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Influence of post harvest interventions on quality attributes of black pepper (*Piper nigrum* L.)

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Abstract
Black pepper (*Piper nigrum* L.) poetically referred as King of Spices, is an important spice crop of Western Ghats tracts. Farmers of this area have two dimensional challenges in production of Black pepper (production and post harvesting process). Black pepper, being a high demand export-oriented spice crop need appropriate post harvesting processing and handling interventions to improve quality, appearance and shelf-life of the end product. Currently market demands deep black, bold berries for export purpose. Different post-harvest techniques have its own influence on these quality attributes. Among the post-harvest interventions blanching and procedure of drying has significant influence on quality of end product. Hence, an observational study was taken up at Spices Board, Regional Station, ICRI, Sakleshpur during 2023 to assess the influence of different post-harvest interventions on quality attributes of black pepper berries. Five different post-harvest practices were evaluated with four replications. Treatments consisting of open sun drying on mat (T_1), Sun drying with covering transparent polythene sheet (solarization -T_2), Sun drying with covering non-transparent polythene sheet (T_3), Blanching deconned berries in hot water for 2 mins and open sun drying (T_4) Blanching deconned berries in hot water for 5 mins and open sun drying (T_5). Quicker drying was observed where berries were blanched and open sun dried (T_4 & $T_5$18h 30min), closely followed by treatments where berries open sun dried (T_1) (19.20h). Relatively highest drying time was observed where berries were covered with transparent and non-transparentpolythene sheet (22 h). Similarly, highest recover percentage was observed in treatments where solarization was adopted (T_2 & T_3 40.08 & 41.01% respectively) and lowest recovery percentage was observed in treatment where berries were blanched and sun dried (T_4&T_5 38.09 and 38.02%respectively). Deep black coloured berries were observed in treatments where solarization was adopted (T_2& T_3). On the contrary, open sun-dried berries had brownish black shade after completion of drying. Hence it can be concluded that initial solarization with polythene cover for 5-6 hours followed by open sun drying helps in achieving better post-harvest quality attributes deep black berry colour in black pepper as compared to regular practice of open sun drying.

Keywords: Black pepper, blanching, drying, recovery, solarization

Introduction
Black pepper (*Piper nigrum*) poetically referred as 'king of spices', can also be referred as "eternal spice" because of its longer shelf life, medicinal and culinary properties. Black pepper being a high demand export-oriented spice crop needs appropriate post-harvest processing and handling interventions for improving its quality appearance and shelf life of end product. In the current situation black pepper export trade demands deep black, bold berries which can be attained with appropriate post-harvest interventions. Among the post-harvest interventions blanching and sun drying is being practiced by pepper growers from long ago. On the contrary blanching processing has its own limitations like consumption of higher labourers, fossil energy as well as a marginal reduction in recovery and dry berry yield. Biochemically deep black colour for black pepper is imparted due to enzymatic browning and oxidation of phenolic compound during the drying process. Hence, an alternative drying process which is convenient, non-laborious retains deep black colour of berries along with higher dry recovery shall be evaluated for its post-harvest quality attributes along with process efficiency. Recently drying black pepper through solarization technique is gaining popularity. Deconned black pepper berries are spread thinly over double folded shade net mat. Covering pepper berries using polythene sheet for minimum of 8 hours

intense sunshine helps to trigger the peroxidase enzymatic activity and imparts even deep black colour to the berries. Double folded shade net mat facilitates quicker drainage of evaporated moisture from the berries. Keeping these points in view an observational trial was conducted at Spices Board, Regional Research Station located at Sakleshpur, Karnataka to evaluate effect of different post harvest interventions on final dry weight and market preferred quality traits of black pepper berries.

