



## DIFFERENCES OF CHEMICAL CONSTITUENTS IN THREE PHYSIOLOGICAL STAGES OF CEYLON CINNAMON (*Cinnamomum zeylanicum* Blume)

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### INTRODUCTION

Cinnamon (*Cinnamomum zeylanicum* Blume) is an evergreen perennial plant, native to Sri Lanka. Grown in tropical regions of the world, its woody stem can reach up to a height of 18m. Flushing, flowering, and fruiting are considered to be the main physiological stages in a cinnamon plant. These physiological stages directly affect the peelability of cinnamon bark. Some physiological stages are unfavourable for peeling and have to be avoided during harvesting. Chemical variations of such stages in cinnamon have not yet been studied and therefore in this study chemical variations in different physiological stages of cinnamon were studied.

### METHODOLOGY

Flushing, Flowering and Fruiting physiological stages were evaluated chemically and physically keeping the genetic factor constant throughout by using asexually grown two accessions of Ceylon Cinnamon, Sri Gamunu and Sri Wijaya. Samples were collected from the same location, National Cinnamon Research and Training Center, Palolpitiya at about 3 years of maturity. Five replicates were evaluated under each treatment.

For the chemical evaluation, the first oil extraction was carried out with hydro distillation method for the collected cinnamon bark and leaf samples. Bark and leaf oil quantities were determined according to the modified Clewenger method, AOAC International, 962.17 – Volatile Oil in Spice. The chemical composition of the extracted oil samples from bark and leaf was analyzed using GC-MS methods. Data obtained on oil content; chemical constituents were statistically analyzed using the one-way analysis of variance (ANOVA) at the 0.05 significance level.

### RESULTS AND DISCUSSION

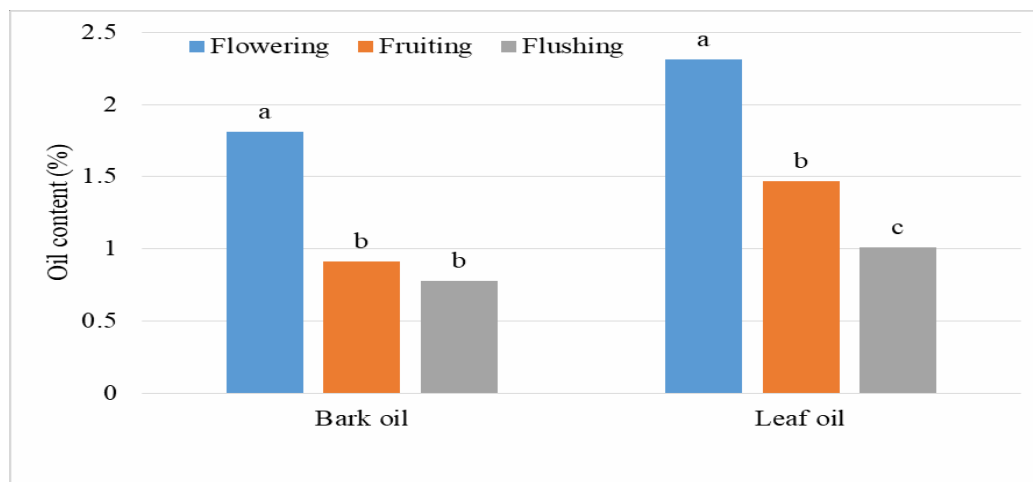
There was a significant difference in the leaf oil contents within three stages: flowering (2.31%), fruiting (1.47%) and flushing (1.01%). Bark oil content in flowering stage (1.81%) was significantly higher than flushing (0.78%) and fruiting (0.91%) stages.

**Table 1.** The comparison oil contents of bark and leaf at three different physiological stages for Sri Gamunu and Sri Wijaya

Factor	Levels	Bark oil (%)	Leaf oil (%)
<b>Variety</b>	Sri Gamunu (G)	1.33a	1.77a
	Sri Wijaya (W)	1.01b	1.42b
	Sig. at $\alpha=0.05$	*	*
<b>Physiological stage</b>	Flowering (1)	1.81a	2.31a
	Fruiting (2)	0.91b	1.47b
	Flushing (3)	0.78b	1.01c
	Sig. at $\alpha=0.05$	***	***
<b>Variety x Physiological stage</b>	G*1	2.17	2.60
	G*2	0.97	1.65
	G*3	0.85	1.07
	W*1	1.45	2.02
	W*2	0.85	1.30
	W*3	0.72	0.95
	Sig. at $\alpha=0.05$	NS	NS
<b>CV%</b>		28.27	21.22



Variety to physiological stage interactions shows no effect of the genotype in the dependence of oil contents on physiological stages.

