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Study of ready to use onion paste for prolonged shelf life

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Abstract

This paper attempts to show the effect of preservatives and storage on the chemical, sensorial and microbial aspect of ready to use (RtU) onion paste, stored at two conditions i.e. ambient temperature (AT: 30±3^{0}C) and refrigerated temperature (RT: 5±1^{0}C) over a period of 180 days after treating with preservatives i.e. Potassium metabisulphites (KMS), Sodium benzoate (SB) and Citric acid (CA) at two levels i.e. 750 and 1000 ppm respectively. In the context of chemical aspect, a throughout observations over 180 days with 60 days' interval showed negligible changes in chemical constituents of RtU onion paste both at AT and RT conditions with a little exception. Over the period p^H slightly increased for both the storage conditions. Towards the sensorial point of view, use of preservatives in RtU onion paste resulted in the acceptance of color, flavor and texture up to 60 and 120 days of storage at AT and RT, respectively. To improve the effect of preservatives, mixture of them (KMS & CA; SB & CA) was also applied into to the sample (onion paste) besides the individual application. As a consequence, sensorial quality was better sustained by the addition of CA (0.8%) with other preservatives in comparison to the samples without CA. Onion paste, in specific, treated with 1000 ppm KMS & 0.8% citric acid stored both at AT and RT condition retained the most acceptable quality attributes compared to other treatments. However, onion paste without any preservative (control) was found acceptable only up to 20 days of storage at RT while storage at AT condition resulted in the worse situation (acceptable up to 5 days). Total bacterial count was found in the lowest amount in RtU onion paste treated with the combination of KMS (1000 ppm) and CA (0.8%).

Key words: Onion paste, temperature, preservative, storage

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Introduction

Spices can broadly be attributed to the whole plant or parts of plants such as bark, stem, leaf, root, rhizome, flower, fruit, seed etc. that are used to enhance the flavor/taste of food products. In this context, frequently used spices are onion, garlic, ginger, turmeric, chili, pepper, cinnamon, cardamom, clove, coriander, cumin, mints etc. Being commonly found in all the cuisines of South-Asian continent, onion is considered as the prominent category of spice in this region. In addition to the taste, flavoring and preservative potentiality, consumers prefer onion due to its health beneficial effects as well (Edwards *et al.,* 2007). For instance, both fresh and cooked onions have anti-platelet adhesiveness, which helps in preventing thrombosis (Sance *et al.,* 2008). Furthermore, apart from lowering blood sugar level, it has been found to be very effective for the patients suffering from high blood pressure (Akash *et al.,* 2014). Due to contain an appreciable

amount of flavonoids (sub-group of polyphenol) and variety of sulphides (anti-cancer agent), onion has been reported to protect against cardiovascular disease and tumor growth, respectively (Lee *et al.,* 2014; Galeone *et al.,* 2009).

In response to the consumer demand, spices (onion paste) must not be technically modified or mixed with any other components, therefore, given importance to the original flavor and pungency. As a consequence, fresh paste is always preferred over the processed one (e.g. dried powders). However, the highly sensitive interaction between the volatile compounds of onion and human eyes during peeling and processing results in the preparation of fresh onion paste quite challenging (Lanzotti, 2006). Besides, fresh onion paste seems to be highly susceptible to the quality deterioration at ambient condition (Ahmed and Shivhare, 2001). By taking quality assurance next to the consumer satisfaction into account, development of Ready to Use (RtU) onion paste with extended shelf life come forward. Despite of having the researches on spice's paste (garlic, ginger) (Khatun, 2005), there remains a paucity of evidence on onion paste and its preservation process. Taking into consideration of the aforementioned facts, the present study therefore set out in order to achieve the following objectives i.e. to study the effect of preservatives and storage conditions on (1) chemical (2) sensorial and (3) microbial aspect of RtU onion paste.

