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Effect of Chemical Pretreatments and Packaging Materials on Quality of Pomace Powder and Its Storage Stability

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ABSTRACT

The grape pomace collected after processing of fully matured grape berries (var. Bangalore blue) was pretreated with T_1 (KMS 1% + $CaCl_2$ 1%) and T_2 (Citric acid 1% + KMS 0.5%) for 5 minutes then dried at 40-65°C for 15 hours in cabinet drier, milled into powder and packaged in Low density polyethylene (LDPE), Metallised polyester (MP) and the dehydrated grape pomace powder without packing was kept as control for three months under ambient condition. During storage, changes in quality composition of this treated grape pomace powder were recorded at every month. Among the treatments, pomace powder pre-treated with Citric acid 1% + KMS 0.5% (T_2) and packed in metallised polyester (MP) had recorded highest quality. This preservation method could be used by the processing industries for bulk storage of grape pomace powder after processing of grapes during peak harvesting season for further end uses.

Key words: *Grape, Pomace powder, Citric acid 1% + KMS 0.5%, Acidity, Moisture content*

INTRODUCTION

Grape processing industries produces million tons of left-over that represent an ecological and economical waste management issue. About 20% of the weight of processed grapes remains as pomace (Pomace is the general term for any solid material such as the skins, pulp and seeds leftover after wine or juice extraction). Unlike grape flesh, grape skin and seeds are the potential source of antioxidant and anticarcinogenic phenolic compounds[1]. It is also known that polyphenols have health-promoting effects and anti-aging properties[2] there by prevent risk factors related to metabolic syndrome and several chronic diseases in aging humans[3]. These biological properties of polyphenols are attributed mainly to their powerful antioxidant, metal chelating and antiradical activities.

Grape pomace utilization for food industrial application has not been fully exploited due to short storage life resulted from its spoilage, instability of quality parameters during storage, difficulty in bulk handling and lack of knowledge on improved methods of storage[4].

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In addition to finding, a productive use for a waste product and market demand for natural antioxidants rather than chemical antioxidants has directly increased the demand for novel polyphenolic and fibre containing ingredients, but the information regarding simple storage technologies of this pomace powder that can be adopted for small farmers at field level is lacking. So far reported research findings on the efficiency of packaging materials and storage on nutritional composition of grape pomace are very limited. Therefore present study was undertaken to identify simple packaging materials for storage of grape pomace.

MATERIALS AND METHODS

The dehydrated grape pomace powder were analyzed for moisture per cent, TSS, titratable acidity and P^H by using standard methods (Ranganna 1991) [5]. All quality characteristics were analyzed in 4 replicates.

Treatment details:

T_1- KMS 1% + $CaCl_2$ 1%

T_2- Citric acid 1% + KMS 0.5%

Packing materials:

P_1-Low density polyethylene (LDPE)

P_2-Metallised polyester (MP)

P_3-Control (without packing)

Treatment combinations:

T_1 – KMS 1% + $CaCl_2$ 1%+ Metallised polyester pouches (MP)

T_2- KMS 1% + $CaCl_2$ 1%+ Low density polyethylene pouches (LDPE)

T_3– Citric acid 1% + KMS 0.5% + Metallised polyester pouches (MP)

T_4– Citric acid 1% + KMS 0.5 %+ Low density polyethylene pouches (LDPE)

T_5- KMS 1% + $CaCl_2$ 1% without packing *i.e.*, Control

T_6- Citric acid 1% + KMS 0.5% without packing *i.e.*, Control

Statistical analysis

To test the significance of variation in the data obtained the analysis of variance technique was adopted as suggested by Fisher[6] for Completely Randomized Design with factorial concept.

