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Quality and shelf-life of ready to use brined ginger (*Zingiber officinale* Rosc.) slices

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ABSTRACT : Ginger (*Zingiber officinale* Rosc.) is one of the widely grown commercially important spices of North East India. Storage of fresh ginger for more than one month is problematic due to severe weight loss and sprouting. The present study was conducted to preserve the peeled ginger slices in acidified brine solution in plastic containers at ambient condition. The ginger rhizomes of Bhola variety harvested at 270 days after planting was found better for preservation of ginger slices of 1.5-2.0 mm thickness in brine. The ginger slices treated with 9 per cent brined solution acidified with 2 per cent citric acid and potassium metabisulphite and benzoic acid 50 ppm each as preservative resulted in better retention of biochemical qualities like crude protein (5.67%), total soluble carbohydrate (12.89%), oleoresin (4.17%) with better organoleptic qualities and no microbial growth after180 days of storage. The ginger slices could be safely stored up to 180 days. The brined ginger slices may serve as substitute for fresh ginger during the lean period.

KEY WORDS : Ginger, Brine, Crude protein, Oleoresin, Organoleptic, Miocrobial growth

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In the North Eastern region of India, Ginger (*Zingiber officinale* Rosc.) is widely cultivated covering an area of 21.86 thousand hectares, and accounts for about 26 per cent of the country's total production (Johnykutty, 1997). Of the total production, a huge amount of ginger becomes a marketable surplus which is sold by the farmers at a very low price. Besides, fresh ginger suffers from severe weight loss and sprouting if stored at ambient condition for more than one month. Due to absence of proper processing units and storage facilities locally, the ginger producers of the region have not been benefited to the desired extent.

Ginger form an important ingredient of every Indian food. The preparation of ginger is laborious and time consuming process. The ginger slices preserved in brine solution may shortcut the preparation process and also solves the problem of non-availability of fresh ginger in the market during May-November. Considering the huge production, potentiality, quality and market demand of ginger and its agro-climatic suitability in the region, the present investigation was undertaken to study the effect of brine solution on quality and shelf-life of ginger slices.

RESEARCH METHODS

The present study was carried out in the Quality Control and Post Harvest Technology Laboratory of the Department of Horticulture, AAU, Jorhat-13. Ginger rhizomes var. 'Bhola' were sampled at 270 days after planting from a farmer's field from Golaghat district, Assam. 'Bhola' is one of the popular local ginger variety with an average weight of 750-800 g per clump. The rhizomes were cleaned removing foreign matters, soil, pests and washed with clean water. The rhizomes were peeled and cut into small pieces of 1.5 to 2.0 mm

thickness. The slices were then preserved in brine solution having concentration of 8 per cent, 9 per cent and 10 per cent with citric acid(1-3%) with potassium metabisulphite (KMS) and benzoic acid 50 ppm each as preservative and kept in plastic container (PET) at ambient condition. The treatment combinations were :

T_1: 8% brine solution + 1%citric acid + KMS and benzoic acid 50 ppm

T_2: 8% brine solution + 2%citric acid + KMS and benzoic acid 50 ppm

T_3: 8% brine solution + 3%citric acid + KMS and benzoic acid 50 ppm

T_4: 9% brine solution + 1%citric acid + KMS and benzoic acid 50 ppm

T_5: 9% brine solution + 2%citric acid + KMS and benzoic acid 50 ppm

T_6: 9% brine solution + 3%citric acid + KMS and benzoic acid 50 ppm

T_7: 10% brine solution +1%citric acid + KMS and benzoic acid 50 ppm

T_8: 10% brine solution + 2%citric acid + KMS and benzoic acid 50 ppm

T_9: 10% brine solution + 3%citric acid + KMS and benzoic acid 50 ppm

T_{10}: Control

The above treatments were replicated thrice .The periodical observations on various physio-chemical parameters were made and data were analyzed in a Completely Randomized Design by Panse and Sukhatme (1978).

