

Influence of curing procedures on sensory quality of vanilla beans

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Abstract — Introduction. During maturation, vanillin is accumulated in green vanilla beans as glucovanillin; it is hydrolyzed to free vanillin by endogenous glucosidases during curing and gives the characteristic flavor of vanilla. The objective of our study was to investigate methods of curing that could greatly reduce the time to complete the process and yield cured beans that retain high concentrations of vanillin and other flavor compounds with high sensory quality rating. **Materials and methods.** Mature green beans were obtained from a commercial grower (Cairns, Queensland, Australia). One batch of beans was continuously sweated at 35 °C at high relative humidity (RH) for 12 d. Two further batches were blanched in water at 67 °C for 3 min, and then sweated at 45 °C at high RH for 4 d or at 35 °C for 5 d. The beans were sweated until they turned brown. Three methods of drying were evaluated: a heat pump dryer at 40 °C and RH 15%, tunnel dryer at 60 °C and RH 20%, and tunnel dryer at 60 °C and RH 10%. Vanillin was extracted from powdered samples of beans with n-pentane and dichloromethane (1:1 v/v) and assayed by HPLC. Glucovanillin was measured as total vanillin after acid hydrolysis of powdered samples of beans. **Results and discussion.** About 90% of the glucovanillin was converted to vanillin in non-blanched beans continuously sweated at 35 °C, but there was only 70% conversion in beans blanched at 67 °C for 3 min and sweated at 45 °C for 4 d or at 35 °C for 5 d. The sensory quality of cured beans was assessed by untrained panelists. Profiling showed that the beans sweated continuously at 35 °C had superior aroma compared with beans blanched in hot water and sweated at 45 °C or at 35 °C but the appearance of non-blanched beans was less attractive. **Conclusion.** The study revealed that a mild hot water blanching treatment followed by sweating at 35–45 °C and rapid drying is required to produce cured beans with excellent appearance and attractive aroma.

Australia / Vanilla planifolia / vanilla (spice)/ vanillin / processing / food technology / hot air drying / quality controls / organoleptic analysis

Influence des méthodes de préparation des gousses de vanille sur leur qualité sensorielle.

Résumé — Introduction. Au cours de la maturation, la vanilline est accumulée dans les gousses de vanille verte sous forme de glucovanilline ; elle est hydrolysée en vanilline par des glucosidases endogènes pendant le processus de préparation et donne la saveur caractéristique de la vanille. L'objectif de notre étude a été d'étudier des méthodes de préparation de la vanille qui pourraient réduire considérablement le temps du déroulement du processus et produire des gousses à fortes concentrations de vanilline et autres composés d'arôme avec de hautes qualités sensorielles. **Matériel et méthodes.** Des gousses de vanille mûres ont été obtenues chez un producteur commercial (Cairns, Queensland, Australie). Un lot de gousses a été continuellement étuvé à 35 °C et à une humidité relative (HR) élevée pendant 12 j. Deux autres lots ont été blanchis dans l'eau à 67 °C pendant 3 min, puis étuvés à 45 °C avec une HR élevée pendant 4 j ou à 35 °C pendant 5 j. Les gousses ont été étuvées jusqu'à ce qu'elles brunissent. Trois méthodes de séchage ont été évaluées : à l'aide d'une pompe à chaleur sèche à 40 °C et 15 % HR, d'un tunnel de séchage à 60 °C et 20 % HR, et d'un tunnel de séchage à 60 °C et 10 % d'HR. La vanilline a été extraite avec du n-pentane et du dichlorométhane (1:1 v/v) et dosée par HPLC, à partir d'échantillons de poudre obtenue des gousses traitées. La glucovanilline a été mesurée par le taux de vanilline totale obtenue après hydrolyse acide des échantillons de poudre. **Résultats et discussion.** Environ 90 % de la glucovanilline ont été convertis en vanilline dans les gousses non blanchies et continuellement étuvées à 35 °C mais il y a eu seulement 70 % de conversion dans les gousses blanchies à 67 °C pendant 3 min et étuvées à 45 °C pendant 4 j ou à 35 °C pendant 5 j. La qualité sensorielle des gousses traitées a été évaluée par des panélistes inexpérimentés. Leur analyse a montré que les gousses étuvées continuellement à 35 °C avaient un arôme supérieur à celui des gousses blanchies dans l'eau chaude et étuvées à 45 °C ou à 35 °C, mais l'apparence des gousses non blanchies était moins attrayante. **Conclusion.** L'étude a révélé qu'un traitement modéré de blanchiment à l'eau chaude, suivi par un étuvage à 35–45 °C et un séchage rapide était nécessaire pour obtenir des gousses préparées ayant un très bel aspect et un arôme intéressant.

Australie / Vanilla planifolia / vanille / vanilline / traitement / technologie alimentaire / séchage par air chaud / contrôle de qualité / analyse organoleptique

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RESUMEN ESPAÑOL, p. 399

1. Introduction

Vanilla (*Vanilla planifolia*, Andrews.) is a climbing orchid indigenous to Mexico [1]. The distinctive flavor and aroma of cured beans is derived mainly from the phenolic compound, vanillin, plus other aromatic compounds that comprise less than 2% of the fresh weight of vanilla beans. Green, mature vanilla beans contain glycosyl precursors of these aroma compounds, of which fifteen have been identified [2, 3]. The most important flavor precursor is glucovanillin, which accumulates in the fruit from approximately (15 to 30) weeks after pollination when the beans are mature [4–6]. The distribution of glucovanillin and β -glucosidase activity in bean tissue is a contentious subject [7]. Joel et al. showed that the enzymes involved in vanillin biosynthesis are present in the secretory tissue that is composed of closely-packed, unicellular hairs, located between the placentae along the central fruit cavity [8]. Odoux et al. showed that glucovanillin and β -glucosidase activity are present in the central placental tissue of the fruit [9]. More recently, Odoux and Brillouet confirmed that more than 90% of the stored glucovanillin is located in the placentae [10].

