



Effect of Different Methods of Drying on Appearance and Quality of Black Pepper

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Abstract Black pepper is also known as black gold, since this has been traded like gold during the dawn of colonialization. The produce fetches higher price in the market based on its colour, lustre as well as bulk density. Sun-drying is the common method of drying, and due to direct exposure to sunlight, characteristic shiny black colour is deteriorated. Blanching is one of the techniques to retain the colour of dried produce. But this process is time-consuming and requires extra labour and large amount of firewood. In order to find an alternative easier method to retain black colour of berries without affecting the quality parameters, an experiment was conducted with 7 treatments, viz. direct sun-drying, hot water blanching for 1 min, hot water blanching for 2 min, covering with 100- and 300-gauge polythene sheets for 3 and 5 h. Among the different treatments, covering the berries with 100-gauge polythene sheet for 3 or 5 h and subsequent drying under direct sunlight not only retained black colour of dried produce with higher dry recovery (39.31 and 39.39%, respectively) but also did not alter the quality parameters, viz. essential oil (EO) content (2.64 and 2.56%, respectively) and oleoresin content (6.75 and 6.45%, respectively) as compared to conventional sun-drying where the dry recovery percentage was 37.98% with 2.69% of essential oil and 6.96% of oleoresin content.

Keywords Blanching · Essential oil · Piperine · Polythene · Hot water

Black pepper (*Piper nigrum* L.) known as king of spices or black gold is one of the oldest known spice that belongs to the family Piperaceae. It is native to Western Ghats region, and the economic part of this plant is dried berries [12]. Black pepper is valued for its dried berries, which undergoes post-harvest processes, viz. threshing, drying, cleaning, grading, packing and storage. Among these processes, drying decides the quality of black pepper, where there will be enzymatic phenolic oxidation, which leads to blackening of pepper pericarp [3]. Traditionally, black pepper is dried by sun-drying, and in the recent past solar driers and electrical driers are developed by research institutions. Conventional sun-drying takes 4–7 days to bring moisture content below 10%, and improper drying may lead to mould growth and aflatoxin contamination [6]. In view of this, an innovative technique was developed by Central Food Technology Research Institute (CFTRI), Mysore, which involves dipping of cleaned green berries in boiling water for one minute. This blanching technique accelerates drying, imparts dark glossy black colour and reduces microbial contamination [4, 8, 9, 11, 14].

Colour, lustre, pungency and flavour influence the quality of black pepper. Pungency of pepper is due to the presence of alkaloid piperine, whereas flavour is attributed to the presence of essential oil (EO). Oleoresin concentrate extracted from the produce contains both pungency and flavour compounds [10].

Though there are many methods of drying, farmers still follow traditional sun-drying method. This is mainly because blanching is cumbersome, which requires skill and firewood, whereas in case of solar driers, cost involved in installation and maintenance is high. Alternatively, farmers need an effective drying method to save labour, cost as well as time to get good appearance and quality black pepper. Thus, the present study was undertaken with an objective to find

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Table 1 Influence of different drying methods on dry recovery, bulk density and quality parameters of black pepper

Treatments	Dry recovery (%)	Bulk density (g/l)	Essential oil (%)	Oleoresin (%)	Piperine (%)
T ₁ –Control	37.98 ^b	653.32	2.69 ^a	6.96 ^a	3.47
T ₂ –Blanching 1 min	38.14 ^b	644.67	2.35 ^b	6.30 ^c	3.36
T ₃ –Blanching 2 min	39.15 ^a	639.26	2.31 ^b	6.45 ^{bc}	3.37
T ₄ –Polythene 300 gauge 3 h	38.16 ^b	638.81	2.37 ^b	6.48 ^{bc}	3.35
T ₅ –Polythene 300 gauge 5 h	37.80 ^b	640.32	2.20 ^b	6.41 ^{bc}	3.19
T ₆ –Polythene 100 gauge 3 h	39.31 ^a	636.33	2.64 ^a	6.75 ^{ab}	3.35
T ₇ –Polythene 100 gauge 5 h	39.39 ^a	635.32	2.56 ^a	6.45 ^{bc}	3.23
Mean	38.56	641.15	2.46	6.55	3.33
CV (%)	0.60	1.24	3.46	3.06	3.33
CD (0.05)	0.41	NS	0.152	0.357	NS
Range	37.80–39.39	635.32–653.32	2.20–2.69	6.30–6.96	3.19–3.37

suitable method of drying to get good appearance of black pepper without deteriorating the quality parameters.

An experiment was conducted at ICAR-Indian Institute of Spices Research, Regional Station, Appangala, Madikeri, during 2021 and 2022. The experiment was laid out in RCBD with 7 treatments replicated 3 times. Black pepper variety used in the experiment was IISR Thevam. Mature spikes were harvested from the vine, and the berries were separated by using thresher/deconning machine. In T₁, berries were sun-dried directly as traditional way. In T₂ and T₃, fresh berries were dipped/blanched in hot/boiling water (80–100 °C) for 1 and 2 min, respectively. In T₄ and T₅, fresh berries were spread in a tray and covered with 300 gauge polythene sheet for 3 and 5 h, respectively, on the first day, whereas in case of T₆ and T₇, berries were covered with 100-gauge polythene sheet for 3 and 5 h, respectively, on the first day. In the polythene covering treatments after specified time of covering polythene sheet was removed and berries were dried directly under sunlight. In all the treatments, berries were dried for 4–6 days until constant weight was recorded.

