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Factors affecting the quality of Vanilla – A Review.

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ABSTRACT

Vanilla (*Vanilla sp)* is a high value spice crop known for its aroma and flavour in food industry. Quality of cured vanilla beans depends on different parameters like geographical origin, maturity at harvest, curing conditions, curing methods etc. The present study aims at optimizing the bean conditioning parameters namely moisture level, temperature and duration of conditioning for obtaining the maximum quality in terms of odour and vanillin content. Besides, two different species of vanilla namely, *Vanilla planifolia* and *Vanilla tahitensis* from different geographical locations of the world were also analyzed for their intact aroma and flavour.

INTRODUCTION

Vanilla grows best in a hot, humid climate from sea level to an elevation of 1500 m. The ideal climate has moderate rainfall, 150–300 cm, evenly distributed through 10 months of the year. Optimum temperatures for cultivation are 15–30 °C (59–86 °F) during the day and 15–20 °C (59–68 °F) during the night. Ideal humidity is around 80%, and under normal greenhouse conditions, it can be achieved by an evaporative cooler. However, since greenhouse vanilla is grown near the equator and under polymer (HDPE) netting (shading of 50%), this humidity can be achieved by the environment. Most successful vanilla growing and processing is done in the region within 10 to 20° of the equator.

Influence of geographical origin and species towards bean quality

Saltron *et al*. [27] reported that vanillin, vanillic acid, para hydroxy benzaldehyde and para hydroxy benzoic acid were the major volatiles present in pentane ether aroma extracts of *Vanilla planifolia.* Sudharshan *et al*. [30] reported that vanillin, para hydroxybenzaldehyde, para hydroxy benzyl methyl ether and acetic acid are the four abundant compounds present in cured vanilla beans. He also reported that *Vanilla planifolia* has traces of anisyl alcohol, anisaldehyde, piperonal and para hydroxy benzoic acid but they are fairly abundant in *Vanilla tahitensis*. *Vanilla pompona* shows relatively abundance of piperonal with para hydroxy benzoic acid and anisyl alcohol in traces.

The aroma and flavour of vanilla extract is attributed mainly due to the presence of vanillin (4-hydroxy-3-methoxybenzaldehyde), which occurs in the concentration of 1.0 – 2.0 per cent (w/w) in cured vanilla pods [5,28,36].

Guzman (2004) reported that the type and levels of the major flavouring compounds varied depending upon the geographical source as well as the species. Major constituents present in vanilla of various origins are tabulated and given as follows:

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S.No	Source	Vanillin (mg per 100 ml)	Vanillic acid (mg per 100 ml)	P-hydroxy benzaldehyde (mg per 100 ml)	P-hydroxy benzoic acid (mg per 100 ml)
1	Mexico	18-100	8-23	5-7	2-7
2	Madagascar	47-216	12-23	6-13.7	2-5.6
3	Comoros	115-154	8-13	9-13	2-7
4	Indonesia	63-142	7.7-11	7-10	2-4
5	Uganda	47-186	5-10	5-8	1-6
6	Tonga	197-320	7.6	10	2.1
7	West Indies	20-136	15-22	2-6	2-4
8	Costa Rica	135-161	12	14	5.2
9	Jamaica	216-235	4.2	5.4	-
10	Tahiti	54-120	4-5	4-13	16-32.8

Sudharshan *et al.* [30] opined that vanillin content in per cent is used as a measure of the quality of the beans and it ranged between 1 and 3 per cent in Indian vanilla. *Vanilla planifolia* has recorded a maximum of 4 per cent vanillin while *Vanilla tahitensis* has a maximum vanillin content of 3.3 per cent.