Mature green pods generate their characteristic flavor or aroma and turn brown when they are cured. The purpose of the curing process is to bring together the flavor precursors and the enzymes that catalyze the hydrolysis of these compounds to flavor products [11]. The traditional curing process consists of four major stages: killing, sweating, drying and conditioning, during which glucosidases are released that hydrolyze glucovanillin and other substrates to release the aroma compounds. All four stages are important, but the killing stage is the most important [12]. Killing stops further physiological activity and promotes cell disorganization which, in turn, causes a mixing of flavor and aroma precursors with their respective enzymes [13]. The most common killing methods involve exposure to sunlight, the use of a controlled temperature oven or hot water [14]. The traditional curing process can take 5 weeks to 5 months depending on the production region and processes used [11].

In the last century, many studies were devoted to the determination of conditions for producing good-quality, cured vanilla beans [15–17], isolation of aroma glucosides responsible for vanilla flavor production [18, 19] and assaying the activity of enzymes that are involved in the production of flavor compounds [11, 17–22]. The aim of our study was to examine methods for optimizing the curing and drying of vanilla beans and to assess the effects of these methods on the sensory quality of cured beans. The study evaluated different combinations of curing times, curing temperatures and drying methods, including a comparison of blanched and non-blanched beans.

2. Materials and methods

2.1. Plant materials and treatments

Mature green vanilla beans were supplied by a commercial grower from Cairns, Queensland, Australia. The beans were harvested on 1 September, 2006, and sent by air to the Postharvest Laboratory at the University of Western Sydney (Hawkesbury Campus), New South Wales. Any beans showing browning or splitting at the blossom end were trimmed with a sharp knife to remove the damaged tissue. The beans were graded into nine matching groups of 30 beans plus one group of 6 beans that served as an unprocessed control. The initial fresh mass of each bean was recorded and the dry matter of fresh beans (18–20% FW) was determined by drying to constant weight using a microwave oven.

2.2. Blanching, curing and sweating methods

Three groups of 30 non-blanched green beans were cured by placing them in plastic bags in an incubator at 35 °C for 12 days. The beans were examined daily until all beans turned dark brown. Generally, this browning started at the blossom end of the beans. Six groups of 30 green beans were blanched by immersion in tap water maintained at 67 °C for 3 min. After blanching, the beans were enclosed in polyethylene

bags and transferred to incubators. Three groups of beans were incubated (sweated) at 45 °C for 4 days and the remaining three groups were sweated at 35 °C for 5 days. Sweating was terminated when all beans turned dark brown. The processed beans were stored at –20 °C until drying. The weight of individual beans was recorded on arrival at the laboratory, after sweating and following drying.

2.3. Drying methods

The nine groups (figure 1) of frozen beans were transported in an insulated container to the University of New South Wales, Department of Food Science and Technology, for drying. One group of beans from each curing treatment was partially dried to about 45% of their fresh weight (dry matter 40–44%) using one of two methods of drying. The first used a heat pump dryer, in which the beans were placed in single layers on trays in the dryer. The beans that were blanched at (45 or 35) °C were dried at 40 °C and RH 15% for 5 days, and non-blanched beans that were cured at 35 °C were dried at 40 °C and RH 15 % for 10 days. The second method of drying used a tunnel dryer, in which groups of beans were placed in single layers on trays and dried at 60 °C at either 20% or 10% RH for 2 days. At the end of the drying period, the nine groups of beans were sealed separately in glass jars fitted with screw lids. The dried beans were stored at 20 °C pending further analyses.

2.4. Extraction of vanillin

The beans were sampled for vanillin content at the green stage, at the end of sweating and at the end of drying. Six representative beans from each stage of the curing and drying treatment were stored at –80 °C pending analysis. Beans were cut into pieces approximately 20 mm long, frozen in liquid N₂ and milled to a fine powder using a domestic coffee blender. This powder was allowed to warm to room temperature. Standard practice was to suspend a sample (200 mg) of powder in 10 mL distilled water and to stir for 10 min at lab temperature 22 °C (pH 5.1) before solvent extraction. Each aqueous

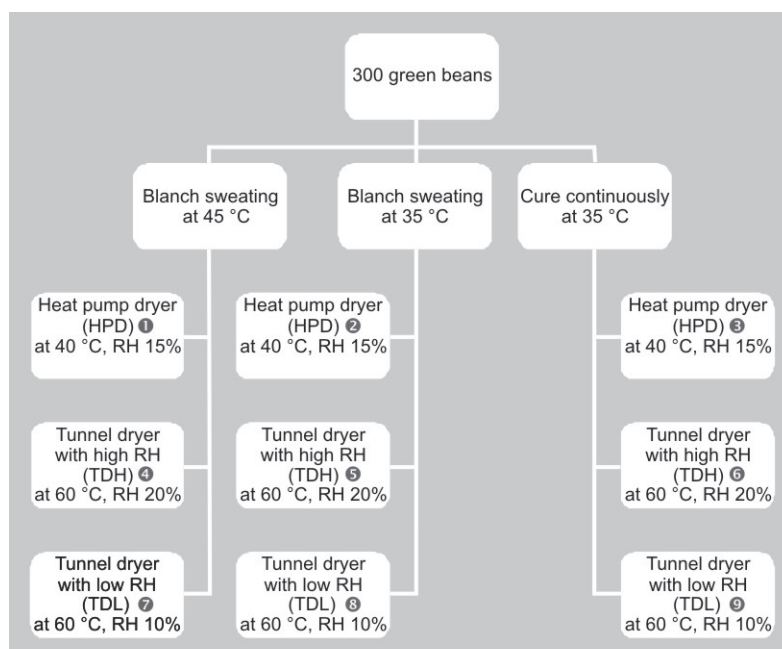
suspension was transferred to a separating funnel, 10 mL of n-pentane and dichloromethane (1:1 v/v) were added to extract the vanillin and the mixture was shaken and allowed to settle. The upper, organic phase was recovered and the remaining aqueous layer was extracted three more times with the n-pentane dichloromethane mixture. The four organic phases were combined, dried over anhydrous Na₂SO₄ and filtered (polyamide: polymer, 6:6). The filtrate was adjusted to 50 mL in a volumetric flask with n-pentane and dichloromethane (1:1 v/v).

