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EVALUATION OF CHEMICAL QUALITY IN BLACK PEPPER AND TURMERIC - A REVIEW

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ABSTRACT

National Research Centre for Spices, Calicut has carried out the evaluation of the chemical quality constituents of black pepper cultivars, white pepper and turmeric germplasm. The popular cultivars were indexed based on the level of essential oil, piperine and oleoresin. The chemical quality of black and white pepper were compared. The turmeric germplasm were evaluated for its curcumin and dry recovery. The effect of climate, location, rainfall etc. on the quality traits are discussed.

Introduction

Spices impart aroma and taste to the food. Aroma of the spice is due to the volatile oils present in it. Volatile oils consist of monterpene hydrocarbons, sesquiterpenes, oxygenated monoterpenes, phenyl ethers and oxygenated sesquiterpenes. The essential oil is separated by hydrodistillation of the powdered spices and is collected in clevenger traps (lighter than water type) (ASTA, 1968). The full taste of the spice is extracted using solvents like acetone, ethyl alcohol or ethylene dichloride. The dark viscous mass obtained after evaporation of the solvent is called 'oleoresin' - it contains the oil and pungent principles and resinoids.

Black pepper

The volatile oil, piperine - the major pungent principle - and oleoresin of 69 black pepper cultivars were estimated. The piperine was estimated by the modified method of Sowhagya et al. (1988). The study led to the ranking of the cultivars into high, medium and low in piperine, volatile oil and oleoresin. Table 1 gives the variation in quality within a variety. The cultivars having superior quality attributes are given in Table 2.

Table 1 Variation for quality traits in some popular black pepper cultivars

cultivar	collection	piperine	rank	oleoresin	rank	essential oil	rank
Karimunda	(1)	6.25	H	12.17	M	4.52	H
	(2)	4.94	M	13.09	M	3.25	M
	(3)	2.94	M	8.27	L	3.20	M
	(4)	2.68	M	9.35	M	4.20	M
	(5)	3.64	M	10.07	M	3.20	M
Kalluvally	(1)	4.40	M	11.00	M	4 00	M
	(2)	4.24	M	8.80	M	3.25	M
	(3)	4.05	M	10.90	M	0.40	L
	(4)	5.40	M	8.44	L	3.00	M
	(5)	2.43	L	14.07	M	5.70	H
	(6)	2.84	M	11.82	M	2.48	M
Kuthiravally	(1)	3.01	M	12.24	M	3.18	M
	(2)	5.97	H	14.90	M	4.50	H

Piperine levels	H > 5. 49	M - 5.49 - 2.59	L < 2.59
Oleoresin levels	H > 14. 62	M - 14.62- 8.38	L < 8.38
Essential oil levels	H > 4. 40	M - 4.40 - 2.40	L < 2.40

* Source : Gopalam, A. and Ravindran, P.N. (1988)

Table 2. Chemical quality of black pepper germplasm*

Piperine %	oleoresin % (range)	essential oil % (range)
2.5 - 6.7	7.6 - 16.0	2.0 - 6.0
high piperine	high oleoresin	high oil
CLTP - 75	55	55
2	61	41
192	192	185

* (- John Zachariah, unpublished). No. of accessions studied - 150

The information developed through this is being utilised in the future breeding programmes of the centre

Table 3 describes the effect of seasons on the quality constituents in black pepper. This phenomenon was also seen in cv. Kottanadan which contains the highest oleoresin and piperine . During a drought season, the berries attained early maturity and it gave a reduction of 25% in the oleoresin (i.e. a decline from the reported value of 17.8 to 14%) (NRCS - unpublished data). This shows that the synthesis of secondary metabolites like oleoresin, piperine and essential oil are vary much dependent on climatic factors. A study by Gopalam and Sadanandan revealed that addition of more nitrogenous fertilizer increases the piperine levels in pepper (personal communication).

