Journal of Spices and Aromatic Crops
Vol. 16 (1) : 31–37 (2007)
Indian Society for Spices

Processing of vanilla (*Vanilla planifolia* Andrews) beans - Influence of storing fresh beans, killing temperature and duration of killing on quality parameters

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Received 19 July 2006; Revised 31 January 2007; Accepted 6 February 2007

Abstract

Experiments were conducted at Myladumpara (Kerala) to study the effect of storing fresh vanilla (*Vanilla planifolia*) beans before killing, killing temperature and duration of killing and further curing on quality parameters. The study indicated that storing of fresh beans for a maximum of 3 days after harvest and before killing is advisable and the vanillin content of such beans was the highest (2.51%) when compared to longer duration of storage. Killing of beans in hot water maintained at 65°C for 3 min or at 63°C for 5 min was on par. Immediate wrapping of killed beans with woollen cloth and storing in sweating box was the ideal method for obtaining optimum weight and vanillin content of beans. A higher percentage of beans (71 to 84) became ready for conditioning within 15 days of slow drying by this method. Interactions of killing temperature and exposing beans either directly or the next day as well as killing temperature and duration of killing were significant.

Keywords: processing, vanilla, *Vanilla planifolia,* vanillin content.

Introduction

The fruit (bean) of the climbing orchid *Vanilla planifolia* Andrews is used for the production of vanillin and other flavour compounds. Fresh vanilla beans lack the characteristic vanilla flavour. However, they contain aroma precursors and in order to produce the distinctive flavour of vanilla, the beans are to be cured, a process, which has been defined as controlled ripening. According to Theodose (1973) the total duration of curing vanilla beans can be from 3 to 6 months. The two main traditional methods of curing employed are those of Mexico and the Indian Ocean Islands producing 'Bourbon' vanilla. Though the curing process adopted varies among vanilla growing countries (Ranadive 1994), all curing methods involve the following four phases that directly affect the amount of vanillin and other flavour components in the beans: 1) wilting or killing of beans to stop their vegetative phase and to allow the onset of enzymatic reactions, 2) sweating, which involves dehydration and slow fermentation to develop key flavor components, 3) drying the beans slowly to a final moisture level of about 20% to 25%, and 4) conditioning, an aging process necessary

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for flavour development that involves placing the dried beans in closed boxes for several months.

The "Bourbon" process, currently practiced in Madagascar, Comoros and Reunion produces the best quality vanilla beans. The harvesting period in Madagascar is from June to September and in Mexico from November to January and often coinciding with the rainy season (Purseglove *et al.* 1988). As the period of harvesting and processing in India is different, it is necessary that required modifications are adopted for the curing methods to be followed to produce high quality vanilla beans. Hence, various studies on curing vanilla beans were taken up at the Indian Cardamom Research Institute (ICRI), Myladumpara (Kerala), from 1998 to 2001.

Materials and methods

Experiment I: Effect of storing fresh beans before killing and curing

Pollination of flowers in the vanillary maintained at ICRI was carried out during the flowering seasons of 1997 and 1998. Only 10 beans were maintained in each bunch to produce 'A' grade beans measuring more than 15 cm at the time of harvest. Harvesting of beans was done in the morning and the blossom-end turning slight yellow was taken as the correct stage of harvest and after harvest they were stored in cement floor in the corner of a room. Thirty beans each were collected from four replications at random on each day from the first day to eighth day of storage and the initial weight of beans was taken on each day. The beans were taken in a bamboo basket and killed by dipping in hot water maintained at 63ºC for 5 min. The basket was then taken out and the water was drained off. Later all the killed beans were subsequently wrapped separately in woollen cloth and kept in a sweating box lined with the same cloth overnight. The bundles were taken out the next day morning, observed for colour change and placed on a raised platform, 1 m from ground and exposed to sunlight for 1½ h from 10 am onwards. The beans were bundled and kept outside for 30 min after which it was kept in the sweating box. This process of sunning and sweating was repeated for 7 days till the beans became ready for slow drying as indicated by suppleness and reduction in weight. The weight of beans at the end of sweating period was recorded. After sweating was completed, the beans were taken for further curing such as slow drying and conditioning, the total duration of which lasted for 3 months. The beans were analysed for moisture and vanillin contents at Quality Evaluation Laboratory, Spices Board, Kochi.

