Archives of Current Research International

Volume 25, Issue 6, Page 438-445, 2025; Article no.ACRI.138390
ISSN: 2454-7077

Impact of Drying Techniques on Quality Attributes of F_2 Generation of Ramnad Mundu Chilli (*Capsicum annuum* L.)

M. Kabilan [a*], P. Janani [a], V. Raja [a], L. Sowmiya [a] K. Poonkodi [b], K. Sundharaiya [c] and G. Sathish [c]

[a] Regional Coffee Research Station, Coffee Board, Thandigudi-624216, Tamil Nadu, India.
[b] Department of Botany, Nesamony Memoriyal Chirstian College, Marthandam-629165, Kanyakumari, Tamil Nadu, India.
[C] Horticultural College and Research Institute, Tamil Nadu Agricultural University, Periyakulam-625064, Tamil Nadu, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/acri/2025/v25i61287

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://pr.sdiarticle5.com/review-history/138390

Original Research Article

Received: 15/04/2025
Accepted: 17/06/2025
Published: 19/06/2025

ABSTRACT

An experiment was conducted at the Department of Vegetable Science, Horticultural College and Research Institute (HC & RI), Tamil Nadu Agricultural University (TNAU), Periyakulam, with the objective of evaluating the influence of different drying techniques on the quality attributes of Mundu chilli (*Capsicum annuum* L.). The study was carried out using a Factorial Completely Randomized

**Corresponding author: Email: kabimathi21@gmail.com;*

Cite as: *Kabilan, M., P. Janani, V. Raja, L. Sowmiya, K. Poonkodi, K. Sundharaiya, and G. Sathish. 2025. "Impact of Drying Techniques on Quality Attributes of F_2 Generation of Ramnad Mundu Chilli (Capsicum Annuum L.)". Archives of Current Research International 25 (6):438-45. https://doi.org/10.9734/acri/2025/v25i61287.*

Design (FCRD) with three replications to ensure statistical validity and precision. The experimental material comprised four F_2 progenies developed from selected parental crosses: PKM CA 38 × PKM CA 33 (denoted as C_1), PKM CA 32 × PKM CA 20 (C_2), PKM CA 32 × PKM CA 33 (C_3), and PKM CA 20 × PKM CA 08 (C_4). These genotypes were subjected to five different post-harvest drying treatments, namely T_0 – Control (open shade drying), T_1 – Sun drying, T_2 – Oven drying, T_3 – Solar cabinet drying, and T_4 – Heat pump-assisted drying. Among the genotypes, the F_2 cross PKM CA 20 × PKM CA 08 (C_4) exhibited the most favorable response to the drying techniques in terms of the retention and enhancement of key quality parameters such as capsaicin and oleoresin content. This was followed by the cross PKM CA 32 × PKM CA 33 (C_3), which showed notable improvements in capsanthin content and colour value. The results of the statistical analysis indicated that all the drying treatments were significantly superior to the control (open shade drying) across the measured quality parameters. Among the various drying methods, heat pump-assisted drying (T_4) was the most effective, resulting in the highest levels of capsaicin, capsanthin, oleoresin, and overall colour value. This was closely followed by solar cabinet drying (T_3), which also performed well in preserving the biochemical and visual quality traits of the dried chillies. These findings highlight the potential of advanced drying technologies, particularly heat pump-assisted drying, in enhancing the post-harvest quality of Mundu chilli and support their adoption for improved processing and value addition in chilli production systems.

Keywords: Mundu chilli; drying techniques; capsaicin; oleoresin content.

1. INTRODUCTION

Chilli (*Capsicum annuum* L.) is one of the most widely cultivated and economically significant spice crops in India. It holds a prominent position not only in Indian agriculture but also in the daily culinary practices of the population. Among the wide array of spices grown across the country, chilli occupies the largest area and boasts the highest production volume, surpassing all other spices. India ranks as the leading producer and consumer of chilli in the world, with no other country matching its scale of cultivation and output (Jyothi et al., 2008). According to the Indian Horticulture Database (2011), chilli contributes to nearly 30% of the total area under spice cultivation in the country, highlighting its vital role in both domestic and export markets. The chilli-growing regions of India are characterized by considerable variability in crop duration, agro-climatic adaptability, and varietal diversity. Numerous local and hybrid varieties of chilli are grown, each distinguished by a unique set of attributes such as phenotypic traits, degree of pungency, flavor, fruit shape, and coloration (Asati & Yadav, 2004). However, environmental factors play a crucial role in determining the quality and yield of the chilli crop. Both low and high temperature extremes adversely affect fruit development and seed viability. In particular, high temperatures during the post-anthesis period significantly reduce fruit set and overall productivity by impairing reproductive development and pollination efficiency.