Table 3. Seasonal fluctations in quality aspects of black pepper (NRCS, unpublished)

Accession No.	piperine		oleoresin		essential oil	
	1990	1991	1990	1991	1990	1991
30	5.2	4.3	14.5	10.4	4.0	3.3
920	4.0	4.3	9.3	11.3	3.0	3.6
115	3.8	5.4	8.0	12.7	3.0	3.3
94	3.6	3.0	9.6	11.0	3.0	4.6
172	3.7	4.6	13.5	10.3	4.7	3.0

White pepper

White pepper is the fruit from which the pericarp has been removed. It is evaluated on its appearance (colour and size), pungency and its aroma/flavour properties.

Traditional method

White pepper is traditionally prepared from fully ripe, decorticated berries. Harvesting is delayed until the berries become bright red. After harvesting, the ripe berries are detached from the spikes and are tightly packed in gunny bags. The bags are then allowed to soak in slow running water of about ten to twelve days. During this period, a bacterial retting process occurs which loosens the pericarp from the core of the fruit. After removal of the bags from the water, the berries are placed in a tank of water and are trambled to remove any remaining adhesing pericarp. The washed produce

is sundried to a moisture level of 10-15 per cent and to achieve a cream or white colour (Purseglove et al. 1981). This traditional method puts farmers in great difficulty as he has to delay the harvest which may lead to loss of berries by bird attack, fruit fall etc.

Modified method

CFTRI has developed a method by which white pepper is produced from green pepper by steaming and rolling. In this method fully matured green bold berries are cleaned and boiled or steam cooked to loosen the pericarp. This has an additional advantage as it reduces the microbial load as to degeneration of skin in other method. Different white pepper preparation methods like rolling, steaming or boiling and running water treatment were compared in three popular cultivars viz. Panniyur - 1, Karimunda and Arakulammunda and the produce were evaluated for its chemical and aroma quality. There was a reduction in the essential oil content of white pepper by all the methods (Table 4) and certain chemical constituents of oil like pinene and caryophyllene which impart off flavour to pepper oil has shown a decline while constituents like netrol, terpineol and phelladrene are either not affected or increased in white pepper prepared by boiling or steaming.

Table 4. Chemical quality of white pepper as affected by different methods of processing in three popular black pepper cultivars*.

Variety		% piperine	% oleoresin	% essential oil
Panniyur- 1	T1	3.72	8.10	3.6
	T2	3.24	7.39	2.4
	T3	3.00	7.39	2.4
	T4	3.51	7.23	2.3
Karimunda	T1	3.86	7.80	4.2
	T2	2.56	6.56	2.5
	T3	2.17	5.49	2.5
	T4	2.54	6.63	2.5
Arakulammunda	T1	3.33	10.00	3.6
	T2	2.99	8.07	2.8
	T3	2.57	8.21	2.9
	T4	2.96	8.07	2.9

T1 = black pepper, T2 = retting, T3 = boiling, T4 = running water.

* Source : Gopalam et al. (1990)

Gopalam et al. (1991) compared fifteen black pepper cultivars for suitability for preparing white pepper. The berries were classified into large, medium and small and the study has revealed that Panniyur - I and Valiakanlakadan are best from large berry cultivars and Arakulammunda and Balankotta from the medium sized cultivars.

Turmeric:

The rhizomes of *Curcuma longa* L. (*C. domestica* Val.) find an important place in Indian culinary. A number of cultivars are distinguished in India by the names of the localities in which they are grown

(Purseglove et al., 1981). Some of the common cultivars are Moovattupuzha, Alleppey, Wynad, Rajpuri, Tekkurpela, Duggirala, Armoor and Amruthapani. The primary product is the cured and dried rhizome. Turmeric is valued principally for its yellow-orange colouring power but it possesses an appreciated aroma and flavour which classify it as a spice. The terms commonly used in commerce to describe the various physical form of turmeric are as follows:

Fingers : Lateral branches or secondary 'daughter' rhizomes which are detached from the central rhizome before curing.

Bulbs : These are the central 'mother' rhizomes which are ovate in shape and are of a shorter length but a greater diameter than fingers (Govindarajan 1980).

