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Research Article

A comparative quality appraisal of exported cardamoms of India, Sri Lanka and Guatemala

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Abstract

Exported cardamoms from India, Sri Lanka and Guatemala were characterized based on physical, biochemical parameters and molecular techniques. For most of the physical quality parameters and for the biochemical traits such as starch and crude fibre Indian cardamom is found superior to the other produces. Further, GC profile of the oil of Indian cardamom indicated higher quantities of α-terpinyl acetate and 1, 8-cineole, which impart aroma and flavour to the cardamom, thus reinforcing the legendary belief of high intrinsic quality of the Indian cardamom. Molecular profiling using RAPD/ISSR primers did not reveal much polymorphism.

Keywords: Cardamom, *Elettaria cardamomum*, India, Sri Lanka, Guatemala, Physical parameters, Biochemical parameters, Molecular technique.

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Introduction

Cardamom [***Elettaria cardamomum* (Linn.) Maton**], popularly known as the Queen of Spices (Hindi — *Choti Elachi*), is one of the most important spices exported from India. Though Indian cardamom topped the list of exported cardamom till 1960s, thereafter India's pre-eminent position in cardamom exports declined. After 1980s Guatemala emerged as a major exporter of cardamom. At present India faces stiff competition in the export of cardamom from other producing countries such as Guatemala, Sri Lanka, etc.

Traditionally, it has been believed that due to the high intrinsic quality, Indian produce is having an edge over cardamoms produced by other countries in the export though Indian export declined since 1980s. In the present context of liberalization of trade, this aspect needs to be studied scientifically so that the lost glory of Indian produce can be regained. India being a signatory to WTO, the reputed commodities like Indian cardamom can be protected through Geographical Indication Appellation (GIA). However, to protect a commodity under GIA, it is mandatory to define the tangible and intangible properties of the candidate commodity including the molecular profiling. The present work is an attempt in this direction to characterize the export grade Indian cardamom as against that of Guatemalan and Sri Lankan produces.

Materials and Methods

Export grade cardamoms from India, Guatemala and Sri Lanka were used in the present study (Fig. 1 A, B, C). Physical and biochemical quality parameters of the produces were recorded as per standard procedure. Moisture content was determined by Sartorius Moisture Analyzer (Ma100/MA50). The volatile oil was extracted from dried powdered seeds in a 1 litre flask with distilled water using Clevenger apparatus[1].

GC profile of 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 70ºC to 210ºC @ 5ºC per min using nitrogen as carrier gas. FID temperature was 300ºC and injection port 200ºC. Whole dried capsules of Indian, Guatemalan and Sri Lankan cardamoms were powdered and isolated the DNA using the protocol developed at our laboratory[2]. The isolated DNA was amplified using RAPD and ISSR primers. Ten random decamer RAPD primers (Operon Technologies, Almada, USA) were used for PCR amplification[3]. Five ISSR primers were also tested. 20ng genomic DNA and 60 Pico moles primer concentration were used for ISSR PCR. Concentrations of $MgCl_2$, dNTP and Taq DNA polymerases were used same as in the RAPD reaction. However, the annealing temperature was raised to 55°C and number of cycle repeats was 32. Two

A B C

Fig. 1: Export grade capsules of Cardamoms (A) Indian, (B) Guatemalan and (C) Sri Lankan

per cent Agarose gel containing 0.5 µg/mL of EtBr was used to run the sample.

Results and Discussion

Physical quality parameters such as weight of 100 capsules, number of capsules in 100 g, seed to husk ratio, bulk density (g/l), weight of splits (in 100 g) and colour intensity, circumference, length of capsules and the biochemical parameters such as total carbohydrates, starch, reducing sugar, protein, total free amino acids, phenols, crude fibre, ash, acid insoluble ash, volatile oil and moisture are given in Table 1.

Indian cardamom is found to be superior to the produces from Sri Lanka and Guatemala for the physical quality parameters such as weight of 100 capsules, seed to husk ratio, bulk density, circumference and length, whereas for the biochemical parameters except for the starch content no significant differences over the produces from the other two countries could be observed. Natarajan *et al* [4] reported physical parameters such as weight of 100 capsules (23-24g), seed to husk ratio (3:1) and biochemical characters such as volatile oil (9.4-9.6%), starch (39-43.7%) and crude fibre (9.5-12.8%) of cardamom growing in different regions of India.