The pungency and characteristic aroma of chilli are primarily attributed to a group of alkaloid compounds known as capsaicinoids, with capsaicin being the most abundant and biologically active component (Zahra et al., 2016). Capsaicin is a tasteless, odorless compound synthesized and accumulated in specialized vesicles within the epidermal cells of the placenta in chilli fruits. Apart from its role in enhancing food flavor, capsaicin has gained considerable attention for its pharmacological properties. Recent research has revealed that capsaicin can selectively bind to proliferating cancer cells, inhibiting their growth and inducing apoptosis. This has led to its inclusion in various pharmaceutical formulations aimed at treating chronic pain, inflammation, and even cancer. In addition to capsaicin, chilli is valued for its high oleoresin content, a concentrated extract that encapsulates both the flavor and color of the spice. Oleoresin is widely used in the food processing, condiment, and beverage industries due to its intense aroma and colorant properties. Freshly extracted oleoresin is a dark, viscous liquid with a potent characteristic aroma and is considered a valuable ingredient in spice blends and flavoring agents. Chilli also contains significant amounts of natural red pigments such as capsanthin and capsorubin, which contribute to the vibrant color of the fruit. These pigments are gaining traction as safer, natural alternatives to synthetic food colorants. In commercial markets, the intensity of red color in dried chilli products is often a key determinant of market value and consumer preference.

Standardized methods for evaluating chilli pigment content and oleoresin yield have been established by authoritative bodies such as the Association of Official Analytical Chemists (AOAC) and the American Spice Trade Association (ASTA). These protocols ensure consistency in assessing quality parameters critical for trade and product formulation. While various chilli genotypes have been developed for improved yield, color, and pungency (Derera, 2000), there is still a significant gap in our understanding of how post-harvest processing, particularly drying methods, influences the biochemical composition and overall quality of chilli fruits. Despite the wealth of genetic diversity, comprehensive studies on the chemical and physical quality traits of specific cultivars such as *mundu* chilli remain limited. In this context, the present study was undertaken to investigate the effect of different drying techniques on the biochemical constituents and quality attributes of selected F_2 progenies of mundu chilli. Special attention was given to key quality parameters such as capsaicin content, oleoresin yield, pigment concentration, and color value, with the aim of identifying the most effective drying method to preserve or enhance these traits. This research not only contributes to a better understanding of varietal responses to drying conditions but also provides valuable insights for optimizing post-harvest handling to improve the marketability and processing quality of chilli.

2. MATERIALS AND METHODS

The PKM CA 38 X PKM CA 33 (C1), PKM CA 32 X PKM CA 20 (C2), PKM CA 32 X PKM CA 33 (C3), and PKM CA 20 X PKM CA 08 (C4) were genetically pure and fresh F_2 generation seed obtained from the Department of Vegetable Science, Horticultural College and Research Institute, TNAU, Periyakulam, Tamil Nadu, and used for the study. Five treatments were used, are as follows: T_0 – Control (open Shade drying), T_1 – Sun drying T_2 – Oven drying, T_3 – Solar cabinet drying, T_4 – Heat pump assisted drying. Data on quality parameters *viz*., Capsaicin, Capsanthin, Colour value and Oleoresin content were recorded. A Factorial Completely Randomized Design (FCRD) with three replications was used to conduct the experiment. The gathered data on various quality parameters was statistically assessed using the approach of Panse et al., (1954).