The quality of cured turmeric is assessed on the basis of several factors like curcumin content, organoleptic character, general appearance, size and physical form of the rhizome. The curcumin contents in all these samples were estimated by the method of American Spice Trade Association (ASTA, 1968). In this 0.1 g of powdered and sieved turmeric sample was refluxed for 2 1/2 hrs. in ethyl alcohol. The cooled extract was filtered into a 100 ml volumetric flask and made upto volume. 20 ml of this was pipetted into a 250 ml volumetric flask and dilute to volume with alcohol. The absorbance of this was read at 425 nm and compard against pure curcumin standard (0.0025 g pure curcumin, Sigma, per litre of 95% alcohol).

The quality is also influenced by the state of maturity at harvest, location, sunlight hours etc. (NRCS, Unpublished data).

Ratnambal (1986) evaluated the curcumin content of many cultivars of *Curcuma longa*. Based on the high curcumin and dry recovery Ratnambal et al. (1986) released three varieties in turmeric viz.,

Table 5. Effect of locations on dry recovery and quality of turmeric

variety	dry recovery (%)		curcumin (%)	
	Peruvannamuzhi	Jagtial	Peruvannamuzhi	Jagtial
Suvarna	17	26.0	4.0	NA
Suguna	12	24.6	7.0	4.5
Sudarshana	13	25.3	6.9	4.5

NA = not available

Suvarna, Suguna and Sudarshana. There are reports that these varieties behave differently in different places (Table 5).

Effect of location and agro - climatic factors on turmeric quality

Turmeric selection PCT-5 gave 6.9% curcumin at Peruvannamuzhi, Calicut, (Ratnambal, 1986) while the same gave only 1.5% at Solan (Himachal Pradesh) and Suvarna at Solan gave only 1.1%. PTS 24 or Roma that gave 9% curcumin at Pottangi (Orissa) gave only 3.5% at Solan (personal communication). The synthesis of curcumin seems to be influenced by factors like location, weather, rainfall etc. At N.R.C.S. an experiment was conducted in which turmeric rhizomes were planted at fortinightly intervals from late April to late June and harvested from early February on wards. Preliminary analysis of the data indicates that planting in May and harvesting in November or December gave the maximum curcumin (i.e. about 190-210 days) while maximum dry recovery was obtained between 250-270 days of maturity. The increases in the dry recovery at Jagtial (A.P.) (Table 6) can be attributed to the longer sunshine hours the crop receive in Andhra Pradesh. In Kerala, because of rainy season in June-August and September, the total percentage of sunlight received will be reduced substantially

and the reduction in dry recovery may be related to this. The reduction in soil moisture after october may be an added reason. There are also reports that pH of soil, level of major and minor nutrients vary in the different turmeric tracts. This also may have a role in the variation of quality traits. Zachariah and Nirmal Babu (1992) carried out a two year study on the effect of storage of turmeric rhizomes

Table 6. Curing percentages of different short duration turmeric cultures at Jagtial (A.P.)*

variety/culture	curing percentage	
	1986-87	1987-88
PCT 5	27.0	26.2
PCT 8 (Suvarna)	-	25.0
PCT 10	20.4	20.3
PCT 11	25.6	25.0
PCT 12	26.4	26.0
PCT 13	20.2	20.4
PCT 14	20.3	20.3
PCT 15	25.7	25.5
PCT 16	25.5	26.0
PCT 17	26.4	25.8
PCT 18	26.5	26.2
PCT 19	25.2	25.4
Kasthuri	25.0	25.6

* Source : M.L.N. Reddy et al. (1989)

on the chemical constituents and concluded that storage did not affect the constituents significantly. Further study in this line is in progress at N.R.C.S, Calicut

Conclusion

National Research Centre for Spices, Calicut carried out evaluation of the chemical quality constituents of black pepper germplasm. The popular cultivars were indexed based on the level of essential oil, piperine and oleoresin. The chemical quality of black pepper and white pepper was compared. The turmeric germplasm was also evaluated for curcumin content and dry recovery. The quality traits were highly variable in relation to cultural practices and agro-climatic conditions.

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