A supplementary experiment was conducted to determine whether there was any glucosidase activity in these aqueous suspensions. Powdered samples were suspended in water for up to 120 min before solvent extraction.

2.5. Hydrolysis of glucovanillin

The beans were also assayed for total vanillin content (vanillin obtained after hydrolysis plus free vanillin) when still green and at the end of sweating and drying. Beans for assay were powdered as above and 200 mg of powder suspended in 10 mL distilled water. After addition of 0.5 mL of sulfuric acid (18 M), the suspension was thoroughly mixed and placed in a steam bath at 60 °C

Figure 1. Plan of the experiment done for studying the influence of curing procedures on sensory quality of vanilla beans.



for 3 h. The mixture was cooled to room temperature and 1 mL KOH (9.4 M) was added to neutralize the mixture. The resulting aqueous mixture was extracted as outlined above.

2.6. Determination of vanillin

Vanillin (12.1 mg) (Aldrich Chemical Company, 99%) was dissolved in 10 mL of HPLC grade n-pentane and dichloromethane (1:1 v/v). The solution was transferred into a 100-mL volumetric flask and diluted to the mark with n-pentane and dichloromethane (1:1 v/v). This standard contained $121 \mu\text{g}\cdot\text{L}^{-1}$ vanillin. Five mL of the vanilla extract was pipetted into four 10-mL volumetric flasks. Aliquots [(0.0, 1.0, 2.0 and 3.0) mL] of the standard vanillin solution were pipetted into these flasks and the extracts made up to volume with n-pentane and dichloromethane (1:1 v/v). Vanillin was separated from other organic compounds extracted from the powdered vanilla beans by HPLC. The chromatograph used was a Varian 9012 equipped with a 20- μL sample loop, a Varian 9050 variable wavelength UV-visible detector and a reverse-phase C18 column (Gemini 5U C18 110A, 250 mm \times 4.60 mm, Phenomenex, Australia). The mobile phase consisted of 10% water, 10% acetonitrile and 80% methanol. Vanillin was identified by comparison with authentic vanillin at 271 nm. The data for six replicates from the nine treatments were subjected to ANOVA using SPSS (version 12) and the means were separated by the Ryan-Einot-Gabriel-Welsch range test at $P \leq 0.05$.

2.7. Sensory analysis

The aroma and sensory quality of dried cured beans were assessed by 64 untrained panelists. The sensory analysis was conducted by Sensory Solutions Ltd. (Northmead, New South Wales). Each of the nine groups of treated beans was divided into three matched samples of six beans. The three samples from each treatment were required to ensure that enough samples were available to accommodate sessions of up to 25 consumers conducting simultaneous evaluations. Each sample of six beans was enclosed in a 2.5-L amber bottle (Plas-

dene Glass Pack) labeled with a three-digit code for identification about 24 h prior to consumer assessment. In addition, three vanillin reference samples were also enclosed in 1-L amber bottles. A total of ten samples, one bottle of the vanillin reference sample and one bottle from each of the nine treatments, were evaluated by each panelist. The reference sample was tested first, followed by the nine treatment samples, that were presented one at a time in random order to reduce the effects of fatigue and positional bias. The session took 45 min.

At the start of the consumer evaluation session and in between each sample, panelists were asked to sniff tissue paper to provide a neutral odor from which to start each evaluation. The panelists were asked to focus on the odor and answer two types of questions: hedonic (liking) and diagnostic (strength) questions. All questions were answered using a 100-mm unstructured line scale with labeled anchor points at 0 mm and 100 mm. The left hand anchor point labels corresponded to either “dislike extremely” or “very weak”, for the hedonic and diagnostic scales, respectively. The right hand anchor point labels were “like extremely” or “very strong”. The questionnaire for the sensory assessment was divided into three sections: in the first part, the panelists were asked to answer short questions about personal information and usage, and attitudes about vanilla before testing the fragrances. The second section contained three hedonic and diagnostic questions about the reference sample of vanillin. The third section contained a total of 30 hedonic and diagnostic questions that were repeated for each of the nine samples. Within the third section, panelists were asked to smell each of the samples three times over the course of the 30 questions. The initial group of questions asked after the first smell included overall liking of the vanilla fragrance, the strength of the aroma and its sweetness. The next group of questions asked after smelling the beans a second time included the level of liking and strength of aroma described as fruity, floral, cereal, spicy, fermented and acidic. The remaining questions asked after smelling the beans a third time covered the quality of the vanilla odor for usage as a fragrance

or for cooking and an overall liking or disliking of the fragrance they perceived.

The data extracted from the 100-mm line scales were entered into Excel spreadsheets (Microsoft Corporation). The data were subjected to ANOVA using SPSS (version 12, SPSS 2004).

