How to Cite:
Vatsyayan, S., Raina, R., & Kumar, M. (2022). Comparative assessment of guar gum for enhancing qualitative properties of dehydrated white skinned bitter gourd (Momordica charantia L.). *International Journal of Health Sciences*, *6*(S2), 6894–6901.
https://doi.org/10.53730/ijhs.v6nS2.6731

Comparative assessment of guar gum for enhancing qualitative properties of dehydrated white skinned bitter gourd (Momordica charantia L.)

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***Abstract*---**The enhancement of physical qualitative properties of a dehydrated product is a highly desirable aspect in processing fresh vegetables. This study compared the use of guar gum (GG) as pre-treatment for enhancing physical qualitative properties of dehydrated white skinned bitter gourd (WSBG). The experiment primarily focused on comparing GG as solo pre-treatment or in combination with other pre-treatment viz. salt solution (SS) or potassium meta bisulphite (KMS) or sodium carbonate (SC) along with water blanching (Wat Blanch) or salt blanching (Sal Blanch). The results are indicative of a significant (P values of < 0.05) impact of using guar gum along with blanching before dehydration of WSBG at 60±5°C in a mechanical dehydrator, in comparison to untreated control. The findings clearly exhibit solo GG sample T_5 (Wat Blanch+1%GG) and combination GG sample T_{16} (2%Sal Blanch+0.2%KMS+1%SC+1%GG) as most superior with highest RR [9.23 (T_5) & 11.30 (T_{16})] and BD [0.50 g/cm^3 (T_5) & 1.08 g/cm^3 (T_{16})] in final dried product. The higher retention of RR and BD indicates that GG pretreated samples have better reconstitution than the control (T_1). Hence, application of GG as a pre-treatment with blanching is beneficial for developing a quality product with good storage dynamics.

Manuscript submitted: 27 Feb 2022, Manuscript revised: 18 March 2022, Accepted for publication: 09 April 2022

***Keywords*---**bulk density, guar gum, momordica charantia, rehydration ratio.

Introduction

Momordica charantia L. (bitter gourd) is an important tropical and sub-tropical vegetable crop, widely popular for its pharmaceutical properties. In India, various types of bitter gourds are available; mainly India long green, India long white and hybrid India baby (Alam *et al.,* 4). Bitter gourd is consumed mainly in cooked, fried and stuffed form, apart from being available in pickled, canned and dehydrated form (Singh and Sagar, 14). Recently, the consumption of bitter gourd, both in raw and processed form has witnessed a progressive increase, primarily due to its anti-diabetic and medicinal properties (Joseph and Jini, 7). White skinned bitter gourd (WSBG) being a seasonal crop is not available in market for round the year consumption in fresh form. Thereby, making it pertinent to develop the value-added products of this therapeutic vegetable to ensure availability both in off-season and geographies where WSBG is not cultivated. Dehydration is recognized as an important method for enhancing shelf life and improving off season availability of bitter gourd for consumers (Kumar *et al.,* 8). But, performing dehydration or other vegetable processing method usually there are undesirable changes in the physical qualitative properties. Guar gum is a natural water soluble polysaccharide, obtained from seeds of *Cyamopsis tetragonoloba* (guar bean) plant (Reulas-Chacon *et al.*, 13). Due to its low cost, biodegradable nature and abundance in supply, guar gum is a resourceful material with handy applications in food industry (Thombare *et al.*, 15). Further, literature on pre-treatment methods for enhancement of the desirable physical qualitative properties for WSBG is not available yet. In general, the quality of dehydrated product may vary greatly when subjected to different pre-treatments before dehydration. Therefore, the present study was conducted for evaluating the potential of guar gum as a beneficial pretreatment for enhancing the physical qualitative attributes of dehydrated WSBG.

Materials and Methods

For the comparative assessment of guar gum for enhancing qualitative properties of dehydrated WSBG, a research experiment was laid down in Factorial CRD (Completely Randomized Design) at Amity Institute of Horticulture Studies and Research, Amity University Uttar Pradesh, Noida, India.