Experiment II: Effect of killing temperature and duration of dipping and curing through sunning and sweating

The beans were stored for a day by heaping in a room. Fifty beans were used for the study with four replications in a three factorial design. Fresh weight of the beans was recorded. These beans were taken in a bamboo basket and killed by dipping fully for 3 min or 5 min in hot water of different temperatures (60°C, 63°C, 65°C and 70°C). After killing, the beans were taken out for draining of water and wiped, if necessary. Fifty per cent of beans were wrapped separately using woollen cloth and stored for one day in an airtight sweating box lined with the same kind of cloth. The remaining batches of beans were directly exposed to sun at 10 am on the same day of killing by spreading them on a woollen cloth in a raised platform, 1 m from ground for 1½ h. These were then wrapped and kept as such for another 30 min and later kept in another sweating box. Both the boxes were opened the next day morning at 10 am, bundles of beans taken out, observed for colour change and exposed to sunlight as mentioned above. At the end of sweating period, the beans were taken further for slow drying by spreading on wooden racks arranged in a room maintained at a relative humidity of 70%. Properly slow dried beans were picked up at different days as and when they became ready for conditioning based on pliability and suppleness. The beans after slow drying were conditioned by packing them in sealed

polypropylene bags and keeping in airtight boxes for 2½ months and after which the moisture and vanillin contents were determined at Quality Evaluation Laboratory, Spices Board, Kochi.

Results and discussion

The results of Experiment I indicated that storing vanilla beans for a maximum of 3 days after harvest before killing (without any splitting of beans at the blossom end) is advisable. Beans stored up to a maximum of 3 days and killed later and kept in sweating box became chocolate brown in colour indicating that the enzymatic reaction has been initiated. When the storage period increased from 0 to 8 days, the time taken for sunning and sweating decreased from 9 to 4 days and the split beans increased from 0% to 9.2%. Beans split at blossom-end are considered to be of inferior quality. As the storage period increased from 0 to 3 days, the loss of moisture from beans ranged from 61% to 64% at the end of sweating period indicating that the reduction of moisture content was at an optimum level during the sunning and sweating stage. When the period of storage further increased from 4 to 8 days, the decrease in moisture content was less, ranging from 58% to 61% at the end of sweating period on account of lower fresh weight of beans due to prolonged initial storing (Table 1). Storage of beans before hot water killing significantly influenced both moisture and vanillin content (Table 2). The highest vanillin content of 2.51% was obtained in beans stored up to 3 days after harvest (before killing). There was considerable reduction in vanillin content in beans stored after harvest beyond this period. In Mexico, vanilla beans are stored in sheds after harvest for a few days until they begin to shrivel and curing is done later (Correll 1953). In Seychelles, vanilla beans harvested in the morning are cured in the afternoon of the same day or at the latest by next day to avoid splitting (Lionnet 1959). In the present study, while curing, splitting was noticed in

Table1. Influence of storing vanilla beans after harvest on quality

Days after harvest*	Initial wt. of beans at harvest*	Condition of beans after storing in sweating box for 24 h	Final wt. of beans after sweating (g)	Days taken for sweating
0	570	90% beans chocolate brown, 10% green brown, no splitting	225 (61)	9
1	570	100% beans chocolate brown, no splitting	230 (60)	8
2	560	100% beans chocolate brown, no splitting	200 (64)	7
3	540	100% beans chocolate brown, no splitting	200 (63)	7
4	535	2.5% of beans showing slight splitting, all beans chocolate brown	209 (61)	6
5	535	3.3% of beans showing slight splitting, all beans chocolate brown	215 (60)	6
6	535	3.8% of beans showing slight splitting, all beans chocolate brown	220 (59)	5
7	525	7.5% of beans showing slight splitting, all beans chocolate brown	215 (59)	5
8	500	9.2% of beans showing slight splitting, all beans chocolate brown	210 (58)	4

Figures in parenthesis are percentage reduction in weight of beans; * Mean of two years and four replications

beans stored beyond a period of 3 days. It could be concluded that beans may be stored only up to 3 days after harvest before killing for obtaining good quality cured beans.

The results of Experiment II revealed that killing of beans by dipping them in hot water maintained at 65°C for 3 min or 5 min at 63°C was ideal as shown by change of colour in beans from dark green to chocolate brown (Table 3). Jones & Vicente (1949) observed that among the various methods employed for killing the beans, hot water treatment gave the best product, freezing second, and scratching third. Lionnet (1959) found that a few hours after killing, the beans turn to the characteristic chocolate brown colour, which is indicative of successful killing. He also reported that beans are to be wrapped or covered immediately after killing so as to conserve heat and moisture, which are essential for the fermentation process (sweating).