3. Results and discussion

All powdered samples were routinely soaked for 10 min in distilled water before solvent extraction of vanillin. A pilot study showed that prolonged soaking of powdered samples of green beans in distilled water at 22 °C for up to 120 min did not affect the concentrations of free vanillin, indicating that β -glucosidase was inactive under these conditions. The pH of the aqueous suspensions was measured at 5.1. Purified β -glucosidase has been shown to be inactive and unstable below pH 6.5 [23].

The concentrations of free vanillin were low in green beans but increased significantly during curing (figure 2). Percentage conversion of glucovanillin to vanillin was highest in non-blanching beans sweated continuously at 35 °C, and least in beans blanched for 3 min in water at 67 °C followed by sweating at (45 or 35) °C. These data suggest that the mixing of glucovanillin and glucosidases was more efficient in beans sweated continuously at 35 °C, but also that blanching at 67 °C partially reduced glucosidase activity [24]. The latter suggestion was supported by the data for cured beans following drying (figure 3). There was a further much larger increase in the percentage of free vanillin during drying in beans sweated continuously at 35 °C compared with beans that were blanched then sweated at (45 or 35) °C (figure 3). These data highlight the large variation in glucovanillin concentrations among beans. Producing green beans of consistent size and glucovanillin content appears essential for the production of uniform, high-quality cured beans. Although less glucovanillin was hydrolyzed in blanched beans compared with those sweated continuously at 35 °C, their appearance was more attractive. Their color was shiny brown-black

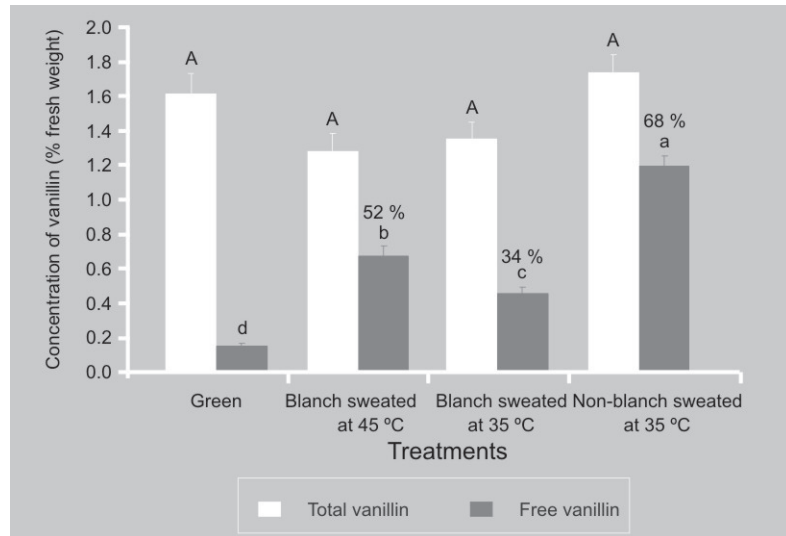


Figure 2.

Total and free vanillin concentrations in green beans and in blanched and non-blanching vanilla beans after sweating. Total vanillin was measured following acid hydrolysis of powdered samples of beans. The inserted numbers show the % conversion from glucovanillin to vanillin. Bars marked by the same letter are not significantly different at $P \leq 0.05$ ($n = 6$).

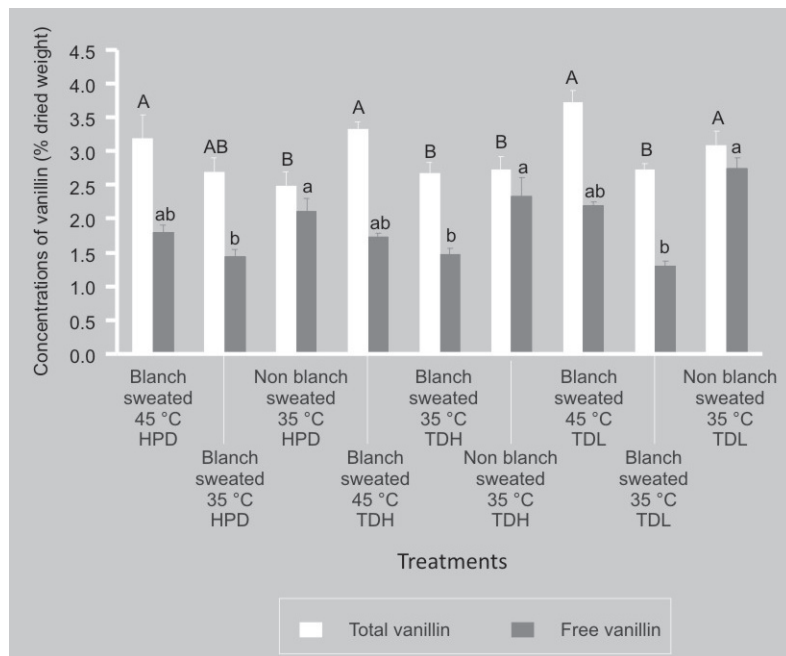


Figure 3.

Concentrations of total and free vanillin in cured vanilla beans at the end of drying stages of each of nine curing treatments. Note that cured beans were dried to an average of 45% of their harvest fresh weight. Bars for each treatment marked by the same letter are not significantly different at $P \leq 0.05$ ($n = 6$). HPD: heat pump dryer, TDH: tunnel dryer with high RH, TDL: tunnel dryer with low RH.

compared with non-blanching beans, which were dull brown. The method of drying appeared not to have had any independent effects on hydrolysis of glucovanillin (figure 3).