RESULTS AND DISCUSSION

Moisture content (%)

The results pertaining to moisture content of the pomace powder packed in different packing materials are presented in **Table 1**. Interactions between the packing and treatments were not significant on moisture content at initial (0 days); however significant difference was observed with increasing the storage period upto 90 days. Pomace powder of two treatments (T_1, T_2) packed in LDPE (P_1) recorded maximum increase in moisture content during entire storage period from 5.49 to 6.07 Per cent in T_1 (KMS 1% + $CaCl_2$ 1%) and from 5.56 to 5.82 per cent in T_2 (Citric acid 1% + KMS 0.5%). The pomace powder packed in metallised polyester (MP) recorded minimum increase in moisture content from 5.56 to 5.68 per cent in T_2 (Citric acid 1% + KMS 0.5%) followed by T_1 (KMS 1% + $CaCl_2$ 1%) from 5.49 to 5.79 per cent, While maximum decrease in moisture content was recorded in pomace powder kept under control i.e. without packing (P_3) from 5.49 to 5.24 per cent in T_1 (KMS 1% + $CaCl_2$ 1%) and from 5.56 to 5.34 per cent in T_2 (Citric acid 1% + KMS 0.5%). In the interactions pomace powder with T_2 (Citric acid 1% + KMS 0.5%) packed in metallised polyester (T_2P_2) recorded minimum moisture content in the range of 5.56 to 5.68 per cent upto 90 days.

The increased moisture content in LDPE might be due to the fact that LDPE bags have high permeability to oxygen and water vapour diffusion as compared to other packing material such as metallised polyester. The loss of moisture in control (i.e. without packing) in pomace powder may be attributed to evaporation of water from pomace powder in low humidity condition (60-70 Per cent RH) or due to higher storage temperatures (ambient conditions). The results of the present investigation are in accordance with the findings of Godson[7] in dehydrated mango slices and Rao *et al*.[8] in storage of quamachil aril powder.

Total soluble solids (°B)

The results pertaining to total soluble solids of the pomace powder packed in different packing materials are presented in **Table 2**. The TSS of pomace powder significantly differed with treatments over the storage period. Initially (0 days of storage) there was no significant difference found between the treatments, however with increase in storage period significant difference was observed. The pomace powder in treatment T_1 (KMS 1% + $CaCl_2$ 1%) recorded maximum TSS of 8.13 °B while minimum TSS of 8.10 °B was recorded in T_2 (CA 1% + KMS 0.5%). Upon further storage upto 90 days, TSS increased from 8.13 to 8.67 °B in T_1 and from 8.10 to 8.56 °B in T_2. Increase of TSS in T_1 (KMS 1% + $CaCl_2$ 1%) pomace powder may be due to the solubilization of pomace constituents during storage.

The TSS (°Brix) results showed that there was a significant difference between the packing materials. The TSS of product increased significantly during the storage of pomace powder in control i.e. without packing (P_3) and recorded maximum TSS. Although no significant difference was noticed initially, with the increase in storage period, the TSS of pomace powder increased significantly upto 90 days from 8.11 to 8.88 °B in control (P_3) and from 8.11 to 8.65 °B in LDPE (P_1) packed powder. Whereas the pomace powder packed in MP (P_2) showed minimum increase in TSS upto 90 days from 8.11 to 8.34 °B. Further the increase in TSS in unpacked pomace powder (control) might be due to loss of moisture and concentration of soluble sugars in open conditions.

The interaction effects were no significant between packing and treatments. This shows that irrespective of packing materials the TSS increased in all the treatments. In the present study, the minimum increase in TSS of pomace powder packed in metallised polyester (P_2) is mainly due to low water vapour transmission rate (WVTR) when compared to LDPE.

Acidity (%)

The results pertaining to acidity of the pomace powder packed in different packing materials are presented in **Table 3**. Interactions between the packing and treatments were not significant on moisture content at initial (0 days); however significant difference was observed with increasing the storage period upto 90 days. Pomace powder of two best treatments (T_1, T_2) kept under control i.e. without packing (P_3) recorded maximum decrease in acidity from 0.64 to 0.40 per cent in T_1 (KMS 1% + $CaCl_2$ 1%) and from 0.66 to 0.46 per cent in T_2 (Citric acid 1% + KMS 0.5%) followed by LDPE (P_1) packed powder recorded 0.64 to 0.49 Per cent in T_1 (KMS 1% + $CaCl_2$ 1%) and from 0.66 to 0.55 per cent in T_2 (Citric acid 1% + KMS 0.5%) during entire period of 90 days storage. The pomace powder packed in metallised polyester (MP) recorded minimum increase in acidity from 0.64 to 0.58 per cent in T_1 (KMS 1% + $CaCl_2$ 1%) and from 0.66 to 0.61 per cent in T_2 (Citric acid 1% + KMS 0.5%). Interaction showed that the pomace powder with T_2 (Citric acid 1% + KMS 0.5%) packed in metallised polyester (T_2P_2) recorded minimum decrease in acidity in the range of 0.66 to 0.61 per cent upto 90 days.