Materials and Methods

The fresh onions procured from the local market (KR market, Bangladesh Agricultural University, Mymensisngh 2202, Bangladesh) were used as raw materials for this research experiments. Following peeling of fresh onions in order to ensure removal of debris, blending was done for 20 minutes to prepare fresh ready to use (RtU) onion paste. This prepared onion paste on the one hand was considered as control sample using no preservatives, on the other hand was used for all other successive experiments. Compositional analysis (moisture contents, ash, p^H, vitamin C) of RtU onion pastes was performed as per AOAC (2005) method immediately after the preparation of the paste and also 60 days' interval during storage.

Preservatives such as potassium metabisulphite ($K_2S_2O_5$), sodium benzoate (C_6H_5-COONA) and other required chemicals were collected from the laboratory stock of the Department of Food Technology and Rural Industries (FTRI), Bangladesh Agricultural University (B.A.U.) while plastic bottles were collected from local market (KR market). To investigate the effect of preservatives on sensory quality and microbial aspects of RtU onion paste, two levels (750 & 1000 ppm of each) of potassium metabisulphite (KMS); Sodium benzoate (SB); KMS &SB (1:1); KMS & 0.8% citric acid were used besides control one. For the storage experiment, both control sample and samples with preservatives were stored for a period of 180 days, at two different storage conditions, namely ambient temperature, (AT, i.e. 30 ± 3^0C) and refrigerator temperature (RT, i.e. 5 ± 1^0C). Compositional analyses were performed at a regular interval of 60 days. For sensory analysis, a set of untrained panel (including faculty members and graduate degree students of the Department of Food Technology and Rural Industries, Bangladesh Agricultural University) evaluated the prepared onion paste. Each panelist was responsible to test color, flavor, texture/softness and overall acceptability of the onion paste. Finally, according to "Recommended Method for the Microbiological Examination of Food" published by American Public Health Association, total viable count (TVC) of bacteria present in the onion paste, standard plate count method was performed for microbial analysis.

Results and Discussion

***Composition of fresh onion and onion paste*:** The fresh onion has about 84.0% moisture, 1.1% protein, 0.08% fat, 1.82% ash, 11.05 mg vitamin C /100 gm and P^H of 5.31 which were in accordance with the findings of Bhagavan *et al.* (1972)**.** It was observed that

composition of the fresh onion paste was as similar to fresh onion, with ignorable variation; as the preparation method might affect the final product composition. The fresh onion paste contains 83.08% moisture, 1.10% protein, 0.07% fat, 1.91% ash, vitamin C (10.02mg/100 gm) and the P^H was 5.29.

***Sensory study*:** The samples of onion paste were subjected to sensory evaluation. The mean score for color, flavor, texture and overall acceptability of different samples are presented in Table 1. A panel of 10 personnel evaluated the color, flavor, texture and overall acceptability on a scale ranging from 1 to 9 as Hedonic Rating Test (HRT) described by (Bhuiyan and Rana, 2012; Bhuiyan and Kabir, 2012; Bhuiyan, 2012), where high score represent higher consumer preference (Rangana, 1991). The scores that obtained from panelist were analyzed with MSTAT-C software as mentioned by (Bhuiyan *et al.,* 2017).

Table 1. Mean score for color, flavor, texture and overall acceptability of RtU onion paste after 180 days of storage at ambient temperature (AT) and refrigerated temperature (RT).