Materials and Methods

An observational trial was conducted at Spices Board, Regional Research Station, ICRI, Sakleshpur during 2023-2024 to evaluate impact of different post harvest interventions on market preferred traits of black pepper berries. The experiment consisted of five treatments and four replications. Observed data was interpreted as per procedure approved for completely randomised block design (CRD). The recorded data was subjected for statistical analysis as outlined by Gomez and Gomez 1976. Matured pepper catkins were harvested and deconned using pepper deconning machine. For each treatment five kgs of fresh pepper berries were used. Litre weight was calculated and expressed as gram/Liter. Colour of the dried berries was assessed by visual observations and time taken for drying was expressed in hours. Active sun shine hours are only considered for calculating the drying time. Once the product attained 8 to 10 percent moisture content, black pepper berry were cleaned, winnowed and post-harvest observations was recorded.

Treatment details

T_1: Open sun drying on mat.
T_2: Sun drying - covering transparent polythene sheet
T_3: Sun drying - covering non-transparent polythene sheet
T_4: Blanching deconned berries for 2 mins & open sun drying
T_5: Blanching deconned berries for 5 mins & open sun drying

Results

It was observed from the current study that, pepper berries deconne and subjected for blanching for 2 minutes and 5 minutes followed by open sun drying attained desirable moisture level of 10 per cent after 18 hours 30 minutes where as treatments receiving solarization of deconned pepper berries using transparent (T_2) and non-transparent polythene sheet recorded 22 hours for attaining 10 per cent moisture. Fresh pepper berries subjected to blanching treatment dried quickly by three hours and 30 minutes when compared to solarization. Similarly, the conventional practice of drying deconned pepper berries took 19 hours 20 minutes time to attain desired moisture level. Significantly higher recovery per cent was observed in the treatment where solarization technique was used (T_3 & T_2). On the contrary fresh to dry recovery rate was significantly low in the treatments where blanching was adopted (T_4 & T_5). Reduction in recovery per cent could be attributed to leach out of some biochemical component from fresh berry during the process of blanching (Table.1). Results of the current study are in conformity with the earlier findings of Gu *et al* (2013) [2] and Joy *et al* (2002) [3]. Similar trend of observations were continued for litre weight also. Highest litre weight was observed in treatment where solarization technique was adopted as compared to blanching and open drying.

Table 1: Effect of different drying procedures on selected quality traits of Black pepper

Treatments	Drying time (hrs)	Recovery (%)	Liter weight (g/l)	Dried berries weight (kg)	Berries colour
T_1: Open sun drying on mat.	19.20	38.40	548	1.920	Brown to black
T_2: Sun drying covering transparent polythene sheet	22.00	40.20	552	2.010	Deep black
T_3: Sun drying - covering non-transparent polythene sheet	22.00	41.00	551	2.050	Deep black
T_4: Blanching deconned berries for 2 mins & open sun drying	18.30	38.10	542	1.905	Black
T_5: Blanching deconned berries for 5 mins & open sun drying	18.30	38.02	540	1.901	Deep black
S.Em±	1.12	0.33	2.82	0.016	-
C.D @ 5%	3.30	1.01	8.86	0.051	-

Fig 1: Blanching of pepper

Fig 2: Solarization & open drying of pepper

Fig 3: Influence of drying methods on colour of black pepper berries

The colour of dried pepper is a key indicator of pepper quality since buyers prefer black pepper with dark/black colouration. Deep black coloured berries were recorded in treatments were blanching and solarization was adopted. Blanching improves colour, removes dust and adheres microbial contamination giving a hygienic product, while pepper volatiles and other chemical loss are minimum. Blanching activates phenolase enzyme responsible for producing black colour as it ruptures the cells and accelerates the escape of moisture from inner core with the help of resinoids pressure on the berry and simultaneously enhances the black colour (Balasubramanian *et al* 2016) [1]. Since, both the techniques accelerate enzymatic browning and imparts deep black colour.

Conclusion

Even though more time is taken for drying of black pepper in solarization approach it has an advantage of post-harvest operation friendly, no fossil fuel burning and less labour consuming. Finally from the current observational study results it affirms that market preferred quality attributes as well as higher dry recovery in black pepper can be achieved even without blanching. Hence, drying of deconned black pepper berries can be done using solarization procedure on the first day, subsequently open drying facilities export market preferred colour preferences.

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