3.1. Sensory analysis

Odor profiling showed that beans cured continuously at 35 °C without blanching

had higher concentrations of impact aromas, including those giving vanilla, sweet, floral, fruity and spicy smells compared with beans that were blanched before sweating (figure 4, 5). Beans that were blanched and sweated at 45 °C had the strongest spicy and acidic odors (figure 6). However, beans cured continuously at 35 °C had the highest quality scores for use in cooking or as a fragrance (figure 7).

Figure 4. Comparison of sensory scores of liking of sweet, fruity, floral and spicy odors of vanilla beans cured using nine different processes. Bars marked by the same letter within each quality attribute are not significantly different at $P \leq 0.05$. HPD: heat pump dryer, TDH: tunnel dryer with high RH, TDL: tunnel dryer with low RH.

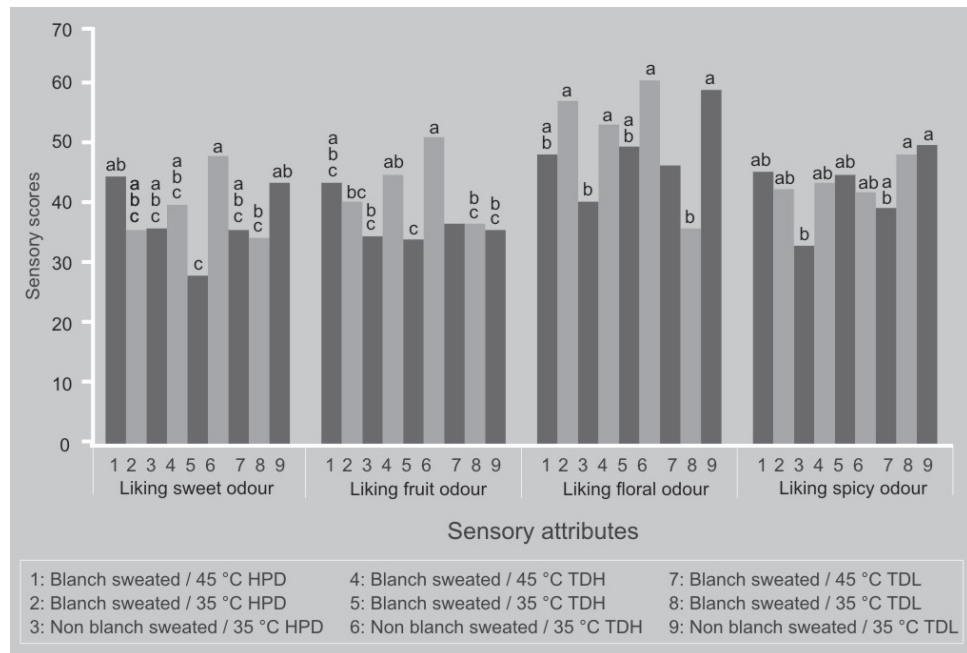
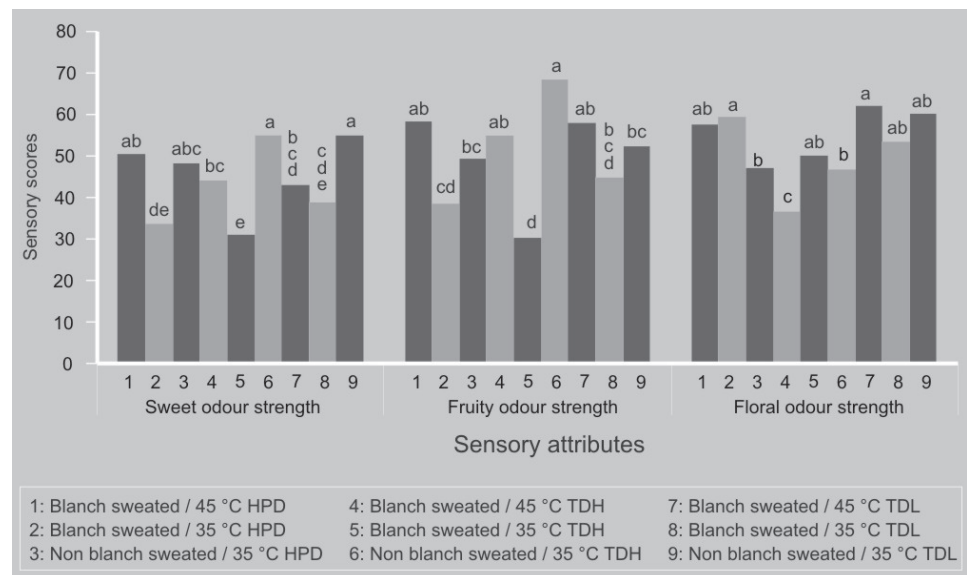


Figure 5. Comparison of sensory scores of strength of sweet, fruity and floral odors of vanilla beans cured using nine different processes. Bars marked by the same letter within each quality attribute are not significantly different at $P \leq 0.05$. HPD: heat pump dryer, TDH: tunnel dryer with high RH, TDL: tunnel dryer with low RH.



