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Chemical quality of berries from black pepper varieties grafted on *Piper colubrinum*

T. John Zachariah*, P.A. Mathew and P. Gobinath

Indian Institute of Spices Research, Marikkunnu, Calicut- 673012, Kerala, India.

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Abstract

Black pepper (*Piper nigrum* L.) is a major spice used in food and medicine and the raw material for extracting volatile oil, oleoresin and piperine. *Phytophthora* foot rot is the major disease affecting pepper plant killing the entire vine. *P. colubrinum* Link, a related species is unaffected by this fungi. Grafting *P.nigrum* on *P. colubrinum* is one approach to safeguard the pepper from this disease. Using *P. colubrinum* as rootstock chemical qualities of pepper berries of important pepper varieties were evaluated, since volatile oil, oleoresin and piperine contribute towards its aroma, taste and pungency. The study included the components of the essential oil such as pinene, sabinene, myrcene, limonene, linalool, terpinene-4-ol, α- terpineol and β-caryophyllene also. Grafting has not influenced the chemical quality of berries.

Key words : *P. nigrum, P. colubrinum,* grafting, rootstock, scion, piperine, caryophyllene, sabinene.

Introduction

Black pepper (*Piper nigrum* L.) is a major economically important spice globally used in food and medicine. Foot rot caused by *Phytophthora capsici* Leonian is the major production constraint in black pepper growing. Though chemical and biological control methods are in vogue, resistant rootstock is one approach adopted in many crops to overcome such problems. *Piper colubrinum* Link is a wild relative of black pepper resistant to the above pathogen and has been tested in Brazil [1] and Indonesia [11].

Similar attempts have been made at Indian Institute of Spices Research, Kerala, India [6] and research is in progress.

The quality of black pepper berries is dependent on the components of volatile oil, oleoresin and piperine [11]. The aroma and flavour of pepper is determined by the composition of its steam volatile oil, which comprises mainly of monoterpene hydrocarbons together with smaller amounts of sesquiterpene hydrocarbons. Oxygenated compounds, though minor, play an important role in deciding the organoleptic properties of this spice and its oleoresin [9]. Pepper also contains about 9% alkaloids (mostly piperine and analogues), about 11% protein and small amounts of minerals. The therapeutic properties of pepper oil are due to these components. However, the content and the intrinsic quality of oil, oleoresin and related principles is dependent on various factors such as variety, geographical origin, age, quality of the materials used and the processing procedure employed [3,9,12,13,]. Nevertheless, a need was felt to study the influence of *P. colubrinum* rootstock on berry quality components to assess its utility. Such studies have been carried out in Malaysia and no rootstock effect was detected [13]. Therefore, this study was carried out to assess the effect of *Piper colubrinum* as a rootstock on the chemical quality profile in different pepper cultivars under Indian conditions.

Materials and methods

Berries collected from five-year-old grafts and non-grafts of Panniyur-I, II, III, IV, V, Malligesara, Pournami, Sreekara, Poonjaranmunda, Kuthiravalli, Panniyur culture and Balankotta were used for the study. The

* E-mail: zacjontj@yahoo.co.uk

plants were maintained at IISR Experimental Farm, Peruvannamuzhi. The pepper berries at full maturity were harvested, sun dried and used for the experiment. Analysis of berries from two seasons were carried out and pooled. Essential oil was determined by hydro distillation adopting Clevenger method (lighter than water) [2] from freshly powdered pepper sample from grafts and non-grafts. Oleoresin from freshly powdered pepper sample was estimated by gravimetric method employing cold percolation technique using acetone. Percentage oleoresin was computed as weight by weight. Piperine was estimated on the Shimadzu LC6A HPLC system using reversed phase column with SPD 6AV UV-visible spectrophotometric detector adopting Winchrom software [4]. GLC profile of the oil was carried out on a Perkin-Elmer Auto System Gas chromatograph equipped with PE Nelson 1022 GC plus integrator. Column used was OV - 17 at an oven temperature of 70 ^{0}C to 210 ^{0}C @ 5 ^{0}C/min. using nitrogen as carrier gas. FID temperature was 300°C and injection port 200°C. The compounds were identified using authentic standards from Sigma Chemical Co., USA.

Results and discussion

The pooled mean values of levels of oil, oleoresin and piperine in different pepper cultivars grafted on *P. colubrinum* showed that Panniyur-II, Pournami and Sreekara recorded highest oil content among the cultivars (Table-1). Grafts and non grafts did not show any substantial variation in oil content, while between grafts and non grafts the difference varied to the extent of 25% in Kuthiravally and to only 7% in Panniyur IV. Since there is no fluctuation to one side i.e. graft or Non graft, the difference in oil levels can be attributed to varietal variation, stage of harvest, maturity at harvest etc. as reported by earlier workers [5,9,14]. Statistical 't' test indicated the variation in response between graft and non-graft as non-significant.