The procedure of immediate wrapping of killed beans with woollen cloth and storing in sweating box was the ideal method for getting properly killed and sweated beans with optimum weight (50% to 51% reduction in initial weight) (Table 4). Wilfred *et al.* (2001) also reported similar results.

The total duration of slow drying was 3 weeks in both the cases of sweating/sunning (Table 5). The percentage of beans that became ready for conditioning after slow drying for 15 days ranged from 60 to 64 in the case of killing by dipping for 3 min or 5 min in hot water of 60°C, whereas, higher percentage of beans (71% to 84%) became ready for conditioning within the same period when the beans were killed by dipping in hot water maintained at 63°C or 65°C for 5 min. Though further increase in percentage of beans becoming ready for conditioning within a period of 15 days was noticed when the hot water temperature was maintained at 70°C and dipping done for 3 min or 5 min, the beans lost more moisture while slow drying and became somewhat brittle thereby reducing the quality.

Table 2. Moisture and vanillin contents of vanilla beans killed after different periods of storage

Storage period (days after harvest)	Moisture content (%)	Vanillin content (%)
0	30.0	2.45
1	28.0	2.49
2	27.0	2.49
3	26.0	2.51
4	26.0	2.19
5	24.0	2.09
6	21.3	2.08
7	19.0	2.10
8	18.7	1.87
CD (P=0.05)	4.2	0.07

Table 3. Influence of temperature of hot water and duration of dipping for killing vanilla beans

Killing temp. (°C)/Time (min)	Condition of beans exposed directly to sunlight after killing*	Condition of beans wrapped in woollen cloth and kept inside sweating box after killing*
60/3	Only 10% of beans brown	All beans green brown
60/5	All beans with irregular patches of green and brown	75% of beans brown
63/3	80% of beans brown	All beans brown
63/5	All beans light chocolate brown	All beans chocolate brown
65/3	90% of beans brown	All beans chocolate brown
65/5	90% of beans brown	All beans chocolate brown
70/3	All beans brown	All beans chocolate brown
70/5	All beans brown	All beans chocolate brown

Means of four replications; *Observations recorded 24 h after killing

Table 4. Initial and final weight of vanilla beans at the end of sweating and moisture loss

Killing temp. (°C)/Time (min)	Beans exposed directly to sunlight after killing			Beans wrapped in woollen cloth and kept in sweating box after killing		
	Initial wt. (before killing) (g)	Final wt. (g)	Reduction in wt. (%)	Initial wt. (before killing) (g)	Final wt. (g)	Reduction in wt. (%)
60/3	420	230	45	390	221	43
60/5	405	230	43	375	195	48
63/3	425	233	43	425	228	46
63/5	385	214	45	388	190	51
65/3	400	233	42	413	205	50
65/5	375	203	46	413	200	52
70/3	380	192	50	395	214	46
70/5	388	188	52	400	185	54

Means of four replications

According to Ranadive (1994), the drying stage is apparently critical to the preservation of flavour quality, but prolonged drying may lead to loss of flavour and vanillin contents. Frenkel *et al.* (2004) opined that as flavour precursors and enzymes, which degrade them into flavour compounds are present in different fruit regions, in order to create contact between flavour substrates and enzymes, it is necessary to disorganize the bean tissue through proper killing of the beans. The results from the present study indicated that dipping in hot water of temperature of 63°C or 65°C for 5 min or 3 min, respectively, is optimum. Immediate wrapping of beans in woollen cloth after dipping was also found to be the ideal method.