2.1 Quality Parameters

Capsaicin content: Sadasivam & Manickam, (1992) described a technique for determining the capsaicin concentration of dried fruit. The dried fruit samples were finely pulverized and sieved using No. 40 sieves. Two grams of powder were placed in a 100 mL volumetric flask. With 0.01 percent ethyl acetate, the volume was raised to 100 ml and stored for 24 hours. The extract was then diluted to five millilitres in one millilitre of ethyl acetate. A 0.5 ml solution of vanadium oxychloride was added and vigorously shaken. The samples were measured using a spectrophotometer at 720 nm. The capsaicin content was determined to be expressed as a percentage using the following formula.

$$\boldsymbol{Capsaicin}\ (\%) = \frac{\boldsymbol{\mu g\ capsaicin}}{\mathbf{1000}\ \boldsymbol{X}\ \mathbf{1000}} \boldsymbol{X} \frac{\mathbf{100}}{\mathbf{1}} \boldsymbol{X} \frac{\mathbf{100}}{\mathbf{2}}$$

Capsanthin content: Ranganna (1997) used a Spectrophotometer to determine the Capsantin concent. 20 ml ethanolic HCl was added to 10 g of fruit sample and the mixture was crushed. The blender was then washed with 15 mL of ethanolic HCL. The mixture was then refrigerated overnight at 4 0C. Whatman filter paper no. 1 was used to filter the extract. The extract was then transferred to a 50 ml volumetric flask and the volume was adjusted with ethanolic HCL. It was then measured using a spectrophotometer at 533 nm.

$$\boldsymbol{Capsanthin}\ (\boldsymbol{mg}\ \mathbf{100}\ \boldsymbol{g} - \mathbf{1}) =$$

$$\frac{\boldsymbol{Absorbance\ at}\ \mathbf{533}\ \boldsymbol{nm}\ \times \mathbf{10} \times \mathbf{50} \times \mathbf{100}}{\mathbf{2} \times \mathbf{10}}$$

Colour value: Woodbury's (1997) approach was used to compute the extractable color in chilli, which was expressed in ASTA units. A US No. 20 sieve was used to filter the dried fruits. A 100 mg sample is properly measured and transferred to a 100 mL volumetric flask. Acetone was applied up to the target and gently stopped pered. The flask was shaken vigorously and kept at room temperature for 16 hours before being shaken again and allowed for two minutes to allow the particles to settle. A portion of the extract was transferred to the spectrophotometer cell and the absorbance (A) at 460 nm with an acetone blank was determined. The absorbance of a glass filter was measured at 465 nm.

Oleoresin content: Mathai's (1988) approach was used to determine the oleoresin content. Powdered oven dried fruits were put in a glass column of the Soxhlet apparatus, and oleoresin was extracted using acetone as the organic solvent. The extract was then evaporated in a steam bath, heated in a 60°C oven for 30 minutes, cooled, measured, and expressed in percentages.

3. RESULTS AND DISCUSSION

Effect of Drying Techniques on Capsaicin Content in F_2 Generation of Mundu Chilli: The results of the study revealed that both the main factors drying techniques (T) and F_2 generations (C) exhibited statistically significant differences in terms of quality parameters, particularly capsaicin content. However, the interaction effect between the drying methods and the F_2 progenies (T × C) was found to be non-significant, indicating that the response of the F_2 progenies to drying techniques was consistent across all genotypes without any specific interaction. The mean values for capsaicin content across different drying methods are summarized in Table 1**.** Among the treatments, heat pump-assisted drying (T_4) proved to be the most effective in retaining capsaicin content, with an average value of 0.58%**,** followed closely by solar cabinet drying (T_3) at 0.55%**.** In contrast, the lowest capsaicin concentration was recorded in the control treatment (T_0 - open shade drying)**,** with a mean value of only 0.12%**,** indicating considerable degradation of pungency-related compounds in the absence of controlled drying conditions. Evaluation of the different F_2 progenies also showed significant variability in capsaicin content under various drying methods, confirming the influence of genetic background on the retention and biosynthesis of biochemical traits. These findings suggest that both genotype and drying environment play critical roles in determining final fruit quality.

The results obtained in this study are in agreement with earlier findings by Reddy & Khan (2001) and Andreoli and Khan (1999)**,** who reported higher capsaicin levels in chilli under optimized drying conditions. Additionally, elevated capsaicin concentrations in various vegetable crops have been documented by Ruminska *et al*. (1978) in cucurbits, Natesh *et al*. (2005) in chilli, and Yogananda *et al*. (2004) in bell pepper, supporting the role of controlled post-harvest processes in enhancing or preserving bioactive compounds. These observations reinforce the significance of adopting suitable drying techniques, particularly heat pump and solar cabinet drying, for maximizing capsaicin retention in chilli fruits while also highlighting the inherent potential of specific F_2 crosses for superior biochemical quality.