Ready to use (RtU) onion paste	Sensory attributes							
	Color		Flavor		Texture		Overall acceptability	
	AT	RT	AT	RT	AT	RT	AT	RT
without preservative	3.2^{d}	4.4^{b}	2.8^{c}	3.8^{c}	3.2^{f}	3.7^{d}	2.8^{c}	3.8^{d}
750 ppm KMS	4.9^{bc}	5.7^{a}	4.6^{b}	5.6^{ab}	5.1^{cd}	5.6^{abc}	4.8^{b}	5.7^{abc}
1000 ppm KMS	5.2^{b}	5.8^{a}	4.7^{b}	5.7^{a}	5.1^{bc}	5.7^{ab}	4.9^{b}	5.8^{ab}
750 ppm SB	4.5^{c}	5.5^{a}	4.5^{b}	5.2^{b}	4.4^{c}	5.1^{c}	4.5^{b}	5.2^{c}
1000 ppm SB	4.7^{bc}	5.6^{a}	4.5^{b}	5.5^{ab}	4.5^{de}	5.2^{bc}	4.5^{b}	5.3^{bc}
750 ppm,(1:1 KMS & SB)	4.8^{bc}	5.6^{a}	4.6^{b}	5.6^{ab}	4.8^{cde}	5.4^{abc}	4.6^{b}	5.4^{abc}
1000 ppm,(1:1, KMS & SB)	4.8^{bc}	5.7^{a}	4.6^{b}	5.7^{a}	4.9^{cde}	5.5^{abc}	4.7^{b}	5.5^{abc}
0.8% CA & 750 ppm KMS	5.8^{a}	5.8^{a}	5.7^{a}	5.8^{a}	5.9^{a}	5.8^{a}	5.7^{a}	5.8^{ab}
0.8% CA &1000 ppm KMS	5.9^{a}	5.9^{a}	5.8^{a}	5.8^{a}	5.9^{a}	5.9^{a}	5.8^{a}	5.9^{a}
LSD (P<0.01)	0.470	0.423	0.478	0.441	0.627	0.502	0.488	0.477

N.B.: KMS=potassium metabisulphide ($K_2S_2O_5$), SB=sodium benzoate (C_6H_5-COONA), CA=citric acid.

Preservatives and storage effect on sensory attributes: The statistical analysis (ANOVA) was carried out and results revealed that there was significant (P<0.01) differences in color, flavor, texture and overall acceptability among RtU onion paste samples with different preservatives. The Duncan's Multiple Range test (DMRT) analysis was performed accordingly to Bhuiyan and Rana (2012) and showed that for color, flavor, texture and overall acceptability of the RtU onion paste, the samples with 1000 ppm KMS in addition with 0.8% CA ranked highest score for the samples stored at both AT and RT conditions. From Table 1, it is noteworthy that RtU onion paste with 0.8% CA and 1000 ppm KMS scored highest overall acceptability among all others when stored at refrigerated temperature (RT), as the low temperature storage favor better quality retention due to slower kinetics of quality degradation at low temperature (Bhuiyan and Kabir, 2012; Nedwell, 1999; Roy *et al.,* 1977).

***Microbiological study*:** For the microbiological study, different onion paste samples were stored for 180 days at ambient temperature (AT) and refrigerated temperature (RT). The study was performed on the basis of standard plate count (SPC) method. After the incubation of 48 hours, developed colonies were

counted. It was noticeable that, the total viable bacteria (TVB) load was not uniform in the samples. The total number of viable bacteria per gm of sample was obtained by multiplying the number of colony forming units (cfu) on the plate with dilution factor. It was then converted into logarithmic form. The total numbers of viable bacteria count in different samples have been shown in (Table 2).

Table 2. The effect of preservatives on the growth of total count of bacteria after 180 days of storage at ambient temperature (AT) and refrigerated temperature (RT).

Ready to use (RtU) onion paste with preservatives	Initial bacterial count		Bacterial count after 180 days of storage			
	(cfu/gm)	Log (cfu/gm)	AT (cfu/gm)	RT (cfu/gm)	AT Log (cfu/gm)	RT Log (cfu/gm)
1000 ppm KMS	95×10^3	4.98	70×10^4	65×10^4	5.85	5.81
1000 ppm SB	95×10^3	4.98	81×10^4	79×10^4	6.91	5.89
1000 ppm (1:1 KMS & SB)	95×10^3	4.98	30×10^4	25×10^4	5.48	5.39
0.8% CA & 750 ppm KMS	95×10^3	4.98	19×10^4	15×10^4	5.28	5.18
0.8% CA & 1000 ppm KMS	95×10^3	4.98	12×10^4	10×10^4	5.08	5.00

The counts of viable bacteria at initial stage of all onion pastes were same, but after 180 days of storage there were changes in bacterial count. It has been observed that, the bacterial load was lowest for onion paste treated with 0.8% citric acid plus 1000ppm KMS and stored at Refrigerated temperature (RT) in comparison with other preservatives and storage condition. These findings support better antimicrobial effect of KMS in food (Srivastava and Kumar, 2002), high antimicrobial effect of higher concentration of preservatives (Srivastava and Kumar, 2002), and lower microbial activity at low temperature during storage of the food products (Nedwell, 1999; Fraziar and Westheff, 1978; Roy *et al.,* 1977).