Standard procedures were followed for determination of moisture content (Ranganna, 1997), crude fibre (AOAC, 1984), crude protein (Ranganna, 1997), total soluble carbohydrate (Thimmaiah, 1999) and oleoresin (Winterson and Richardson,1965), The storage life of ginger slices was evaluated based on the visual quality of the products following the method suggested by Bhowmik and Pan(1992). A 9 point hedonic scale (1=poor,inedible; 9=excellent) was used to evaluate the organoleptic qualities (Amerine *et al.*, 1965). Microbial load of ginger samples was tested as per method described by Seeley and Van Denmark (1970).

RESEARCH FINDINGS AND DISCUSSION

The findings of the present study as well as relevant discussion have been presented under following heads :

Crude fibre :

It was found that crude fibre content of ginger slices decreased with increase in storage period (Table 1) which appeared to be similar to that found in bamboo pickles (Bhagawati, 2002) and in brined slices (Ogunjobi *et al.*, 2005). The lowest crude fibre content (2.04%) was obtained in slices treated with 9 per cent brine solution +

Table 1 : Effect of post harvest treatments on crude fibre(%) and crude protein (%) content of ginger slices

Treatments (T)	Crude fibre(%)				Crude protein(%)			
	Days in storage (D)				Days in storage (D)			
	D_1 (60)	D_2 (120)	D_3 (180)	Mean	D_1 (60)	D_2 (120)	D_3 (180)	Mean
T_1	2.30	2.20	2.08	2.19	6.07	5.57	5.07	5.57
T_2	2.32	2.18	2.08	2.19	6.10	5.57	5.07	5.58
T_3	2.35	2.28	2.23	2.29	6.03	5.53	5.03	5.53
T_4	2.13	2.00	1.98	2.04	6.10	5.60	5.13	5.61
T_5	2.12	2.03	1.97	2.04	6.17	5.67	5.17	5.67
T_6	2.12	2.07	1.98	2.06	6.13	5.63	5.17	5.64
T_7	2.17	2.10	2.02	2.09	5.93	5.43	4.95	5.44
T_8	2.17	2.07	2.00	2.08	5.93	5.43	5.00	5.46
T_9	2.27	2.12	2.05	2.14	5.95	5.45	5.00	5.47
T_{10}	-	-	-		-	-	-	-
Mean	2.21	2.12	2.04		6.05	5.54	5.06	
	S.E.±	C.D. (P=0.05)			S.E.±	C.D. (P=0.05)		
Treatment(T)	0.05	0.10			0.05	0.09		
Days(D)	0.02	0.05			0.03	0.05		
T×D	0.07	NS			0.08	NS		

Initial value = 2.50 Initial value = 6.30 NS=Non-significant

* Analysis was done excluding T_{10}, since T_{10} did not continue upto 60 days.

2 per cent citric acid with KMS and benzoic acid 50 ppm each. The decrease in crude fibre may be attributed to the loss of soluble fibre into the brine during storage. This might also be due to salt-soak effect which caused calcium displacement from tissues (Van Buren, 1986) and resulted in loss of soluble fibre.

Crude protein:

It is evident from data (Table 1) that the change in protein content of ginger slices demonstrated a decreasing trend with time. The findings are in agreement with those reported by Ravisankar *et al.* (1998) in ground ginger and Saikia (1999) in dehydrated banana powder. The highest crude protein (5.67%) was

Table 2 : Effect of post harvest treatments on total soluble carbohydrate (%) and oleoresin(%) content of ginger slices

Treatments (T)	Total soluble carbohydrate(%)				Oleoresin(%)			
	Days in storage (D)				Days in storage (D)			
	D_1 (60)	D_2 (120)	D_3 (180)	Mean	D_1 (60)	D_2 (120)	D_3 (180)	Mean
T_1	12.60	12.34	12.24	12.39	4.00	3.93	3.67	3.87
T_2	12.73	12.34	12.18	12.42	3.81	3.74	3.63	3.73
T_3	12.50	12.33	12.03	12.29	4.20	3.92	4.00	4.04
T_4	12.90	12.68	12.51	12.70	4.03	3.77	3.70	3.83
T_5	13.00	12.89	12.77	12.89	4.30	4.10	4.10	4.17
T_6	12.77	12.53	12.46	12.59	4.17	4.02	3.97	4.05
T_7	12.37	12.25	12.14	12.25	4.20	3.93	3.84	3.99
T_8	12.43	12.25	12.11	12.27	4.10	4.00	3.88	4.00
T_9	11.93	11.82	11.72	11.83	4.03	3.84	3.96	3.94
T_{10}	-	-	-		-	-	-	-
Mean	12.58	12.38	12.24		4.09	3.92	3.86	
	S.E±	C.D. (P=0.05)			S.E±	C.D. (P=0.05)		
Treatment(T)	0.08	0.16			0.09	0.19		
Days(D)	0.05	0.09			0.05	0.11		
T×D	0.14	NS			0.16	NS		