Selection of raw material: The chemicals of analytical grade were obtained from the market and used for conducting the study. Fresh, raw and disease-free fruits of WSBG were selected for study.

Preparation of sample: For experimental studies, 500 g of fresh fruits of WSBG were selected and washed properly to remove any dust or foreign matter adhered to its skin, followed by cutting into rings with a sharp stainless-steel knife. For study, each pre-treatment sample was replicated thrice.

Blanching & Pre-treatment methods: Each treatment was first subjected to either water blanching (Wat Blanch) in hot water at 90° C for 3 minutes (Wang *et al.*, 17) or salt blanching (Sal Blanch) in 2% hot salt solution at 90° C for 3 minutes (Abano *et al.*, 2), followed by steeping in solo pre-treatment solution of (T_2) Wat Blanch+2%SS or (T_3) Wat Blanch+0.2%KMS or (T_4) Wat Blanch+1%SC or (T_5) Wat Blanch+1%GG and their combination viz. (T_6) Wat Blanch+2%SS+0.2%KMS, (T_7) Wat Blanch+2% SS+1% SC, (T_8) Wat Blanch+2% SS+1%GG, (T_9) Wat Blanch+0.2% KMS+ 1% SC), (T_{10}) Wat Blanch+0.2% KMS+1% GG, (T_{11}) Wat Blanch+1% SC+1% GG, (T_{12}) 2%Sal Blanch+1% SC, (T_{13}) 2%Sal Blanch+1%GG+1% SC, (T_{14}) 2%Sal Blanch+0.2% KMS+1% SC, (T_{15}) 2%Sal Blanch+0.2% KMS+1% GG and (T_{16}) 2%Sal Blanch+0.2% KMS+1%SC+1% GG, where SS – Salt Solution; KMS – Potassium meta bisulphite; SC- Sodium carbonate; GG – Guar gum. Each sample was steeped in pre-treatment solution for 5 minutes. For control (T_1), the sample was only blanched in hot water (at 90° C) for 3 minutes without any pre-treatment steeping.

Process of drying: After pre-treatment, the samples were spread uniformly over a perforated tray to drip off the excess solution and then allowed to dry in shade for almost one hour (Nyangena *et al.*, 10). Subsequently, the samples were subjected to drying in a laboratory mechanical dehydrator at 60±5 °C till the moisture content is reduced to 6 % in the final dried product (Tiwari *et al.*, 16).

Estimation of physical qualitative properties: Further, the estimation of physical qualitative properties mainly moisture percentage (MP), bulk density (BD), rehydration ratio (RR) and blemish count (BC) of dehydrated product of white skinned bitter gourd was carried as per the standardized methods of Ranganna (12) and Association of Official Analytical Chemists (AOAC) (1).

Moisture percentage (MP): The moisture percentage of dehydrated WSBG rings was calculated when weight of the dried sample becomes constant (AOAC, 1) and expressed as:

$$\text{Moisture content of dehydrated sample} = \frac{[\text{Initial Sample Weight} - \text{Final Sample Weight}]}{\text{Initial Sample Weight}} \text{ X } 100\ (\%)$$

Rehydration ratio (RR): According to Ranganna (12), the RR was expressed as:

$$\text{RR} = \frac{\text{Rehydrated sample weight}}{\text{Dehydrated sample weight}}$$

Bulk density (BD): BD of dehydrated rings of WSBG was calculated as per the method of Ranganna (12) and expressed as:

$$\text{BD (g/cm3)} = \frac{\text{Sample weight}}{10}$$

Blemish count (BC): The blemishes on dehydrated rings of WSBG were estimated by visual counting of surface blemishes (in numbers) on dehydrated sample. The number of surface blemishes counted were multiplied by 2 and reported as number of blemishes per 100g of sample (Ranganna, 12).