Effect of Drying Techniques on Capsanthin Content in F_2 Generation of Mundu Chilli: Among the various drying techniques evaluated, heat pump-assisted drying (T_4) emerged as the most effective method for preserving capsanthin content, recording the highest value of 324.78 mg/100g. This was followed by oven drying (T_2), which also maintained a relatively high capsanthin level of 312.74 mg/100g. In contrast, the lowest capsanthin content was observed in the control treatment (T_0 - open shade drying), with a value of 245.31 mg/100g. The superior performance of heat pump-assisted and oven drying methods in retaining capsanthin can be attributed to the controlled temperature and reduced oxidative degradation during the drying process. Capsanthin, a major carotenoid responsible for the red coloration in chilli, is sensitive to heat, light, and oxygen. Thus, drying methods that minimize exposure to these degrading factors are more effective in conserving pigment integrity. These findings are

Table 1. Effect of drying techniques on capsaicin content in F_2 generation of mundu chilli

Treatments	C_1	C_2	C_3	C_4
T_0	0.48	0.42	0.52	0.51
T_1	0.34	0.46	0.35	0.38
T_2	0.45	0.39	0.42	0.41
T_3	0.29	0.32	0.35	0.30
T_4	0.54	0.53	0.58	0.62
Source	**SEd**		**CD 5%**	
F_2 crosses	0.49		0.99	
Treatment	0.65		1.31	
Interaction	1.31		2.62	

Table 2. Effect of drying techniques on capsanthin content in F_2 generation of mundu chilli

Treatments	C_1	C_2	C_3	C_4
T_0	296.30	294.19	285.64	283.15
T_1	245.31	263.52	249.27	259.37
T_2	301.54	312.74	264.28	297.37
T_3	295.34	296.59	289.67	302.39
T_4	310.72	304.38	311.92	324.78
Source	**SEd**		**CD 5%**	
F_2 crosses	11.789		23.61	
Treatment	15.595		31.24	
Interaction	31.191		62.48	

consistent with previous studies conducted by Kumar, (2005) and Bassi *et al*., (2007), who also reported better retention of carotenoids under controlled drying environments. Similarly, Peyvast *et al*., (2009) and Farooq *et al*., (2007) demonstrated that drying techniques employing moderate, uniform heat without direct sunlight or extreme temperatures are ideal for maintaining carotenoid pigments, including capsanthin. The results of the present study highlight the importance of selecting appropriate post-harvest drying technologies to preserve key quality parameters such as color and nutritional value. Among the techniques tested, heat pump-assisted drying offers a promising approach for retaining high levels of capsanthin in Mundu chilli, thus enhancing its market appeal and processing potential.

Effect of Drying Techniques on Colour Value in F_2 Generation of Mundu Chilli: The analysis of variance revealed that both the main factors drying techniques and F_2 progenies as well as their interaction effects, exhibited statistically significant differences in terms of colour value, indicating that the impact of drying methods on colour retention varied among the different progenies. This suggests a genotype-specific response to drying techniques, particularly in how pigment stability and extractable colour are influenced. As presented in Table 3, among the various drying treatments, heat pump-assisted drying (T_4) recorded the highest colour value of 69.77 ASTA units, signifying its effectiveness in preserving the natural red pigments during dehydration. This was followed by oven drying (T_2), which achieved a colour value of 64.21 ASTA units. In contrast, the lowest colour value was observed in the control treatment (T_0 - open shade drying), with only 36.24 ASTA units, likely due to greater pigment degradation caused by uncontrolled environmental conditions such as light, temperature fluctuations, and prolonged drying duration. The superior performance of heat pump and oven drying can be attributed to the regulated temperature and minimal exposure to oxidative stress, which are critical for maintaining pigment compounds such as capsanthin and capsorubin key contributors to the bright red colour of chilli. These findings are in agreement with earlier reports by Bassi *et al.* (2007), Peyvast *et al*. (2009), and Singh *et al.* (1999), who emphasized the importance of controlled drying environments in retaining ASTA colour value in chilli and other spice crops. The preservation of colour is not only important for consumer appeal but also directly influences the commercial value of chilli products in both domestic and export markets. Therefore, heat pump-assisted drying stands out as a highly effective post-harvest technology for enhancing the visual and economic quality of dried chilli fruits.