Initial value = 13.5 Initial value = 4.5 NS=Non-significant

* Analysis was done excluding T_{10}, since T_{10} did not continue upto 60 days.

Table 3 : Effect of post harvest treatments on colour and taste (1-9 scale) of ginger slices

Treatments (T)	Colour(1-9 scale)				Taste(1-9 scale)			
	Days in storage (D)				Days in storage (D)			
	D_1 (60)	D_2 (120)	D_3 (180)	Mean	D_1 (60)	D_2 (120)	D_3 (180)	Mean
T_1	6.00	5.90	5.80	5.90	6.00	6.00	5.90	5.97
T_2	7.00	6.90	6.80	6.90	7.00	6.50	6.20	6.57
T_3	7.00	6.90	6.80	6.90	7.00	7.00	6.00	6.67
T_4	7.50	7.40	7.30	7.40	7.50	7.60	7.40	7.50
T_5	8.50	8.17	7.83	8.17	8.00	8.13	7.90	8.01
T_6	7.00	7.00	6.90	6.97	8.00	8.10	7.50	7.87
T_7	6.50	6.40	6.40	6.43	7.00	6.90	6.80	6.90
T_8	6.00	6.00	5.90	5.97	6.50	6.50	6.40	6.47
T_9	6.20	6.10	6.00	6.10	6.00	6.00	6.00	6.00
T_{10}	-	-	-		-	-	-	
Mean	6.86	6.75	6.64		7.00	6.97	6.68	
	S.E.±	C.D. (P=0.05)			S.E.±	C.D. (P=0.05)		
Treatment(T)	0.16	0.32			0.18	0.36		
Days(D)	0.09	NS			0.10	0.21		
T×D	0.28	NS			0.31	NS		

NS=Non-significant

* Analysis was done excluding T_{10}, since T_{10} did not continue upto 60 days.

retained in slices treated with 9 per cent brine solution + 2 per cent citric acid with KMS and benzoic acid 50 ppm each. The decrease in crude protein content might be because of loss of the globulin fraction of protein into the brine as globulin is a salt soluble protein.The decease is also thought to be due to the denaturation of protein by salt (Potter, 1984).

Total soluble carbohydrate:

There appeared to be a slight decrease in the total soluble carbohydrate content of ginger regardless of the brining treatment (Table 2). Ginger slices treated with 9 % brine solution + 2 % citric acid with KMS and benzoic acid 50 ppm each retained the highest total soluble carbohydrate content (12.89%). The decrease in total soluble carbohydrate content may be attributed to the loss of soluble carbohydrate (mainly sugars) into the brine during storage. The decrease in total soluble carbohydrate might also be related to the decrease in soluble crude fibre during storage.

Oleoresin content:

Oleoresin content (Table 2) decreased with extension of storage period irrespective of brining treatments. The highest oleoresin content of 4.17 per cent was recorded in ginger slices treated with 9 % brine

Table 4 : Effect of post harvest treatments on texture and visual quality (1-9 scale) of ginger slices