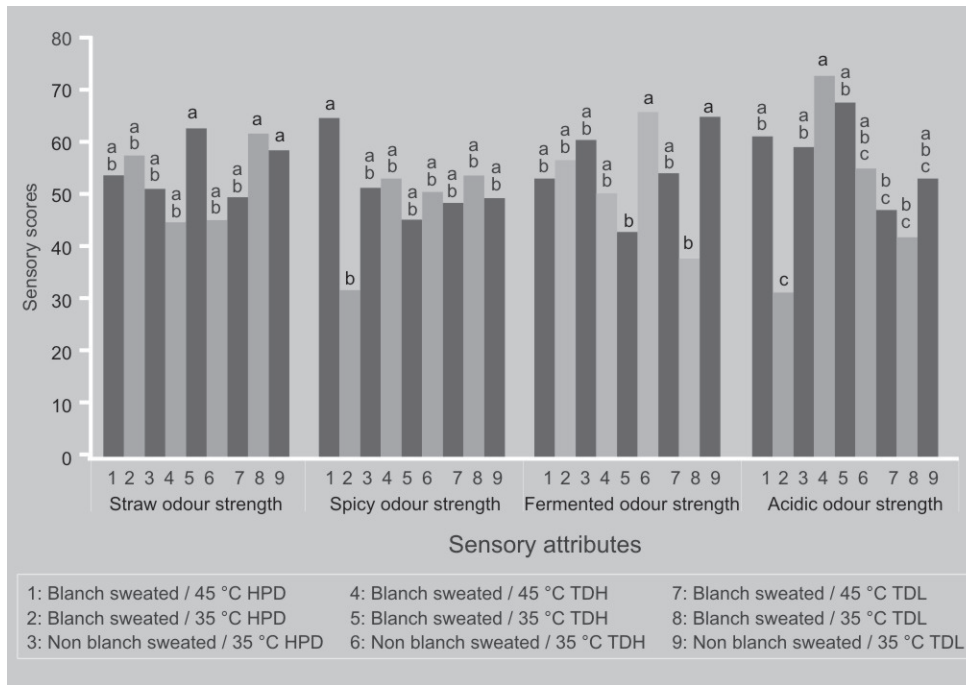


Figure 6. Sensory scores of strength of straw, spicy, fermented and acidic odors of vanilla beans cured using nine different processes. Bars marked by the same letter within each quality attribute are not significantly different at $P \leq 0.05$. HPD: heat pump dryer, TDH: tunnel dryer with high RH, TDL: tunnel dryer with low RH.

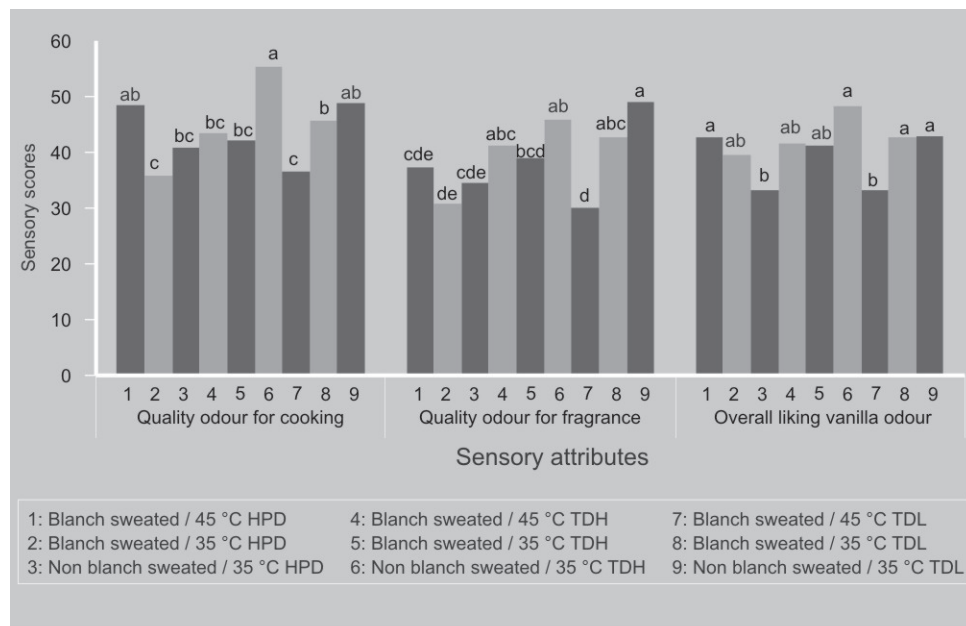


Figure 7. Sensory scores of odor quality for cooking or fragrance and overall liking of vanilla odor of vanilla beans cured using nine different processes. Bars marked by the same letter within each quality attribute are not significantly different at $P \leq 0.05$. HPD: Heat pump dryer, HPD: heat pump dryer, TDH: tunnel dryer with high RH, TDL: tunnel dryer with low RH.

3.2. Correlation between vanillin concentrations and sensory scores

Overall liking of the fragrance of the cured vanilla beans among the nine curing and drying treatments was highly correlated