Statistical analysis: OPSTAT software was used to analyze the data obtained. The significant differences between the sample treatment means were determined by Duncan Multiple Range Test (DMRT) procedure at P values of < 0.05.

Results and Discussion

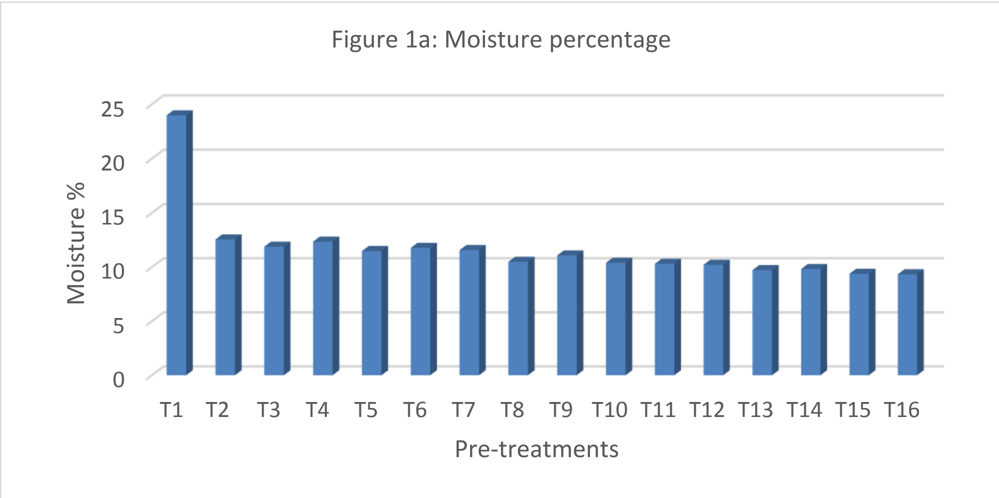
The data obtained for the physical qualitative properties of dehydrated WSBG samples were studied and presented in Figure 1a, 1b, 1c & 1d. The results clearly indicate that samples pretreated with guar gum performed superior in comparison to control (T_1).

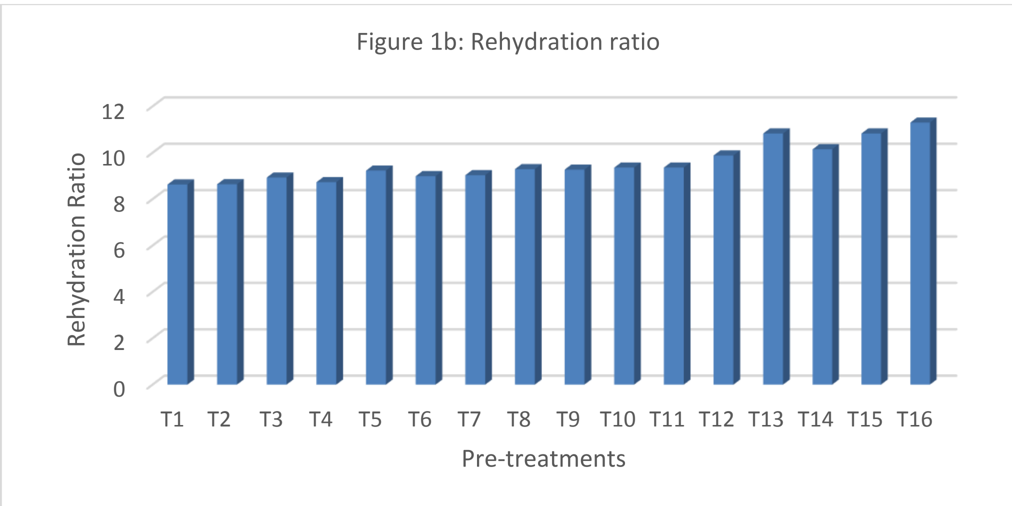
Moisture percentage: The positive impact of using guar gum as solo pre-treatment with blanching or in combination with other pre-treatments on the final MP of dried rings is clear from the results obtained (Figure 1a). The mean for MP of dehydrated WSBG varied from 9.33 to 23.98. The control samples retained more moisture as compared to the pre-treated samples due to osmotic pressure; while guar gum treatment T_5 (Wat Blanch+1%GG) and T_{16} (2%Sal Blanch+0.2%KMS+1%SC+1%GG reported minimum MP, both in solo or in combination samples, respectively. These results indicate that the osmotic pressure exerted by the osmotic solution of pre-treatment forces the moisture of the internal tissues to come out before undergoing dehydration (Jia *et al.*, 6). Nyangena *et al.* (10) reported that low moisture content attributes to better shelf life and reduction in bacterial, yeast and mould growth during storage.