***Compositional study*:** The effect of storage condition (AT & RT), preservatives (KMS, SB, KMS + SB, CA + KMS) and their level, on the composition of onion paste packed in plastic bottle and stored for a period of 180 days are given in Table 3. It has been observed (Table 3) that there was slight change of (around 5%) initial moisture content i.e. 83.08%. and the change in moisture content was higher in sample at AT storage than RT condition. This difference is may be due to higher moisture migration (evaporation) through packaging materials at higher temperature, as higher temperature favors higher evaporation of moisture (Bhuiyan, 2012; Barwal *et al.,* 2005). In favor of this finding, it was mentioned earlier in literature that, the refrigerated storage favors better retention of moisture, and low temperature storage favor longer shelf life of stored products (Nedwell, 1999; Roy *et al.,* 1977).

Regarding p^H, it was observed that the p^H was lowest (4.06) for the onion pasted treated with the mixture of 0.8% Citric acid & KMS; as Citric acid itself can reduce the p^H of the products regardless the level of the KMS (Srivastava and Kumar, 2002). It was also noted that, there was positive relation between storage period and P^H i.e. P^H of the onion paste (treated with different preservatives) increased with storage period (Table 3). This increase of P^H might be associated with the reduction of vitamin C concentration of the products; that might favor microbial growth (Table 2) and spoilage during storage.

From Figure 1 and 2, it was observed that the vitamin C concentration of onion paste decreased with storage period. The rate of vitamin C degradation was higher at ambient storage condition; consequently, the concentration was lower after the storage period of 180 days. This may be due to the fact that vitamin C was oxidized more in room temperature than refrigerated

condition (Bhuiyan, 2012; Saron *et al.,* 2007; Smoot *et al.,* 1980; Roy *et al.,* 1977). For the loss of vitamin C, storage temperature was might be the main role player not the preservatives; as the low temperature favor better retention of vitamin C (Smoot *et al.,* 1980) and preservatives did not affect the vitamin concentration of stored food products.

Table 3. The moisture content and P^H of RtU onion pastes with different preservatives (750 ppm, 1000ppm) and stored at ambient condition (AT: 30±3^{0}C) and refrigerated condition (RT: 5±1^{0}C) for a period of 180 days.

Storage condition	Day	Moisture								P^H							
		750 ppm				1000 ppm				750 ppm				1000 ppm			
		KMS	SB	KMS & SB	0.8% CA & KMS	KMS	SB	KMS & SB	0.8% CA & KMS	KMS	SB	KMS & SB	0.8% CA & KMS	KMS	SB	KMS & SB	0.8% CA & KMS
AT	0	83.08	83.08	83.08	83.08	83.08	83.08	83.08	83.08	5.29	5.29	5.29	4.06	5.29	5.29	5.29	4.06
	60	83.02	82.17	81.71	82.60	82.70	82.78	81.61	82.71	5.32	5.31	5.32	4.14	5.31	5.30	5.31	4.16
	120	81.56	82.16	80.81	81.05	81.36	82.23	80.53	80.91	5.35	5.32	5.35	4.16	5.34	5.31	5.34	4.18
	180	79.47	82.05	80.15	80.00	79.00	81.90	79.77	80.13	5.38	5.33	5.38	4.17	5.35	5.32	5.35	4.18
RT	0	83.08	83.08	83.08	82.82	83.08	83.08	83.08	82.82	5.29	5.29	5.29	4.13	5.29	5.29	5.29	4.13
	60	82.89	82.89	81.70	82.81	83.05	83.06	81.64	82.75	5.31	5.31	5.31	4.14	5.30	5.30	5.30	4.15
	120	82.77	82.77	81.67	82.77	82.57	82.55	81.60	82.72	5.34	5.32	5.34	4.17	5.31	5.32	5.31	4.18
	180	82.44	82.44	81.54	82.64	82.51	82.49	81.49	82.62	5.35	5.33	5.35	4.18	5.32	5.34	5.32	4.19