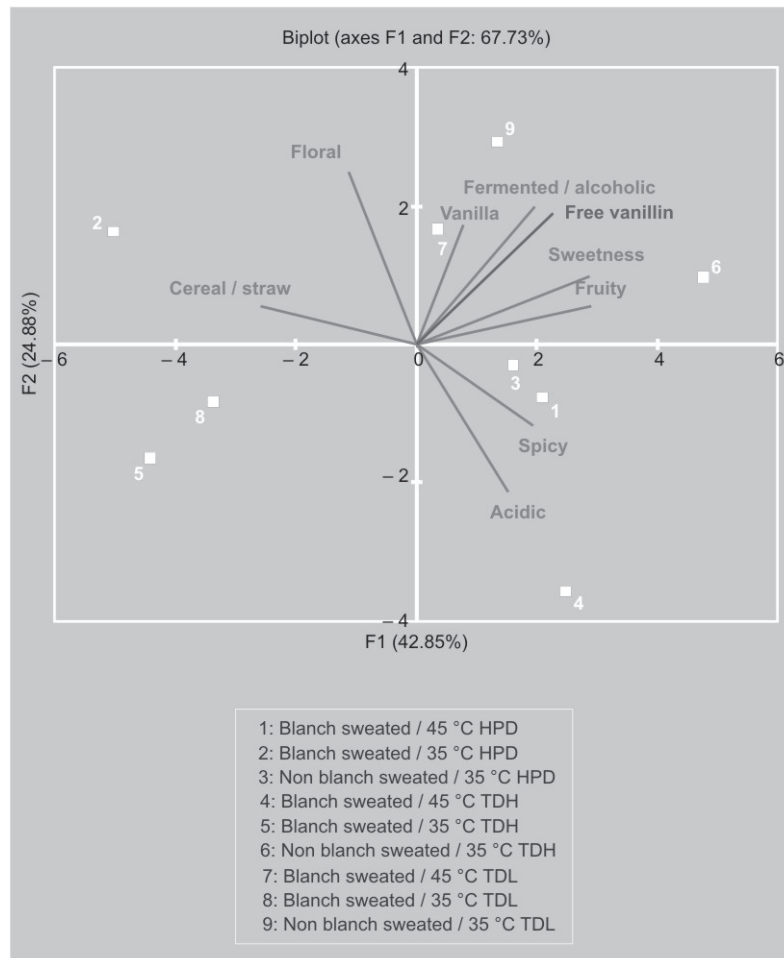
with quality of the aroma for cooking or as a fragrance, liking of sweetness and the presence of fruity, straw and spicy odors. Liking of acidic fragrance of the cured vanilla beans was not correlated with liking of sweet, fruity and floral odors (table D).

Table I. Correlation coefficients (r) from the sensory evaluation of cured vanilla beans. Values > 0.50 are the most important correlations.

Sensory evaluation	Overall liking vanilla fragrance	Like sweet fragrance	Like fruit fragrance	Like floral fragrance	Like beany fragrance	Like straw fragrance	Like spicy fragrance	Like acidic fragrance	Quality fragrance for cooking	Quality for fragrance	Overall like the fragrance perceived
Overall liking vanilla fragrance	–										
Like sweet fragrance	0.612	–									
Like fruit fragrance	0.629	0.733	–								
Like floral fragrance	0.318	0.582	0.513	–							
Like beany fragrance	0.567	0.565	0.565	0.409	–						
Like straw fragrance	0.610	0.623	0.628	0.625	0.735	–					
Like spicy fragrance	0.616	0.517	0.670	0.360	0.514	0.515	–				
Like acidic fragrance	0.202	0.116	0.191	0.178	-0.11	0.233	0.202	–			
Quality fragrance for cooking	0.587	0.586	0.595	0.386	0.628	0.571	0.585	0.093	–		
Quality for fragrance	0.634	0.456	0.537	0.201	0.524	0.449	0.583	-0.10	0.678	–	
Overall like the fragrance perceived	0.730	0.613	0.688	0.465	0.729	0.786	0.637	-0.10	0.748	0.704	–

The strength of the spicy odor was highly correlated with the strength of the acidic odor. Similarly, the strength of the sweetness odor from cured vanilla beans among the treatments was highly correlated with the strength of spicy and acidic odors. The quality of the vanilla fragrance for cooking was highly correlated with the quality of the beans for fragrance and overall liking of the fragrance of the cured vanilla beans (table II).

The scores for vanilla, floral, fruity and sweet fragrances were high in beans cured continuously at 35 °C, due in part to higher vanillin concentrations (groups 6, 7 and 9) (figure 8). The fermented odor scores were also high in beans cured continuously at 35 °C, presumably because respiratory enzymes remained active. The spicy odor scores were high in beans blanched and sweated at 45 °C (groups 1, 3 and 4) (figure 8); however, these beans had lower concentrations of vanillin. These data show that the sensory quality of vanilla beans does not depend only on vanillin content but is also affected by the formation of other volatile compounds that may include vanillic acid, p-hydroxybenzoic acid and p-hydroxybenzaldehyde [11, 25, 26]. Adedeji et al. identified 250 constituents that may impart cured vanilla beans with their characteristic aroma and flavor; chief among them is vanillin [27]. Arana found that sweating and drying at 45 °C gave superior quality beans [28], whereas Rivera and Hageman found that sweating of beans at 38 °C produced a better product than at 45 °C [29]. Arana emphasized the potential importance of peroxidases in particular and oxidative enzymes in general during curing, because peroxidase is resistant to inactivation by various killing and conditioning treatments. Peroxidase activity in vanilla beans was found to be high during curing [30]. According to Arana, vanillin formed during sweating and drying may be further oxidized to produce quinone compounds with more complex structures and different aroma. This process occurs slowly during conditioning and this could explain the delayed development of the characteristic vanilla aroma in some treatments. Peroxidase may be responsible for further oxidation to pro-



duce different aroma compounds and, thus, partially contribute to the overall aroma of vanilla beans [31].

Our research showed that beans blanched at 67 °C for 3 min and sweated at 45 °C for 4 d had relatively low vanillin concentrations but high concentrations of aromatic odors. The relatively large proportion of glucovanillin remaining in these beans after curing may have been due to rapid inactivation of β -glucosidase or to retention of some cellular compartmentation that kept some glucovanillin separate from β -glucosidase. The differential effects of blanching and sweating at 45 °C for 4 d on the production of aroma volatiles may be explained by the retention of the activity of enzymes other than glucosidases such as peroxidases (22, 31, 32).

Figure 8.

Principal component analysis of vanillin measurement and sensory attributes given by untrained panelists regarding samples of vanilla beans cured using nine different processes. HPD: heat pump dryer, TDH: tunnel dryer with high RH, TDL: tunnel dryer with low RH.

Table II. Correlation coefficients (r) from the sensory evaluation of cured vanilla beans. Values > 0.50 are the most important correlations.