Adedeji *et al.* (1993) studied the aromatic compounds present in ten different cured bean extracts of various origins, including Tahiti beans and found a vanillin range of 0.34 per cent in Java to 2.0 per cent in Bali (Indonesia) beans. Ranadive [21] reported a quantitative data on major volatiles present in cured vanilla beans of *Vanilla planifolia* originated from Madagascar, Indonesia, Mexico, Jamaica, Costa Rica, Tonga and *Vanilla tahitensis* from Tahiti. *Vanilla planifolia* from Madagascar showed a highest vanillin content of 164 mg per 100 ml of vanilla extract and the highest being 216 mg per ml from Jamaica. The concentration of vanillin in *Vanilla tahitensis* was found to be low.

Voisine *et al.* [34] made an extensive study to analyze the major volatiles present in aroma extracts of Java and Bourbon beans of *Vanilla planifolia* and found that beans from Java showed high vanillin content of 2.0 per cent. Ehlers *et al.* [10] compared the results of HPLC analysis of extracts prepared from *Vanilla planifolia* and *Vanilla tahitensis* and reported that the Tahitian beans contained relatively low amounts of vanillin, vanillic acid, relatively a high amount of para hydroxybenzoic acid and considerable amount of anisic acid and anisyl alcohol.

Raonizafinimanana *et al.* [24] analyzed the extracts prepared from *Vanilla planifolia* and *Vanilla tahitensis* and reported that origin differentiation of vanilla can be carried out based on the profiles developed using the demethylsterol and triterpene alcohols content present in cured beans.

Boyce *et al.* [6] analyzed the key components in natural extracts of vanilla beans originated from Indonesia, Madagascar, Tonga, Tahiti and Mexico through HPLC and Mixed cellar electro kinetic cellular chromatography and reported that the highest vanillin content of 3.81 and 3. 62 mg per ml respectively in the beans originated from Madagascar.

Influence of maturity in quality of cured beans

A period of 10-12 months is required for producing fully matured vanilla beans with greenish yellow colour and can be harvested when distal end of bean turning yellow to have maximum activity of enzyme precursors during processing [20]. The highest glucovanillin concentration was found in fully matured beans [7,23,33]. However, scalding of beans in hot water (65° C) will increase the contact between enzymes and substrates resulting in better enzymatic reactions for the formation of aromatic compounds. β-glucosidase and glucovanillin, the immediate precursor of vanillin, increased notably from the third month of bean growth [16].

Krishnakumar *et al.* [15] reported that storing of matured beans for a period of around 3 days before killing produced maximum vanillin (2.51 per cent) upon processing. Jones and Vincente [14] investigated the quality of cured vanilla in relation to natural factors and reported that the best quality beans were obtained if they were harvested when the blossom end turns yellow and also added that early maturing beans were of higher quality than those ripened in late season.

Dignum *et al.* [8] reported that the final quality of vanilla beans depends mostly on the glucovanillin content of green beans and added that if curing starts with mature beans with the high glucovanillin content, the quality will be superior.

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Influence of curing processes on bean quality

Muralidharan and Balagopal [17] made a comparison of different methods of curing vanilla beans and reported that Mexican process gave better results *i.e.,* 4.15 per cent vanillin content on moisture free basis than other methods tested. Curing studies carried out in Central Horticultural Research Station, Ambalavayal, Kerala in 1978 concluded for the Mexican method of killing the beans under sun as the best method. But Spices board, Cochin recommends Bourbon process for curing matured beans under Indian conditions [30].

Ranadive *et al.* [23] investigated the effect of scalding on enzyme activities of green beans and reported that the relationship between vanillin biosynthesis and maturation is independent of the geographic origin of beans but known differences between the cured beans occur during curing process. Ansaldi *et al.* (1990) reported that freezing beans immediately after harvest and thawing after storage at -18^0C for 5 days will produce vanillin up to 4.7 per cent.

Mane and Zucca [16] reported that the treatment of green beans with pectinase and glucosidase resulted in production of 6 per cent vanillin when compared to 1.75 per cent in traditional curing methods. Dignum *et al.* [9] studied on the β-glucosidase and peroxidase stability in crude extracts of green vanilla beans and reported that the cooling or freezing of green beans reduces the β- glucosidase activity and thereby reducing the vanillin formation.