Decrease in acidity might be attributed to utilization of acids for converting them to other compounds. Besides, metallised polyester film blocks this conversion of acid to other compounds and hence was able to retain maximum acidity. The results of the present investigation are in accordance with the findings of Mozumder *et al.*[9] in storage studies of tomato powder and Sharma *et al.* (2013) [10] in storage of anardana arils under ambient condition.

pH

The data pertaining to pH of pomace powder packed in different packing materials are presented in **Table 4**. A significant difference observed among the treatments upto 90 days. The treatment T_2 (Citric acid 1% + KMS 0.5 %) recorded the minimum pH of 4.10 and maximum pH of 4.15 was recorded in T_1 (KMS 1% + $CaCl_2$ 1%) at initial day of storage. During storage upto 90 days, the pH increased in T_1 from 4.15 to 4.31 per cent and in T_2 from 4.10 to 4.17 per cent. The maximum increase in pH of pomace powder in KMS 1% and $CaCl_2$ 1% (T_1) may be due to maximum decline in acidity.

The pH of pomace powder significantly increased in different packing materials. Although, no significant difference was observed initially (0 days of storage), with advancement of storage period significant increase was observed in pH of pomace powder under different packing materials upto 90 days of storage. The pH of pomace powder packed in Metallised Polyester (P_2) showed minimum increase in pH from 4.12 to 4.18. The maximum increase of pH from 4.12 to 4.29 was recorded in pomace powder kept under control (P_3) without packing followed LDPE (P_1) packed powder recorded 4.12 to 4.26 pH.

The interaction effects were not significant between packing and treatments. This shows that irrespective of packing materials the pH increased in all the treatments. As a result of decreasing acidity, a significant increase in pH of pomace powder was noticed. The results of the present investigation are in accordance with the findings of Sahoo *et al*.[11] in banana powder.

Table 1: Interaction effect of chemical pretreatments and packing materials on moisture content (%) of grape pomace powder stored at ambient condition.

Packing material (P)	Storage period (days)											
	Initial (0 days)			30DAS			60DAS			90DAS		
	T1	T2	Package Mean(P)	T1	T2	Package Mean(P)	T1	T2	Package Mean(P)	T1	T2	Package Mean(P)
P_1- Low density polyethylene	5.49	5.56	5.52	5.67	5.63	5.65	5.86	5.71	5.79	6.07	5.82	5.95
P_2- Metallised polyester	5.49	5.56	5.52	5.55	5.59	5.57	5.66	5.64	5.65	5.79	5.68	5.74
P_3- Control (without packing)	5.49	5.56	5.52	5.43	5.50	5.46	5.34	5.43	5.39	5.24	5.34	5.29
Mean	5.49	5.56		5.55	5.57		5.62	5.59		5.70	5.61	

	S.Em±	CD at 5%	S.Em±	CD at 5%	S.Em±	CD at 5%	S.Em±	CD at 5%
Packing material (P)	0.018	N.S.	0.004	0.014	0.004	0.013	0.004	0.013
Treatments (T)	0.015	0.045	0.004	0.012	0.003	0.012	0.003	0.012
Interaction (PXT)	0.027	N.S.	0.006	0.020	0.006	0.019	0.006	0.019

*T_1 (KMS 1% + $CaCl_2$ 1%); T_2 (Citric acid 1% + KMS 0.5%); DAS- days after storage

Table 2: Interaction effect of chemical pretreatments and packing materials on total soluble solids (°Brix) of grape pomace powder stored at ambient condition

Packing material (P)	Storage period (days)											
	Initial (0 days)			30DAS			60DAS			90DAS		
	T1	T2	Package Mean(P)	T1	T2	Package Mean(P)	T1	T2	Package Mean(P)	T1	T2	Package Mean(P)
P_1 - Low density polyethylene	8.13	8.10	8.11	8.21	8.17	8.19	8.34	8.26	8.30	8.70	8.60	8.65
P_2 -Metallised polyester	8.13	8.10	8.11	8.16	8.11	8.13	8.23	8.12	8.18	8.39	8.28	8.34
P_3 -Control (without packing)	8.13	8.10	8.11	8.31	8.26	8.29	8.43	8.36	8.39	8.93	8.82	8.88
Mean	8.13	8.10		8.23	8.18		8.33	8.25		8.67	8.56	