Sensory evaluation	Overall liking vanilla fragrance	Overall liking vanilla fragrance strength	Sweet fragrance strength	Fruit fragrance strength	Floral fragrance strength	Straw fragrance strength	Spicy fragrance strength	Fermented fragrance strength	Acidic fragrance strength	Quality fragrance for cooking	Quality for fragrance	Overall like the fragrance perceived
Overall liking vanilla fragrance	–											
Overall liking vanilla fragrance strength	0.559	–										
Sweet fragrance strength	0.341	0.485	–									
Fruit fragrance strength	0.083	0.136	0.438	–								
Floral fragrance strength	-0.061	0.121	0.114	0.285	–							
Straw fragrance strength	0.006	0.156	0.133	-0.040	0.333	–						
Spicy fragrance strength	0.258	0.335	0.571	0.300	0.353	0.470	–					
Fermented fragrance strength	-0.202	0.100	0.253	0.129	0.148	0.370	0.468	–				
Acidic fragrance strength	0.170	0.165	0.515	0.216	-0.070	0.488	0.764	0.460	–			
Quality fragrance for cooking	0.587	0.447	0.405	0.222	0.136	-0.112	0.439	0.093	0.289	–		
Quality for fragrance	0.634	0.461	0.328	0.195	0.049	-0.061	0.289	-0.102	0.107	0.678	–	
Overall like the fragrance perceived	0.730	0.403	0.387	0.224	0.035	-0.074	0.280	-0.101	0.031	0.748	0.704	–

This research confirmed that curing of vanilla beans is a complex process that involves many more variables than simply the hydrolysis of glucovanillin. About 90% of glucovanillin was converted to vanillin in beans cured continuously (non-blached) at 35 °C for 12 d, much higher than in beans that were blached at 67 °C for 3 min and then sweated. The lower percent conversion of glucovanillin to vanillin in beans blached at 67 °C for 3 min and sweated at 45 °C for 4 d or at 35 °C for 5 d suggests that the blanching treatment drastically reduced β -glucosidase activity [14, 18, 22, 32]. Drying methods may also affect vanillin levels by direct effects on enzyme activities and by sublimation of vanillin. Overall, tunnel drying at 60 °C at either 20% or 10% RH was preferred because the rate of drying was much faster and the moisture content of the dried beans was uniform. Since sensory analysis showed that the flavor of beans sweated continuously at 35 °C was better but appearance was inferior to beans that were blached then sweated, further work is required to develop a mild blanching treatment that disrupts the tissue enough to facilitate mixing of glucovanillin and glucosidases without denaturing glucosidases and other enzymes involved in flavor formation. Nevertheless, the quality of cured vanilla beans will be higher if the curing starts with mature beans of consistent size that have the highest glucovanillin concentration and the highest β -glucosidase activity. The data presented in this paper showed that higher concentrations of vanillin can be maintained in cured dried vanilla beans than those reported in previous publications.

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Influencia de los métodos de preparación de las vainas de vainilla en su calidad sensorial.

Resumen — Introducción. A lo largo de la maduración, la vainillina se acumula en las vainas de vainilla verde en forma de glucovainillina, y es hidrolizada en vainillina mediante glucosidasas endógenas durante el proceso de preparación y aporta el sabor característico de la vainilla. El objetivo de nuestro trabajo fue el estudio de métodos de preparación de la vainilla que podrían reducir considerablemente el tiempo del desarrollo del proceso y producir vainas con concentraciones fuertes, así como otros compuestos de aroma con altas calidades sensoriales. **Material y métodos.** Se obtuvieron vainas de vainilla maduras por un productor comercial (Cairns, Queensland, Australia). Un lote de vainas fue continuamente incubado a 35 °C y con una humedad relativa (HR) elevada durante 12 días. Otros dos lotes se blanquearon en agua a 67 °C durante 3 min, a continuación fueron incubados a 45 °C con una HR elevada durante 4 d, o a 35 °C durante 5 d. Las vainas fueron incubadas hasta quedar bronceadas. Se evaluaron tres métodos de secado: con ayuda de una bomba de calor seco a 40 °C y 15% HR, de un túnel de secado a 60 °C y 20% HR, y de un túnel de secado a 60 °C y 10% HR. Se extrajo la vainillina con n-pentano y diclorometano (1:1 v/v) y se dosificó por HPLC, a partir de muestras de polvo obtenido de las vainas tratadas. Se midió la glucovainillina por el índice de vainillina total obtenida tras la hidrólisis ácida de las muestras de polvo. **Resultados y discusión.** Cerca del 90% de la glucovainillina se convirtió en vainillina en las vainas no blanqueadas e incubadas continuamente a 35 °C, mientras que en las vainas blanqueadas a 67 °C durante 3 min e incubadas a 45 °C durante 4 d o a 35 °C durante 5 d pero sólo hubo un 70% de conversión. Se evaluó la calidad sensorial de las vainas tratadas por un grupo especial inexperimentado. Su análisis mostró que las vainas incubadas continuamente a 35 °C poseían un aroma superior a aquél de las vainas blanqueadas en agua caliente e incubadas a 45 °C o a 35 °C, pero la apariencia de las vainas no blanqueadas era menos atrayente. **Conclusión.** El estudio mostró que un tratamiento moderado de blanqueamiento con agua caliente, seguido por una incubación a 35–45 °C y un secado rápido era necesario para obtener vainas preparadas con un muy buen aspecto y un aroma interesante.

Australia / Vanilla planifolia / vainilla / vainillina / procesamiento / tecnología de alimentos / secado por aire caliente / control de calidad / análisis organoléptico