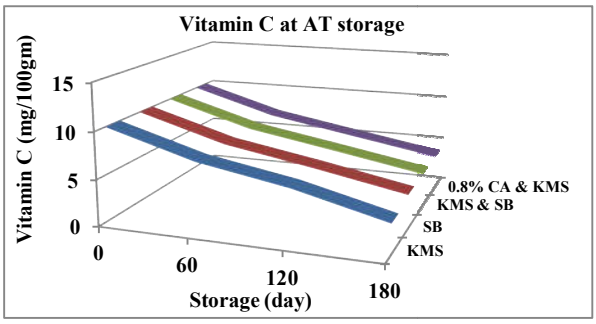

Figure 1. Vitamin C concentration of the onion paste with different preservatives (1000 ppm level) and stored for 180 days at ambient storage (AT) condition (30±3^{0}C).

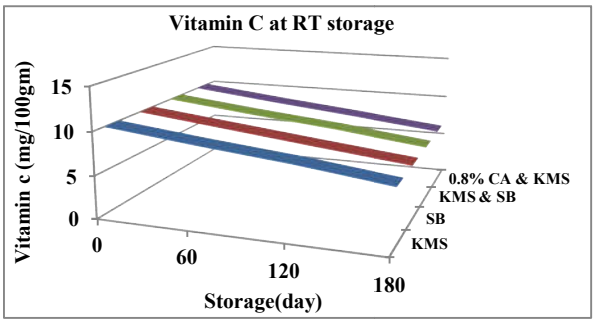

Figure 2. Vitamin C concentration of the onion paste with different preservatives (1000 ppm level) and stored for 180 days at refrigerated storage (RT) condition (5±1^{0}C).

From Table 4 it was observed that there were considerable changes in sensory attributes of RtU onion paste (without any preservatives) during storage at ambient and refrigerated condition. The color of RtU onion paste at fresh condition was off white (OW), which changed to slightly brown (SB) from 15th and 35th days of storage at ambient (AT) and refrigerated (RT) condition, respectively. For RtU onion paste (with preservatives) color changed to slightly brown (SB) on 180 days of storage for two levels (1000 ppm of each) of potassium metabisulphite (KMS); Sodium benzoate (SB); KMS &SB (1:1); KMS & 0.8% citric acid at ambient (AT) condition (Table 5).

Table 4. Sensory attributes of RtU onion paste without preservative.

Sensory attributes	Storage condition	Storage period (Day)									
		0	5	10	15	20	25	30	35	40	45
Color	AT	OW	OW	OW	SB	SB	B	B	F	F	F
	RT	OW	OW	OW	OW	OW	OW	OW	SB	SB	SB
Flavor	AT	G	SOF	SOF	OF	OF	OF	OF	OF	OF	OF
	RT	G	G	G	G	SOF	SOF	SOF	SOF	OF	OF
Texture	AT	ST	ST	SLT	SLT	LT	LT	LT	VLT	VLT	VLT
	RT	ST	ST	ST	ST	ST	ST	ST	SLT	SLT	LT

N.B.: For Color: OW=Off white, SB=Slightly brown, LB=Light brown, B=Brown, F=Fade; For Flavor: G=Good, VG=Very good, SOF=Slightly off flavor, OF=Off flavor; For Texture, ST=Soft texture, SLT=Slightly loose texture, LT= Loose texture, VLT=Very loose texture.

Table 5. Sensory attributes of RtU onion paste with preservative (Color and flavor).

