	S_3	Change	Off flavor	Soft	Slightly spoiled
	S_4	No change	No off flavor	Firm	Good
	S_5	No change	No off flavor	Firm	Good
10	S_1	Change	Off flavor	Extremely soft	Completely spoiled
	S_2	Change	Off flavor	Extremely soft	Spoiled
	S_3	Change	Off flavor	Extremely soft	Spoiled
	S_4	Slight change	Slight off flavor	Soft	Slightly spoiled
	S_5	No change	No off flavor	Firm	Good
12	S_1	Change	Off flavor	Extremely soft	Completely spoiled
	S_2	Change	Off flavor	Extremely soft	Completely spoiled
	S_3	Change	Off flavor	Extremely soft	Spoiled
	S_4	Change	Off flavor	Soft	Slightly spoiled
	S_5	No change	No off flavor	Firm	Good

change in texture is due to the production of pectinase by fungi which softened vegetables and thereby leading to the deterioration in flavor (Xiong *et al.* 2016). There was no fungal growth appearance on
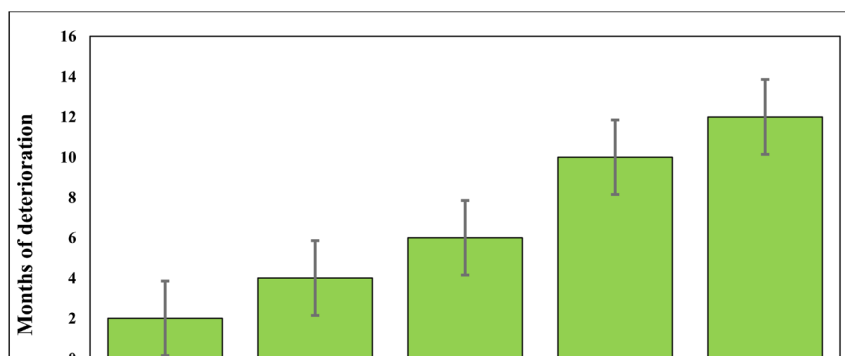
Fig. 3. Storage life of king chilli pickle.

Table 6. Pearson's correlation coefficient (r) matrix between the quality parameters of various sample of king chilli pickle. The correlation coefficient (r) values are significant at p < 0.01 (Boldfaced italics) and p < 0.05 (Bold) levels of probability (2-tailed). The correlation coefficient (r) values correspond directly to the color codes from green to yellow and red.

	Color	Aroma	Appearance	Texture	Taste	Overall acceptability
Color	1.000	0.774	0.964	0.962	0.979	0.931
Aroma	0.774	1.000	0.817	0.882	0.750	0.834
Appearance	0.964	0.817	1.000	0.991	0.960	0.993
Texture	0.962	0.882	0.991	1.000	0.955	0.985
Taste	0.979	0.750	0.960	0.955	1.000	0.920
Overall acceptability	0.931	0.834	0.993	0.985	0.920	1.000

the surface of the pickle with T_4 and T_5 treatments due to higher concentration of salt and mustard oil, vinegar and acetic acid. Use of salt, as preservative has been well known (Mishra *et al.* 2011). The covering of mustard oil as well as proper concentration of salt helped to prevent microbial contamination and vinegar and acetic acid helped to maintain the proper pH of the pickle.

Correlation analysis

Results of the Pearson's correlation coefficient analysis (Table 6) revealed the existence of significant correlation between color and aroma (p < 0.05 and r = 0.774) and highly significant positive correlation with appearance (p < 0.01 and r = 0.964), texture (p < 0.01 and r = 0.964), taste (p < 0.01 and r = 0.979) and overall acceptability (p < 0.01 and r = 0.931). Similarly, aroma showed the existence of significant positive correlation between with appearance (p < 0.01 and r = 0.964), texture (p < 0.01 and r = 0.964), taste (p < 0.01 and r = 0.979) and overall acceptability (p < 0.01 and r = 0.931). Similarly, aroma showed the existence of significant positive correlation between with appearance (p < 0.01 and r = 0.964), texture (p < 0.01 and r = 0.964), taste (p < 0.01 and r = 0.979) and overall acceptability (p < 0.01 and r = 0.931). Appearance was found to correlate positively with texture (p < 0.01 and r = 0.991), taste (p < 0.01 and r = 0.960) and overall acceptability (p < 0.01 and r = 0.993). Likewise, texture showed highly significant positive correlation with taste (p < 0.01 and r = 0.955) and overall acceptability (p < 0.01 and r = 0.985) and taste was correlated significantly and positively with overall acceptability (p < 0.01 and r = 0.920).

The overall results of correlation analysis (Table 6) indicates that all the sensory parameters are correlated to each other and this implies that the increment in one of the sensory parameter improved the other parameters and vice-versa and they are dependent on each other. Similar finding was reported by Shanta *et al.*(2014) who also observed the correlation between color, flavor, texture and overall acceptability, wherein increment in any of the aforementioned parameters induced augmentation of the other parameters and vice-versa and ultimately overall acceptability of the product also enhanced.

CONCLUSION

King chilli is highly perishable; which entailed value addition in the form of pickle having the ability to extend the shelf life, thereby making it available throughout the year and increasing earning capacity for enterpreneurs involved in it. For longer shelf life, preservatives like salt, mustard oil, acetic acid and vinegar can be used in proper concentration to extend the shelf life of the pickle. From this study, it was observed that fungal growth, which is not desirable, is a serious problem in pickle making. Addition of proper concentration of preservatives becomes an important factor to maintain the quality of pickles. Sensory test conducted by panel of women indicated that the pickle which was prepared with vinegar cured king chilli (T_5) was the most acceptable among the five treatments. In case of storage life T_5 also had the longest shelf life with no change in color, texture and flavor and no visual fungal growth. This study gives a good prospect on pickling king chilli and on their shelf life and technology may be adopted on large

scale by the women enterpreneurs and farm women in order to generate income and occupy a space in the market.

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