Effect of Drying Techniques on Oleoresin Content in F_2 Generation of Mundu Chilli: The statistical analysis revealed that both the main effects drying techniques and F_2 progenies as well as their interaction effects were significantly different in relation to oleoresin content, indicating that the efficacy of drying methods in retaining oleoresin varied across the different F_2 genotypes. This significant interaction highlights the role of both genetic and post-harvest factors in determining oleoresin yield in chilli fruits. As detailed in Table 4, among the five drying techniques evaluated, heat pump-assisted drying (T_4) recorded the highest oleoresin content of 29.56%, establishing it as the most effective method for preserving volatile and non-volatile compounds responsible for the characteristic aroma, flavor, and color of chilli. This was closely followed by oven drying (T_2), which achieved an oleoresin content of 26.65%. In contrast, the lowest oleoresin yield was observed in the control treatment (T_0 - open shade drying), with only 13.24%, likely due to greater losses of essential oils and pigments

Table 3. Effect of drying techniques on Colour value in F_2 generation of mundu chilli

Treatments	C_1	C_2	C_3	C_4
T_0	56.21	49.45	36.24	58.41
T_1	56.84	48.79	43.57	58.74
T_2	52.41	41.24	64.21	43.17
T_3	48.67	43.64	49.78	51.37
T_4	61.85	63.12	59.45	69.77
Source	**SEd**		**CD 5%**	
F_2 crosses	0.042		0.084	
Treatment	0.055		0.112	
Interaction	0.111		0.224	

Table 4. Effect of drying techniques on Oleoresin content in F_2 generation of mundu chilli

Treatments	C_1	C_2	C_3	C_4
T_0	13.24	16.28	21.43	23.48
T_1	14.25	19.56	15.35	20.97
T_2	12.49	26.65	19.23	16.36
T_3	18.49	16.89	19.36	17.25
T_4	23.78	20.24	24.37	29.56
Source	**SEd**		**CD 5%**	
F_2 crosses	0.112		0.224	
Treatment	0.148		0.297	
Interaction	0.297		0.595	

during the uncontrolled drying process. Oleoresin is a concentrated, viscous extract containing essential oil and resinous matter, and its content is a critical parameter for evaluating the processing quality of chilli, particularly for its use in the food, cosmetic, and pharmaceutical industries. The significantly higher oleoresin content observed under heat pump-assisted and oven drying can be attributed to better retention of thermo-sensitive compounds due to precise temperature control, shorter drying duration, and protection from light and oxygen exposure. These results are in close agreement with earlier studies conducted by Islam *et al*. (2012), Singh and Lal (2005), Kumar (2005), Valeria *et al*. (2012), and Yogananda *et al*. (2004), who reported that controlled and energy-efficient drying methods help retain a higher proportion of oleoresin in chilli and other spice crops. Overall, the findings strongly support the adoption of advanced drying techniques, particularly heat pump-assisted drying, as a reliable post-harvest intervention for maximizing oleoresin yield and enhancing the commercial and sensory quality of chilli products (Demir & Okeu, 2004).

4. CONCLUSION

The present study clearly demonstrated that the quality attributes of Mundu chilli namely capsaicin, capsanthin, colour value, and oleoresin content were significantly influenced by the drying techniques employed. Although both the drying methods and F_2 generations independently affected the quality parameters, no significant interaction was observed between the two factors across all quality traits. This indicates that the effectiveness of each drying method was consistent across all F_2 progenies, and the genetic variation among the crosses did not alter the response to different drying conditions. Among the treatments, heat pump-assisted drying consistently resulted in the highest retention of capsaicin, capsanthin, colour value, and oleoresin, followed by solar cabinet and oven drying methods. In contrast, the control treatment (open shade drying) recorded the lowest values for all measured parameters, underscoring the importance of controlled post-harvest processing environments. These findings underscore the critical role of drying technology in preserving the sensory, nutritional, and commercial quality of chilli. Regardless of the genotype, selecting an appropriate drying method particularly heat pump-assisted drying ensures optimal quality retention, making it a viable option for commercial and industrial processing of Mundu chilli.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

Andreoli, C & Khan, A (1999) Matric conditioning integrated with gibberellic acid to hasten seed germination and improve stand establishment of pepper and tomato. *Pesq Agropec Bras Brasilia, 34*: 1953-58.

