Indian Cocoa, Arecanut & Spices Journal. Vol. XII. No. 2.

BLACK PEPPER OIL—CHEMICAL AND AROMA QUALITY

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Among 30 species of piper known in India few including *P. nigrum., Piper longum* (long pepper), *P. cubeb* (cubeb) and *P. betel* (betel vine) are known to be cultivated. *P. nigrum* L. from which black pepper is obtained is a perennial climbing vine. The cultivars of black pepper were generally evolved by natural selection and natural hybridization. More than 69 cultivars are known to be cultivated in India and these are distinguished by different names either given by the planters or generally known by the names of the places of cultivation. Transportation of one variety or cultivar from one area to another caused a natural variation within the same genotype due to differential ecological situations. This has resulted in the same variety being known by different names in different places.

Generally black pepper yields 2.6% of volatile oil. The oil yield depends on the maturity of pepper at harvest. In laboratory where hydro distillation is employed the oil yield goes up from 2.5 to 7.0% depending on the variety and maturity. In the industry where steam distillation is employed the extraction of oil, is essentialiy, a primary step in the by product manufacture. Oil depleted black pepper powder is further used for oleoresin manufacture and hydrodistillation by the industry is detrimental to solvent extraction. Hence in industry the spices is required to be kept in contact with water for the minimum time and the condensed steam in black pepper is removed by air drying of pepper powder. Research on chemical and aroma quality is scanty. Present paper is an attempt to outline the chemical and aroma quality of black pepper oil which includes some aspects of the physical properties of the latter.

Volatile oil derived by steam distillation is generally a colourless liquid. Occasionally green tinge in the white liquid is seen with a mild taste of black pepper. The pungency which is mainly due to piperine is totally absent. Some physical properties of the black pepper oil are presented in Table-1.

Table 1 : Physical properties of the black pepper oil

Physical constituent	Consistency of black pepper powder		
	Whole	Middle grades	Low grade dust
Specific gravity . .	0.87	0.88	0.91
Optical rotation . .	—1° to +3°	—1 to 1.55	—1° to —23°
Refractice index . .	1.48	1.48	1.49
Acid number . . .	1.1	N.A.	N.A.
Ester number . . .	0.5 to 6.5	N.A.	N.A.
Solubility in alcohol . .	Soluble (1:3)	Soluble (1:3)	Soluble (1:3)
Phellandrone test . .	Positive	Slightly positive	Negative

From the Table it can be seen that the optical rotation among the physical properties is an important parameter which the industry should look for. Oils having dextro rotation give a definite phellandrene test indicative or tone pepper aroma and as shift towards leave rotation occurs the phellandrene content also decrease indicating the poor quality of oil.

Chemical quality of the oil has been studied satisfactorily in recent years following advances in gas chromatography. Nigam and Handa (1964) studies the composition of pepper oil using initial fractional distillation of oil and a subsequent identification by UV and IR spectral characters. As many as 30 oxygenated compounds were identified by MS and NMR. With the advances in gas chromatography and separation techniques considerable improvements are made in detection to a greater degree of specificity and sensitivity. Mono and sesquiterpene hydrocarbons and their oxygenated compounds in some popular horticultural varieties of pepper were studied by Richards *et al* (1971) and are abstracted in Table-2.

Table 2: Per cent mono and sesquiterpene hydrocarbons and their oxygenated compounds in some popular horticultural varieties of black pepper

Cultivar	Terpenes		Oxygenated compounds
	Mono	Sesqui	
Balankotta	68	30	2
Karimunda	61	37	2
Kalluvally	73	24	3
Kottanandan	60	35	5
Panniyur-1	65	32	3

It will be interesting to note that there is not much of variation in the gas chromotagraphic profile of terpenoid compounds in the cultivars studied. Except that in Kottanadan and Karimunda cultivars monoterpenes are low and sesquiterpenes are high, there is no remarkable variation. There are 13 monoterpenes, 7 sesqui terpenes and 5 oxygenated compounds which mainly contribute to the characteristic pepper oil aroma (Table-3). Eventhough it is difficult to attribute one individual or group of compounds as a reason for true pepper aroma a composite odour of all these compounds appear to play an important role in determining the aroma of black pepper oil.

Table 3: Commonly occurring mono and sesqui terpene hydrocarbons and their oxygenated compounds in black pepper

TERPENES		Oxygenated Compounds
Mono	Sesqui	
—pinene	B— caryophyllens	Linalool
B— pinene	—humdene	—terpineol
Camphene	—Selinene	Carvone
Sabinene	—bergamotene	Caryophyllens oxide
Myrsene	Bisabolene	1—terpineol
Lononene	Cubenene	
—terpinene	B—clemene	
—terpinene		
—cymene		
—thujene		
—carene Ocimene		
—phellandrene		

Observations regarding the role of various chemical compounds contributing to true pepper aroma can only be visualized by an indepth study of the sensory quality of the pepper oil. 'GC finger printing' for the use of characterization of the natural spices was suggested by Przdziecka and Baldwin (1976) but a complex containing not less than 70 compounds likely to give a distorted picture on the correlation of chemical composition and perceived aroma.

Different mono and sesqui terpene hydrocarbons and the oxygenated compounds commonly occurring in black pepper oil, their normal source and perceived aroma are listed in Table-4. From the Table it is evident that black pepper oil rich in pinenes give a terpentine type of aroma whereas phellandrenes and limonenes give true pepper aroma. Sailzer (1971) recommended the analysis of black pepper oils by gas chromatography and clucidate the ratio of cabinene + B — pinene + Carene/caryophyllene for use as an index for pepper oil quality.

Table 4 : Mono and sesqui terpene hydrocarbons and the oxygenated compounds commonly occurring in black pepper their natural source and perceived aroma

Perpinic hydrocarbon	Source	Perceived aroma
—pinene	Turpentine Oil	Turpentine
B—pinene	Turpentine oil	Turpentine
Campnene	Cypress oil	Inspid
Sabinene	..	ND
Myrsene	Bay of verbena	Pleasant
Limonene	Lemon oil	Lemony
Terpinene	Cardamom Marjaram oils	Lemony
Cymene	..	ND
Thujene	Thuja	ND
Carene	Turpentine	Sweet pungent
Ocimene	..	Pleasant
Phellandrene	Eucylyptus	Pepper like
B-caryophyllene	Clove oil	Turpentine
Humelene	..	ND
Cubenines	Cubeb	ND
Linalool	Linalo oil	ND
—terpineol	Perit grain oil	ND
Carvene	Dill seed oil	Gingery

—Not available ND: Not distinct

Studies are on the way to index all the available pepper cultivars on the basis of these important aroma perceiving compounds to define the black pepper aroma in a more tangible manner.