Dry weight of the berries is recorded, and dry recovery is estimated

$$\text{Dry recovery (\%)} = \frac{\text{Dry weight of berries}}{\text{Fresh weight of berries}} \times 100$$

Bulk density (g/l) is measured as weight by volume of the sample. Piperine estimation was carried out as per [2], EO content was estimated using the AOAC method [1] and extraction of oleoresin was done using acetone as solvent in gravimetric method.

Among five characters studied, a statistical significance was observed for three characters, viz. dry recovery, essential oil, and oleoresin, and for bulk density and piperine there was no statistical significance between the treatments.

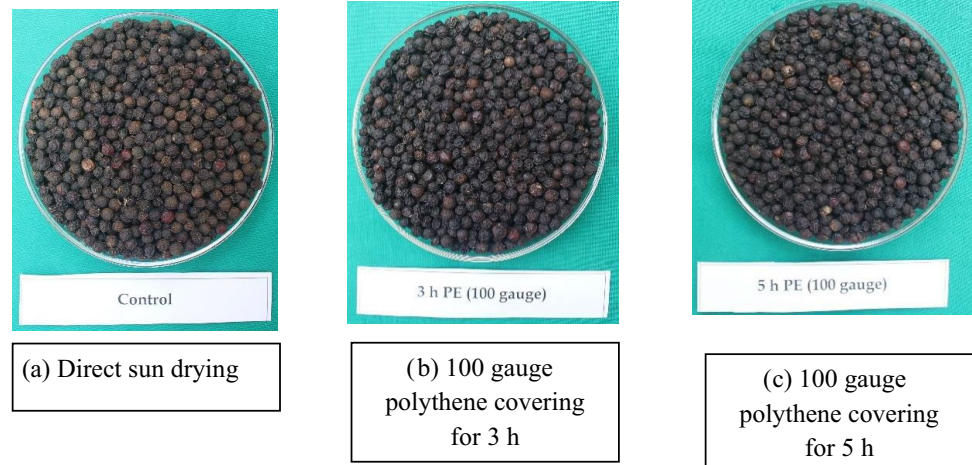
Among the different methods of drying, dry recovery percentage ranged from 37.80 to 39.39% and the highest

dry recovery percentage was recorded in the berries covered with 100 gauge polythene for 5 h (39.39%) and in the berries covered with 100 gauge polythene for 3 h as well as in the berries blanched in hot water for 2 min (39.15%) (Table 1). Polythene-covered and blanched berries took 4 days, whereas direct sun-dried berries took 6 days to reach constant weight. Similar results were reported by Ganapathi et al. [5], where the dry recovery was higher in the berries processed between 200-gauge polythene sheets for 2–3 h.

Essential oil content in different treatments ranged from 2.20 to 2.69%. There was not much variation in the essential oil content in the control (not blanched) and in the berries covered with 100-gauge polythene for 3 and 5 h. But there was reduction in the essential oil content in the berries, which are blanched in hot water and also in the berries covered with 300-gauge polythene. Jacob et al. [7] reported reduction in volatiles content in the blanched samples. In case of oleoresin content also, there was not much variation in the sun-dried samples (6.96%) and in the berries covered with 100-gauge polythene for 3 h (6.75%). These results are in accordance with Ganapathi et al. [5], where there was no variation in the content of oil and oleoresin in open sun-dried samples and samples dried by covering polythene. Similarly, there was no influence of harvest season, drying methods and drying temperature on piperine content in black pepper and Kampot red pepper [10, 14].

Dark black colour pepper fetches higher price in the market. Blanching the black pepper berries in hot water helps to improve the colour, but prolonged exposure may lead to deactivation of enzymes responsible for browning reaction, which may lead to discoloration of pepper [13]. Paul et al. [11] reported that the black pepper, which were moderately blanched for about 1–3 min, was preferred by consumers due to its uniform shiny black colour. In contrast, black pepper that is blanched for long duration was not preferred by consumers due to its deteriorated colour. In this present investigation, covering black pepper with polythene sheets helps

Fig. 1 Dried black pepper berries: **a** direct sun-drying; **b** 100-gauge polythene covering for 3 h; **c** 100-gauge polythene covering for 5 h



to get attractive black colour end-product compared to the direct sun-dried produce (Fig. 1).

Drying the black pepper berries by covering with polythene sheet will accelerate uniform drying and imparts dark black colour to the dried produce without affecting the dry recovery, essential oil, oleoresin and piperine content compared to the conventional method of direct sun-drying. So, covering the despiked black pepper berries with 100-gauge polythene sheet for first 3 or 5 h under good sunlight and subsequent drying under direct sunlight for 3–4 days will help in obtaining dark black colour produce with higher dry recovery and without affecting the quality parameters.

Declarations

Conflict of interest Authors declare that they have no conflict of interest.

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