Asati BS, Yadav DS. (2004) Diversity of horticultural crops in north eastern region. ENVIS Bull Him Eco. 2004:12:1-11.

Bassi, G. Kanwar, J. S. & Singh, J. (2007) Seed enhancement treatments and seed quality in brinjal (*Solanum melongena*). *Veg Sci 34*: 202-03.

Demir, I. & Okeu, G. (2004). Aerated hydration treatment for improved germination and seedling growth in aubergine (*Solanum melongena* L.) and pepper (*Capsicum annuum* L.). *Annals of Applied Biology, 144,* 121–123.

Derrera, N.F. (2000) Condiment paprika - Apotential new crop. Agric Sci 1: 24-27.

Farooq, M. Basra, S. M. A. Rehman, H. Ahmad, N. & Saleem, B. A. (2007) Osmopriming improves the germination and early seedling growth of melons (*Cucumis Melo* L.). *Pak J Agri Sci 44*: 529-33.

Indian Horticulture Database (2011) Indian horticulture production at a glance. Government Of India.

Islam, M. S. Abdul, M. B. M. Hossain, T. Ahmed, J. U. and Khan, H. I. (2012) Priming on embryo emergence and seedling vigour of small fruited bitter gourd (*Momordica charantia* L.) under sub-optimal temperature. *Int J Agric Sci Res 2*: 1-10.

Jyothi Pandey, Jagdish Singh, Ajay Verma, Singh, A.K., Mathura Rai, and Sanjeet Kumar. (2008). Evaluation of chilli (Capsicum annuum L) genotypes for some quality traits. 45(5): 463-465.

Kumar, S. (2005) Influence of pre-sowing seed treatment and seed pelleting on storability in brinjal (*Solanum melongena* L.) M.Sc. thesis, University Agricultural Science, Dharwad.

Natesh, N. Vyakaranahal, B. S. Gouda, M. S. and Deshpande, V. K. (2005) Influence of growth regulators on growth, seed yield and quality of chilli cv. ByadagiKaddi. *Karnataka J Agric Sci 18*: 36-38.

NHB. Online statistical database. National Horticultural Board, Ministry of Agriculture, Govt. of India, 2020.

Panse, V. G. and Sukatme, P. V. (1985). Statistical Methods for Agricultural Workers. ICAR Publications, New Delhi, India. 359 pp.

Peyvast, G. H. Olfati, J. A. Piri, M. & Mahdieh, M. B. (2009) Germination and seedling development of cucumber are enhanced by priming at low temperature. *Int J Veg Sci 15*: 285-92.

Reddy, Y. T. N. and Khan, M. M. (2001). Effect of osmo priming on germination, seedling growth and vigour of khirni (*Mimusops hexandra*) seeds. *Seed Res 29*:24-27.

Ruminska, A. Suchorska, K. & Weglarz, Z. (1978). Effect of gibberelic acid on seed germination of some vegetable and medicinal plants. *Acta Hort 73*:131-36.

Sadasivam S, Manickam A. (1992) Biochemical methods for agricultural sciences. New Delhi: Wiley Eastern Limited.

Singh, D. K. and Lal, G. (2005) Effect of cultivars and harvesting stages on yield and quality of tomato seed. *Prog Hort 37*: 199-203.

Singh, G. Gill, S. S. and Sandhu, K. K. (1999) Improved performance of muskmelon (*Cucumis melo*) seeds with osmoconditionin. *Acta Agrobotanica 52*: 121-26.

Valeria, C. H. Esperon, R. K. Guimarae, R. M. Vieira, A. R. and Goncalves, N.R. (2012) Physiological quality of osmoprimed eggplant seeds. *Agric Sci 36*:526-32.

Yogananda, D. K. Vyakarnahal, B. S. and Shekhargouda, M. (2004) Effect of seed invigoration with growth regulations and micronutrients on germination and seedling vigour of bell pepper cv. California Wonder. *Karnataka J Agric Sci 17*: 811-13.

Zahra N, Alim-un-Nisa, Kalim I, Hina S, Javed A, Inam S M, Malik S M and Arshad F (2016) Estimation of capsaicin in different chilli varieties using different Extraction Techniques and HPLC method: A Review. Pak J Food Sci 26: 54-60.

Peer-review history:
The peer review history for this paper can be accessed here:
https://pr.sdiarticle5.com/review-history/138390