Analysis of moisture and vanillin contents showed that all the factors significantly

Table 5. Number of vanilla beans available after different periods of slow drying

Killing temp. (°C)/ Time (min.)	Beans exposed directly to sunlight after dipping in hot water					Beans wrapped in woollen cloth after dipping in hot water and kept in sweating box				
	(Days of slow drying)					(Days of slow drying)				
	10	12	15	18	21	10	12	15	18	21
60/3	-	30	32	18	20	-	34	26	25	15
60/5	-	33	31	20	16	-	35	28	25	12
63/3	-	33	38	13	16	-	33	39	9	9
63/5	-	46	32	15	7	-	42	42	10	6
65/3	-	44	35	17	4	-	39	39	14	8
65/5	-	45	31	15	9	-	52	32	16	-
70/3	-	52	37	8	3	-	61	30	7	2
70/5	80	20	-	-	-	87	13	-	-	-

Table 6. Effect of killing temperature and time on moisture and vanillins contents of vanilla beans

Killing temp. (°C)/ Time (min.)	Beans exposed directly to sunlight after dipping in hot water		Beans wrapped in woollen cloth after dipping in hot water and kept in sweating box	
	Moisture content (%)	Vanillin content (%)	Moisture content (%)	Vanillin content (%)
60/3	29.40	1.60	32.15	1.82
60/5	28.35	1.65	30.06	2.08
63/3	27.63	1.67	29.75	2.38
63/5	26.35	2.02	28.24	2.71
65/3	26.00	2.29	28.07	2.53
65/5	25.75	1.83	25.72	2.32
70/3	24.40	1.86	24.85	2.18
70/5	22.07	1.69	22.35	1.94

Mean values (Moisture content)

A1=26.24	A2=27.65			CD (P=0.05)=0.573
B1=29.99	B2=27.99	B3=26.39	B4=23.42	CD (P=0.05)=0.810
C1=27.78	C2=26.11			CD (P=0.05)=0.573

Mean values (Vanillin content)

A1=1.83	A2=2.24			CD (P=0.05)=0.096
B1=1.79	B2=2.19	B3=2.24	B4=1.92	CD (P=0.05)=0.136
C1=2.04	C2=2.03			CD (P=0.05)=NS

CD (P=0.05) for A x B & B x C interactions =0.193

A= Exposing beans either directly or on the next day; B=Killing temperature; C= Duration of killing

influenced these parameters of conditioned beans except duration of killing for vanillin content (Table 6). Wrapping in woollen cloth after dipping in hot water and keeping in the sweating box produced beans with moisture and vanillin contents of 27.65% and 2.24%, respectively. Douglas (1971) opined that in order to induce fermentation, the beans after killing are to be rolled up in blankets and put in closed boxes, and exposed daily for an hour or two in sunshine and this process may be repeated for 2 to 3 weeks or more when the pods will have become dry, brown and pliable. Though killing at 60°C gave beans with the highest moisture content of 29.99%, the vanillin content was the highest (2.24%) when the temperature of hot water was maintained at 65°C.

According to Odoux (2000) the hydrolysis of glucovanillin occurs during the initial thermal steps of killing-sweating processes. Killing of beans by dipping in hot water for 3 min was ideal for obtaining a higher moisture content (27.78%). Interactions of killing temperature and exposing beans either directly or the next day as well as killing temperature and duration of killing were significant. Killing beans by dipping in hot water kept at 63°C or 65°C and wrapping in woolen cloth and storing in sweating box were on par and gave vanillin contents of 2.54% and 2.43%, respectively. Similarly, killing beans by dipping in hot water kept at 63°min or 65°C either for 3 or 5 min were on par and gave vanillin contents of 2.47% and 2.37% respectively. In vanilla, the principal compounds of flavours are present in the form of glycosides and their hydrolysis by one or more glucosidases intervenes mainly during the killing process. The hydrolysis of this precursor by the endogenous β-glucosidase allows the formation of vanillin and glucose. Thus, hot water killing supports the establishment of contact between various substrates with their enzymes. Adedeji *et al.* (1993) and Frenkel *et al.* (2004) suggested that the purpose of the curing process is to create contact between flavour precursors and the enzymes that catalyse the hydrolysis of precursor compounds to vanillin and other flavour compounds.

Acknowledgements

The senior author wishes to place on record the deep sense of gratitude to Dr C K George, Executive Director (Retired), Spices Board, Kochi, for the encouragement given during the course of the experiment. The guidance given by Dr K J Madhusoodanan, Project Officer, DBT project on vanilla, and the help provided by Sri B A Vadiraj, Scientist (Soil Science), ICRI, Myladumpara, are also thankfully acknowledged. The authors are also thankful to Dr C R Sivadas, Senior Scientist (Retired), Quality Evaluation Laboratory, Spices Board, Kochi, for the analysis of vanilla beans and Dr J Thomas, Director, ICRI, Myladumpara, for permitting to publish the results.

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