	S.Em±	CD at 5%	S.Em±	CD at 5%	S.Em±	CD at 5%	S.Em±	CD at 5%
Packing material (P)	0.014	N.S.	0.010	0.029	0.016	0.047	0.008	0.024
Treatments (T)	0.011	N.S	0.008	0.024	0.013	0.038	0.006	0.019
Interaction (PXT)	0.019	N.S	0.014	N.S.	0.022	N.S.	0.011	N.S.

*T_1 (KMS 1% + $CaCl_2$ 1%); T_2 (Citric acid 1% + KMS 0.5%); DAS- days after storage

Table 3: Interaction effect of chemical pretreatments and packing materials on acidity (%) of grape pomace powder stored at ambient condition

Packing material (P)	Storage period (days)											
	Initial (0 days)			30DAS			60DAS			90DAS		
	T1	T2	Package Mean(P)	T1	T2	Package Mean(P)	T1	T2	Package Mean(P)	T1	T2	Package Mean(P)
P_1 - Low density polyethylene	0.64	0.66	0.65	0.57	0.61	0.59	0.53	0.58	0.55	0.49	0.55	0.52
P_2 - Metallised polyester	0.64	0.66	0.65	0.60	0.63	0.61	0.59	0.62	0.60	0.58	0.61	0.59
P_3 - Control (without packing)	0.64	0.66	0.65	0.55	0.58	0.56	0.49	0.54	0.51	0.40	0.46	0.43
Mean	0.64	0.66		0.57	0.60		0.53	0.58		0.49	0.54	

	S.Em±	CD at 5%	S.Em±	CD at 5%	S.Em±	CD at 5%	S.Em±	CD at 5%
Packing material (P)	0.015	N.S	0.015	0.047	0.014	0.041	0.016	0.049
Treatments (T)	0.012	0.038	0.013	N.S.	0.011	0.033	0.013	0.040
Interaction (PXT)	0.022	N.S.	0.022	N.S.	0.019	N.S.	0.023	N.S.

*T_1 (KMS 1% + $CaCl_2$ 1%); T_2 (Citric acid 1% + KMS 0.5%); DAS- days after storage

Table 4: Interaction effect of chemical pretreatments and packing materials on pH of grape pomace powder stored at ambient condition

Packing material (P)	Storage period (days)											
	Initial (0 days)			30DAS			60DAS			90DAS		
	T1	T2	Package Mean(P)	T1	T2	Package Mean(P)	T1	T2	Package Mean(P)	T1	T2	Package Mean(P)
P_1 - Low density polyethylene	4.15	4.10	4.12	4.17	4.11	4.14	4.25	4.14	4.19	4.34	4.18	4.26
P_2 - Metallised polyester	4.15	4.10	4.12	4.17	4.11	4.14	4.20	4.11	4.15	4.24	4.12	4.18
P_3 - Control (without packing)	4.15	4.10	4.12	4.17	4.11	4.14	4.27	4.16	4.21	4.37	4.22	4.29
Mean	4.15	4.10		4.17	4.11		4.24	4.13		4.31	4.17	

	S.Em±	CD at 5%	S.Em±	CD at 5%	S.Em±	CD at 5%	S.Em±	CD at 5%
Packing material (P)	0.016	N.S.	0.015	N.S.	0.015	0.045	0.010	0.040
Treatments (T)	0.013	0.040	0.012	0.030	0.012	0.037	0.010	0.031
Interaction (PXT)	0.023	N.S.	0.022	N.S.	0.021	N.S.	0.020	N.S.

*T_1 (KMS 1% + $CaCl_2$ 1%); T_2 (Citric acid 1% + KMS 0.5%); DAS- days after storage

CONCLUSION

The study revealed that high quality of pomace powder can be prepared by pre-treating pomace with Citric acid 1% + KMS 0.5% (T_2) and packing in metallised polyester (P_2) (T_2P_2), which prevent fermentation and retains the quality of pomace powder.

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