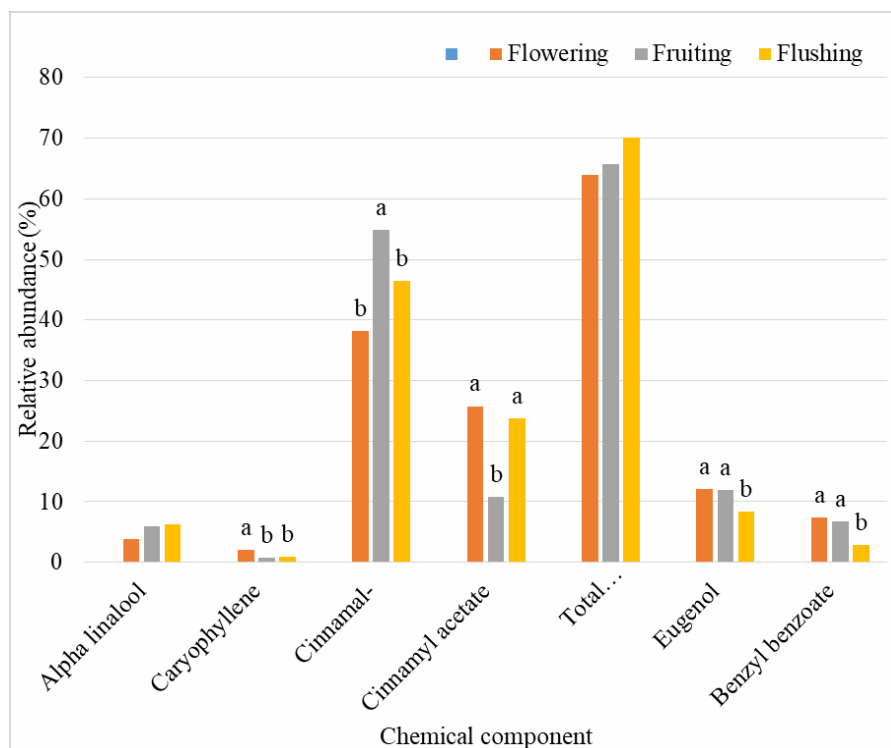


**Figure 1.** Comparison oil contents of the bark and leaf in Sri Gamunu at three different physiological stages

Concentration of the major constituent, total cinnamaldehyde, among flowering (63.99%), fruiting (65.74%), and flushing stages (70.16%) in bark oil was also similar. The eugenol content in bark oil was significantly higher in both flowering (12.11%) and fruiting (11.92 %) stages compared to the flushing state (8.36 %), while a similar trend was observed in benzyl benzoate content. Alpha linalool was similar in three stages, while caryophyllene content was significantly higher in flowering stage compared to the other two stages.

**Table 2.** The comparison of mean percentage values of different chemical compounds in the bark oil of Sri Gamunu and Sri Wijaya at three different physiological stages

Factor	Levels	Alpha linalool (%)	Caryophyllen (%)	Cinnamal-Dehyde (%)	Cinnamyl acetate (%)	Total cinnamaldehyde (%)	Eugenol (%)	Benzyl benzoate (%)
<b>Variety</b>	Sri Gamunu	6.30	1.03	55.24	16.43	71.67	6.78	3.25
	Sri Wijaya	4.51	1.52	37.78	23.81	61.59	14.81	8.08
	Sig. at $\alpha=0.05$	NS	*	***	*	**	***	***
<b>Physiological stage</b>	Flowering (1)	3.92	2.04a	38.22b	25.78a	63.99	12.11a	7.43a
	Fruiting (2)	6.01	0.81b	54.87a	10.86b	65.74	11.92a	6.74a
	Flushing (3)	6.29	0.98b	46.44b	23.73a	70.16	8.36b	2.82b
	Sig. at $\alpha=0.05$	NS	***	**	***	NS	**	*
<b>Variety Physiological stage</b>	G*1	3.90b	1.51	46.43	25.23	71.66	9.12	4.35
	G*2	5.90ab	0.75	63.17	5.72	68.89	7.59	4.24
	G*3	9.11a	0.82	56.11	18.35	74.46	3.61	1.16
	W*1	3.93b	2.57	30.00	26.32	56.32	15.09	10.52
	W*2	6.12ab	0.87	46.57	16.01	62.58	16.24	9.24
	W*3	3.47b	1.13	36.76	29.10	65.87	13.10	4.47
	Sig. at $\alpha=0.05$	*	NS	NS	NS	NS	NS	NS
<b>CV%</b>		44.37	37.32	18.59	32.76	11.22	22.51	54.36