Similar trend can be observed with regard to levels of oleoresin and piperine. Oleoresin content varied from 7 to 12%. Difference between graft and non graft varied from 2 to 20% in few cases. In piperine content a 49% reduction was observed in Panniyur culture non-graft. In other varieties the difference varied from 10 to 33%.

Table -1. Levels of oil, oleoresin and piperine in pepper varieties grafted on *P. colubrinum* and non-grafted plants

	Oil (%)		Oleoresin (%)		Piperine (%)	
	Graft	Non graft	Graft	Non graft	Graft	Non graft
Panniyur I	2.40	3.20	8.53	8.91	3.42	2.79
Panniyur II	4.00	4.40	10.57	12.77	3.66	3.66
Panniyur III	3.20	4.00	8.91	11.22	3.27	3.60
Panniyur IV	2.60	2.80	7.39	9.73	2.82	3.48
Panniyur V	3.20	2.40	8.06	8.23	3.18	3.60
Pournami	4.40	3.60	9.70	10.91	2.70	3.60
Panchami	3.60	3.20	9.30	8.69	2.80	3.06
Malligesara	3.60	3.20	8.92	8.84	3.18	3.00
Sreekara	4.00	3.20	9.78	9.37	4.44	3.87
Panniyur Culture	3.20	2.00	10.23	6.90	3.96	2.00
Poonjaranmunda	3.60	2.80	10.15	8.69	3.00	3.54
Kuthiravally	2.00	3.20	9.50	9.95	3.25	3.00
Balankatta	2.80	2.40	8.50	7.28	2.2	1.98
t value	1.054		-0.322		0.791	
Level of significance	N. S.		N. S.		N. S.	

The major essential oil constituents in grafts and non-grafts of pepper varieties were pinene, sabinene, myrcene, limonene, linalool, terpinene-4-ol, α-terpineol and β-caryophyllene (Table-2). The trend seen in main constituents was also repeated in oil profile. Caryophyllene content varied from 12 to 27% in graft and 7 to 29% in non graft. Limonene content varied from 13 to 24% in graft and 13 to 22% in non graft. Previous studies report that oil with high monoterpenes like limonene and caryophyllene has pleasing odour [7,8,10].

Table -2. Essential oil constituents in grafts and non grafts of pepper varieties

Sample name	Pinene		Sabinene		Myrcene		Limonene		Linalool		Terpine 4-ol		α-Terpineol		Caryophyllene	
G-graft, NG-Non graft,	G	NG	G	NG	G	NG	G	NG	G	NG	G	NG	G	NG	G	NG
Panniyur I	7.86	6.35	16.47	16.60	0.59	2.82	15.33	15.44	0.47	0.36	0.51	0.35	0.13	0.12	24.57	25.60
Panniyur II	10.18	13.4	17.98	24.62	2.04	1.37	17.44	19.77	0.90	1.58	0.56	0.62	0.18	0.58	27.20	11.44
Panniyur III	6.15	11.0	17.0	20.80	NA	1.90	24.6	16.35	4.57	1.31	0.34	0.86	1.02	0.04	12.14	7.88
Panniyur V	7.18	6.93	18.63	13.47	NA	2.00	16.71	13.05	1.72	0.96	0.38	0.45	0.57	0.40	15.3	21.50
Pournami	10.36	13.6	18.2	29.7	1.67	6.15	15.64	22.20	2.36	1.31	1.01	0.72	0.12	0.35	25.9	7.88
Panchami	7.1	6.39	14.2	13.18	3.12	2.54	14.2	13.78	2.82	2.64	0.42	0.30	0.38	0.27	19.15	18.47
Malligesara	7.82	9.05	15.2	16.08	2.31	2.06	19.78	13.82	0.83	1.52	0.22	0.48	0.12	0.17	21.10	23.47
Sreekara	6.50	8.02	14.54	14.12	NA	1.95	13.46	13.84	1.98	0.67	0.07	0.25	0.27	0.16	21.22	19.21
t value			-1.082				0.444								1.277	
Level of significance			N.S.				N.S.								N.S.	

NA = Sample not available
NS = Not Significant

Statistical analysis does not show any significance with respect to caryophyllene, limonene and sabinene in graft and non-graft.

The above study involving grafts and non grafts of different varieties establish the fact that grafting *P. nigrum* on *P. colubrinum* does not lead to any substantial change in pepper quality and that there is no varietal preference or specific rootstock effects.

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