Treatments(T)	Texture(1-9 scale)				Visual quality(1-9 scale)			
	Days in storage (D)				Days in storage (D)			
	D_1 (60)	D_2 (120)	D_3 (180)	Mean	D_1 (60)	D_2 (120)	D_3 (180)	Mean
T_1	6.50	6.30	6.00	6.27	6.50	6.35	6.05	6.30
T_2	7.00	6.50	6.30	6.60	6.75	6.45	6.20	6.47
T_3	6.70	6.50	6.20	6.47	6.85	6.70	6.40	6.65
T_4	8.00	8.00	7.00	7.67	8.00	7.95	7.25	7.73
T_5	9.00	8.90	8.43	8.78	8.75	8.65	8.28	8.56
T_6	8.50	8.40	7.80	8.23	8.58	8.40	7.82	8.27
T_7	7.20	7.10	6.90	7.07	7.35	7.25	7.05	7.22
T_8	7.50	7.40	6.50	7.13	7.25	7.15	6.60	7.00
T_9	7.00	7.00	6.50	6.83	7.00	6.95	6.60	6.85
T_{10}	-	-	-		-	-	-	-
Mean	7.49	7.34	6.85		7.45	7.32	6.92	
	S.E.±	C.D. (P=0.05)			S.E.±	C.D. (P=0.05)		
Treatment(T)	0.16	0.32			0.14	0.28		
Days(D)	0.09	0.19			0.07	0.13		
T×D	0.28	NS			0.20	NS		

NS=Non-significant

* Analysis was done excluding T_{10}, since T_{10} did not continue upto 60 days.

Table 5 : Total microbial load of ginger slices in brine solution at the end of 180 days

Treatments (T)	Colony forming unit per ml	
	NA	PDA
T_1	-	-
T_2	6.2×10^5	7.0×10^5
T_3	-	-
T_4	5.4×10^5	6.8×10^5
T_5	-	-
T_6	-	-
T_7	-	-
T_8	-	-
T_9	-	-
T_{10} (Control)	8.1×10^5	9.4×10^5

NA = Nutrient Agar, PDA = Potato Dextrose Agar

solution + 2 % citric acid with KMS and benzoic acid 50 ppm each. The declining trend of oleoresin content might be the result of loss of volatile oil due to evaporation (Sakamura, 1987) and also may be due to increased temperature during storage (Raina *et al*., 1980). Similar findings have been reported by Das and Sarma (2001) in ginger and Sagar (2001) in onion powder.

Organoleptic evaluation :

The organoleptic rating (Table 3 and 4) in terms of colur, taste and texture was maximum (8.17, 8.01 and 8.78, respectively) in ginger slices treated with 9 % brine solution + 2 % citric acid with KMS and benzoic acid 50 ppm each. The organoleptic qualities were found to decrease across storage. This might be due to salt-soak effect which caused firmness loss, presumably due to calcium displacement from the tissue (Van Buren, 1986). Discolouration of the slices is due to the browning reaction which might be due to Mailard reactions accelerated by heat and low moisture content of products (Srivastava and Kumar, 1994). This may be due to potassium metabisulphite used as preservative which prevented the browning reaction. Although decline in sensory quality occurred in all the treated slices during storage, the slices remained in acceptable condition till the end of storage period.

Shelf-life:

Shelf-life was assessed based on the visual quality of ginger slices. It is evident from Table 4, that the treated ginger slices were at marketable condition upto 180 days of storage. The shelf-life of non treated ginger slices were 40 days only. The increased shelf-life in treated ginger slices were due to the action of salt which acted as a preservative. Salt has high osmotic pressure and draws water from microbial cells, or prevent normal diffusion of water into these cells, and thus, a preservative action exists. The ginger slices remained in very good condition when treated with 9 % brine solution + 2 % citric acid with KMS and benzoic acid 50 ppm each.

Microbial evaluation :

The microbial; study carried out at the end of 180 days storage (Table 5) revealed that the ginger slices of most of the treatments except T_2, T_4 and the non treated one showed no microbial contamination. This was due to action of salt which, exerted its preservative action by ionizing to yield chloride ions which was harmful to microorganisms. Potassium metabisulphite might act as antimicrobial agent with more inhibitory effect on bacteria and mold (Joslyn and Braverman, 1954). Benzoic acid enhanced antimicrobial effect against yeast.

Thus, ginger can be processed into brined ginger slices. Retention of physico-chemical and organoleptic qualities in ginger slices of 1.5-2.0 mm thickness can be achieved with 9 per cent brine solution acidified with 2 per cent citric acid with KMS and benzoic acid 50 ppm each . The slices could be stored safely without microbial growth up to 180 days of storage at ambient condition.

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