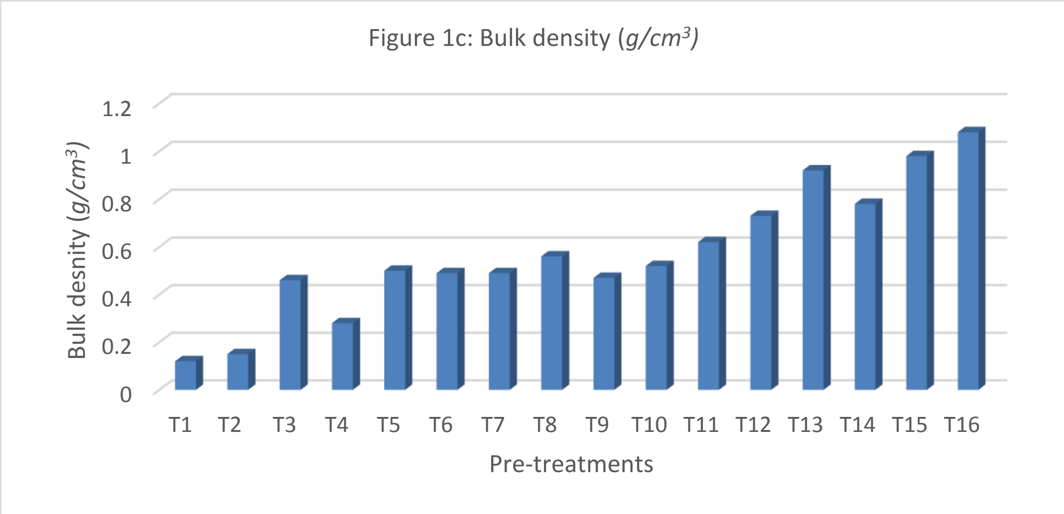
Rehydration ratio (RR): The successful dehydration is largely dependent on the reconstitution property of the dried product. To analyze the rehydration property of the dehydrated rings of WSBG, the dried product was boiled for final reconstitution. The mean scores for rehydration ratio of dehydrated WSBG with different pre-treatments varied from 8.63 to 11.30. It is clear from the results that the pre-treated samples had a positive impact on RR of the dehydrated WSBG in comparison to control sample (T_1) (Figure 1b). Among the solo and combination pre-treatments, T_5 (Wat Blanch+1%GG) and T_{16} (2%Sal Blanch+0.2%KMS+1%SC+1%GG was found to have maximum RR, respectively. These findings corroborate to the observations of Al-amin *et al.* (5), indicating that there is substantial difference between the re-constitutability of dehydrated rings with respect to different pre-treatments in spite of being subjected to similar drying conditions in the mechanical drier. According to Alam *et al.,* (3), pre-treatment of samples before dehydration results in enzyme denaturation, air pockets removal from the tissues, hydrolysis and solubilization of structural polymers, which causes starch granules to gelatinise, thereby positively influencing the water binding ability of the rehydrated product.