Immediate wrapping of killed beans with woolen cloth and storing in sweating boxes produced properly killed and sweated beans [15,25].

Hari Om *et al.* [13] reported that the iproved methods of Mexican and Bourbon process of curing vanilla beans by drying the beans in an oven at 50^0C to a moisture content of 25-30 per cent, which resulted in the production of cured beans with vanillin content of 930 mg and 1100 mg l^{-1} of extract respectively.

Sreedhar *et al.* [29] found that scarification of beans followed by treating them with Ethrel (1 per cent) and NAA (5 mg l^{-1}) produced 4 and 3.6 fold higher vanillin respectively than the control on 10 th day of conditioning thus reducing the curing period.

Krishnakumar *et al.* [15] reported that killing of beans in hot water at 65^0C for 3 minutes or 63^0C for 5 minutes produced characteristic brown colour beans with good aroma and flavour. Jones and Vincent [14] found that hot water treatment *i.e,* killing of bean's vegetative growth by dipping in hot water gave the best results of good aroma and quality than the other methods namely, freezing and scratching used for killing the beans.

Waliszewski *et al.*, [35] studied the effect of enzymatic pretreatment of vanilla pods using different cellulytic enzymes and found that as much as one-half of the amount of vanillin trapped in the cellulose structure of cured vanilla pods in free form or in glucovanillin form can be extracted and liberated by enzymatic pretreatment.

The mechanism of glucovanillin hydrolysis in vanilla beans is regulated by cellular compartmentation and destructuralization of the tissues at the membrane and cell wall levels is obtained [18,19].

Effect of moisture on bean quality

It is widely reported that moisture content of vanilla beans at the end of drying phase and commencing of conditioning phase had profound influence in the overall quality of vanilla beans in terms of vanillin content, keeping quality, colour and texture.

According to International Standards Specifications (ISO 5565-1: 1999(E)), the permissible limit of moisture content in whole beans is upto 38 per cent and that of vanilla bulk and vanilla powder are upto 30 and 35 per cent respectively.

Ranadive [22] postulated that prolonged drying of vanilla beans below 25 to 30 per cent moisture produced cured beans of poor vanillin content, loss of flavour volatiles and less suppleness.

Thomas and Bindumol [32] and Sudharshan *et al.* [30] reported that vanilla beans are susceptible to infection by storage moulds like *Penicillium* and *Aspergillus* due to harvesting of immature beans, improper killing and drying and high relative moisture content in beans. Krishnakumar *et al.* [15] reported that keeping vanilla beans with moisture content of 30 per cent at the end of drying phase for conditioning showed a highest vanillin content of 2.24 per cent.

Arana [3,4] examined the relationship between the moisture content and the quality of cured beans and reported that beans with high moisture content (50-54 per cent) tended to have slightly fermented aroma and were less suave than those conditioned at low moisture levels.

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Arana [3,4] reported that beans with an average moisture content of 32 per cent had a well developed, suave aroma and a high degree of flexibility *i.e.,* suppleness.

Effect of temperature on bean quality

Jones and Vincent [14] reported that conditioning of vanilla beans were accelerated at the temperatures in the range of 35°C than conditioning beans at 13°C or 27°C. Broderick [7] has suggested that conditioning of dried vanilla beans at 38°C for 2-3 months might be safer to produce cured beans having superior aroma and flavour.

Effect of microbial communities on bean quality

Degradation of lignin by wide range of micro organisms such as white rot fungi, *Actinomycetes* and some other bacteria yields aromatic compounds [11].

Microbial activities on cell wall compounds release ferulic acid that can be transformed by a large variety of bacteria and fungi into flavour compounds like vanillin and guaicol [26,31].

Roling *et al.* [25] studied the microbial ecology of traditional post harvest processing of vanilla beans and found that the fungal and yeast growth disappeared after scalding, while thermophilic and thermo tolerant bacteria remained constant in least number upto the end of conditioning period.

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