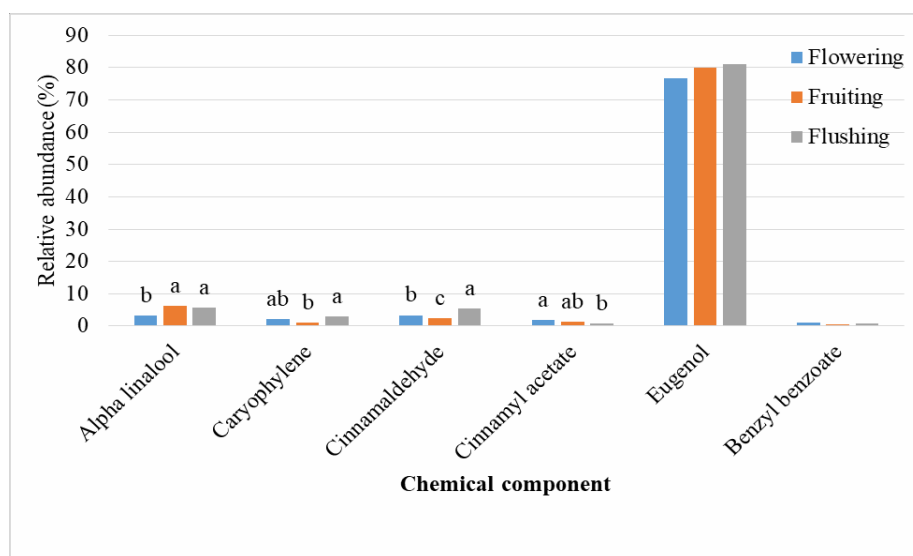


**Figure 2.** Mean percentage values of different chemical constituents in the bark oil of Sri Gamunu and Sri Wijaya at three different physiological stages.

**Table 3.** Comparison of mean percentage values of different chemical compounds in the leaf oil of Sri Gamunu and Sri Wijaya at three different physiological stages.

Factor	Levels	Alpha linalool (%)	Caryophyllene (%)	Cinnamaldehyde (%)	Cinnamyl acetate (%)	Eugenol (%)	Benzyl benzoate (%)
<b>Variety</b>	Sri Gamunu	4.77	2.45	4.57	1.30	77.22	0.97
	Sri Wijaya	5.23	1.56	2.84	1.32	81.26	0.47
	Sig. at $\alpha=0.05$	NS	*	***	NS	*	NS
<b>Physiological stage</b>	Flowering (1)	3.12b	2.05ab	3.38b	1.93a	76.73	1.06
	Fruiting (2)	6.24a	1.11b	2.35c	1.30ab	79.98	0.39
	Flushing (3)	5.66a	2.86a	5.38a	0.71b	81.01	0.69
	Sig. at $\alpha=0.05$	*	**	***	**	NS	NS
<b>Variety</b>	G*1	2.47c	2.68	3.25b	1.51	75.48	1.58
	G*2	4.79bc	1.41	3.80b	1.43	78.82	0.44
	G*3	7.06ab	3.26	6.66a	0.98	77.34	0.88
	W*1	3.76b	1.41	3.50b	2.34	77.98	0.54
	W*2	7.69a	0.81	0.89c	1.18	81.13	0.34
	W*3	4.25bc	2.45	4.11b	0.45	84.67	0.51
	Sig. at $\alpha=0.05$	*	NS	**	NS	NS	NS
<b>CV%</b>		40.4	46.4	21.9	44.8	5.0	86.4

Eugenol percentage in leaf oil among three stages, flowering (76.73 %), fruiting (79.98%), and flushing (81.01%) has no significant difference, and also not affected by genetical variation. Acetaldehyde and cinnamyl acetate whose sum accounts about 5% of the oil, are different in three stages while alpha linalool percentage is considerably higher in both fruiting and flushing stages compared to the flowering stage. Caryophyllene and benzyl benzoate are higher in the flowering and flushing stages compared to the fruiting stage.



**Figure 3.** Mean percentage values of different chemical constituents in the leaf oil of Sri Gamunu and Sri Wijaya at different physiological stages

## CONCLUSIONS/RECOMMENDATIONS

This analysis concludes that there was a significant dependence of oil contents on physiological stages and also on the effect of the genotype. There was no significant difference in the content of the major constituent, total cinnamaldehyde, in the bark oil among flowering, fruiting and flushing stages. The next major constituent eugenol was significantly higher in both flowering and fruiting stages compared to the flushing stage and a similar trend can be observed in benzyl benzoate content. Alpha linalool showed no significant variation among three stages while caryophyllene content was significantly higher in flowering stage compared to the other two stages. Eugenol percentage in leaf oil among three stages, flowering, fruiting, and flushing, had a significant difference, and also affected by genetical variation. The effect of genetic factor on the variation of chemical constituents in both bark and leaf oil among three stages was insignificant. In general, conclusion can be made as the flowering and fruiting stages may be better than flushing stage for harvesting.

## REFERENCES

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