Bulk density (g/cm^3): In the present work, the BD varied in a restricted range from 0.12 to 1.08 g/cm^3 with different pre-treatments during dehydration of WSBG rings. Among the different pre-treatments, T_5 (Wat Blanch+1%GG) and T_{16} (2%Sal Blanch+0.2%KMS+1%SC+1%GG showed highest BD in guar gum solo & combination pretreated samples, respectively (Figure 1c), whereas the lowest BD was reported by control (T_1). According to Mayor *et al.* (9), BD tends to increase in beginning, reach its peak and starts decreasing by the end of the drying process. The heat & mass transfer in solids largely depends on the BD in addition to the sensory and textural properties of the dried product. Also, the information pertaining to the BD of food materials is a critical aspect for proper planning of storage, transport, mixing and packaging operations.

Blemish count: Figure 1d depicts the mean score of blemish counts observed on WSBG dehydrated rings. In comparison to control sample (T_1). The samples subjected to pre-treatment solutions before dehydration experienced less blemish count in comparison to the control sample. T_{16} (2%Sal Blanch+0.2%KMS+1%SC+1%GG has reported the lowest BC. In general, the presence of blemishes on a dehydrated product is considered to be an undesirable property. The results obtained are indicative for the presence of minor blemishes, which were permitted in dehydrated product on a commercial scale. Similar trend was reported by Pandya and Yadav (11).







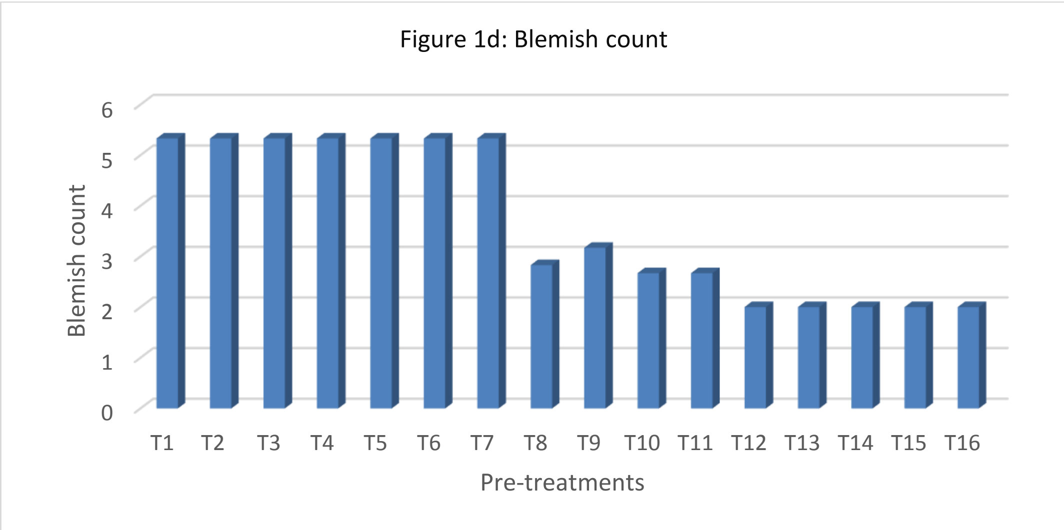


Figure 1a, 1b, 1c & 1d. Effect of blanching and pre-treatments on qualitative physical properties of dehydrated white skinned bitter gourd

Conclusion

The present investigation shows that the guar gum performed superior both individually as well as in combination with other pretreatment solutions for enhancing the physical qualitative properties of the white skinned bitter gourd. The higher retention of RR and BD indicates that the guar gum pretreated samples were found to have better reconstitution than T_1 (control sample) after dehydration. These findings thereby provide a way forward for application of guar gum as a suitable natural, edible & biodegradable pretreatment solution for enhancement of properties & shelf life of the white bitter gourd in dried form, thereby making feasible it's off season availability to the consumers round the year.

Author's contribution

Conceptualization of research (SV, RR, MK); Designing of the experiments (SV, RR, MK); Contribution of experimental materials (SV, RR, MK); Execution of lab experiments and data collection (SV); Analysis of data and interpretation (SV); Preparation of the manuscript (SV, RR, MK)

Declaration: The authors declare that there is no conflict of interest.

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