Storage	Day	Color								Flavor							
		750 ppm				1000 ppm				750 ppm				1000 ppm			
		KMS	SB	KMS & SB	0.8% CA & KMS	KMS	SB	KMS & SB	0.8% CA & KMS	KMS	SB	KMS & SB	0.8% CA & KMS	KMS	SB	KMS & SB	0.8% CA & KMS
AT	0	OW	OW	OW	OW	OW	OW	OW	OW	G	G	G	VG	G	G	G	VG
	60	OW	OW	OW	OW	OW	OW	OW	OW	G	G	G	VG	G	G	G	VG
	120	LB	LB	LB	LB	OW	OW	OW	SB	SOF	SOF	SOF	G	G	G	G	G
	180	B	B	B	B	SB	SB	SB	SB	OF	OF	OF	OF	SOF	SOF	SOF	SOF
RT	0	OW	OW	OW	OW	OW	OW	OW	OW	G	G	G	VG	G	G	G	VG
	60	OW	OW	OW	OW	OW	OW	OW	OW	G	G	G	VG	G	G	G	VG
	120	OW	OW	OW	OW	OW	OW	OW	OW	G	G	G	G	G	G	G	G
	180	SB	SB	SB	SB	OW	OW	OW	OW	SOF	SOF	SOF	SOF	G	G	G	G

N.B.: For color, OW=Off white, SB=Slightly brown, LB=Light brown, B=Brown; For flavor, G=Good, VG=Very good, SOF= Slightly off flavor, OF=Off flavor.

The flavor of RtU onion paste at fresh condition was ranked as good (G), which degraded to slightly off flavor (SOF) from 5th and 20th days of storage at ambient (AT) and refrigerated (RT) condition respectively. These earlier changes of flavor, in comparison with the color changes might be due to the loss of volatiles compound at high rate from onion paste. And for RtU onion paste (with preservatives) flavor degraded to slightly off flavor (SOF) on 120 and 180 days of storage for two levels (750 ppm of each) of potassium metabisulphite (KMS); Sodium benzoate (SB); KMS &SB (1:1) at ambient (AT) and refrigerated (RT) condition respectively and also degraded to slightly off flavor (SOF) on 180 days of storage for two levels (1000 ppm of each) of potassium metabisulphite (KMS); Sodium benzoate (SB); KMS &SB (1:1); KMS & 0.8% citric acid at ambient (AT) condition (table 5). The texture of RtU onion paste at fresh condition was soft in nature (ST), which changes to slightly loose texture (SLT) from 10th and 35th days

of storage at ambient (AT) and refrigerated (RT) condition respectively. And texture of RtU onion paste (with preservatives) changes to slightly hard (SH) on 180 days of storage at ambient (AT) condition (Table 6).

Table 6. Sensory attributes of RtU onion paste with preservative (Texture).

Storage	Day	Texture							
		750 ppm				1000 ppm			
		KMS	SB	KMS & SB	0.8% CA & KMS	KMS	SB	KMS & SB	0.8% CA & KMS
AT	0	ST	ST	ST	ST	ST	ST	ST	ST
	60	ST	ST	ST	ST	ST	ST	ST	ST
	120	ST	ST	ST	ST	ST	ST	ST	ST
	180	SH	SH	SH	SH	SH	SH	SH	SH
RT	0	ST	ST	ST	ST	ST	ST	ST	ST
	60	ST	ST	ST	ST	ST	ST	ST	ST
	120	ST	ST	ST	ST	ST	ST	ST	ST
	180	ST	ST	ST	ST	ST	ST	ST	ST

N.B.: The following notifications are used for describing the texture of the onion pastes. ST: Soft texture, SH: Slightly hard.

It is noteworthy that the changes of sensory attributes of RtU onion paste was higher at ambient (AT) storage than refrigerated (RT) which is in harmony of the finding of Bhuiyan *et al.,* (2017). And these can be explained by the low antimicrobial activity, lower rate of volatiles compounds loss and slower changes of color pigments during storage at low temperature (Jenshiroobha *et al.,* 2011). It is conclusive that the RtU onion pates without any preservatives cannot be preserved for a longer period; as the sensory properties changes less than 5 days of storage at (AT) storage condition. This storage period of RtU onion paste without preservatives can be prolonged up to around 15 days of storage at refrigerated (RT) condition.

Summary and Conclusion

This study has paved the way for commercial production of ready to use (RtU) onion paste from raw onion keeping its natural color, flavor and texture with a potential prolonged shelf life. The developed RtU onion paste may find its extensive use in the home as well as in catering industries such as hotels, restaurants, canteens, hospitals and other establishments. The newly developed RtU onion paste, for its anticipated widespread use, may help to fill the needs of consumer's choice of convenient food ingredient.

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