Sri Lankan produce had higher oil content than those from India and Guatemala. However, in an earlier report of oil content of seeds varied from 6.6-10.6% for the two types of cardamom (cv. 'Mysore' and 'Malabar') grown in India[5]. Moisture content of Indian produce was significantly less as compared to Guatemalan and Sri Lankan, which indicates comparatively the better post-harvest practices being followed in India. Poor post-harvest processing of cardamom existing in other countries is reflected in low oil percentage and less splits in Guatemala produce as well. Protein content did not differ much among the three produces.

Though the oil percentage was comparatively low in the Indian cardamom, the GC profiling of oil indicates that Indian produce is rich in 1, 8-cineole and α-terpinyl acetate, the two most important quality traits of Indian cardamom as compared to the produces from Guatemala and Sri Lanka (Table 2 and Fig. 2 A,B,C). The legendary intrinsic quality of Indian cardamom may be due to these high volatile components.

Molecular profiling of cardamoms from the three sources revealed lack of significant polymorphism (Fig. 3). Ten random decamer primers produced a total of thirty one polymorphic bands. The percentage of polymorphism ranged from maximum of 32.1% (primer OPA19) to a minimum of 0.4% (primer OPB 01) among the Indian, Guatemalan and Sri Lankan cardamoms. In the RAPD banding pattern Sri Lankan and Guatemalan cardamoms shared many common bands, indicating their comparatively high genetic similarity.

In case of five ISSR primers, $(CAC)_3GC$, $(CTC)_3GC$, $(GACA)_3$, $(CA)_7AG$, $(AT)_7G$ studied, only one primer $(GACA)_3$ gave two polymorphic band with 11.1% polymorphism. The other four primers did not show any different banding pattern among the three cardamoms.

E. cardamomum is considered to be originated in the Western Ghats of India from where it has spreaded to other countries. It is believed that cardamom was introduced to Sri Lanka during the beginning of the 19th Century and to Guatemala by 1920s from Sri Lanka or India. Thus, the cardamom has a history of hardly 200 years of domestication in Sri Lanka and about 85 years of domestication history in Guatemala. Cardamom being a perennial crop, propagated vegetatively/sexually, the chances of evolving distinct types during the period of 100-200 years of domestication is not so bright though locally adapted population is a possibility. In other words Sri Lankan and Guatemalan cardamom will not be genetically far from their original gene pool (Indian cardamom).

Table 1: Comparative physical and biochemical quality parameters of Indian, Guatemalan and Sri Lankan cardamoms

Parameter	Indian cardamom	Guatemalan cardamom	Sri Lankan cardamom
Weight of 100 capsules(g)	24.26 ± 0.43	12.18 ± 0.27	18.23 ± 0.27
No. of capsules in 100g	334	807	554
Seed husk ratio	3:1	1.7:1	2.1:1
Bulk density (g/l)	384.64 ± 6.33	338.08 ± 3.45	286 ± 7.24
Weight of splits (in 100 g)	21.46 ± 0.49	6.8 ± 0.30	Nil
Colour intensity*(hue-lightness)	23 -13 to 24 -8	24-13 to 24-7	24-10
Circumference of the capsules(cm)**	2.46 ± 0.02	2.08 ± 0.02	2.13 ± 0.01
Length of capsules(cm)**	1.89 ± 0.12	1.60 ± 0.06	1.95 ± 0.07
Chemical Composition (%)			
Moisture	5.08	15.74	18.84
Oil	10	5	14
Starch	39.26	29.4	29.52
Carbohydrate	40.16	35.25	31.75
Reducing sugar	3.14	4.18	3.17
Phenols	3.26	4.75	3.88
Protein	1.03	1.05	1.42
Crude fibre	16.3	12.2	12.5
Ash	7.45	8.4	8.6
Acid insoluble ash	1.76	1.07	1.23

*A limit colour cascade — colour is assigned a two - part number, the first part designating the hue and second part denotes the lightness. Hue No.16-26 was assigned to green; on the lightness scale the palest colour assigned the number 1 and the darkest number 16.
**Average of 100 capsules.

Table 2: GC profile of volatile oil of cardamoms

Constituent (Area %)	Indian cardamom	Guatemalan cardamom	Sri Lankan cardamom
Pinene	1.95	1.43	1.93
Sabinene + Myrcene	7.11	5.62	7.00
Limonene	3.60	3.67	3.63
1,8-Cineole	32.55	27.89	31.39
α-Terpinene	2.31	2.32	1.90
Linalyl acetate	0.79	1.81	3.31
Geraniol	2.00	2.94	2.10
α-Terpinyl acetate	41.20	37.93	34.92

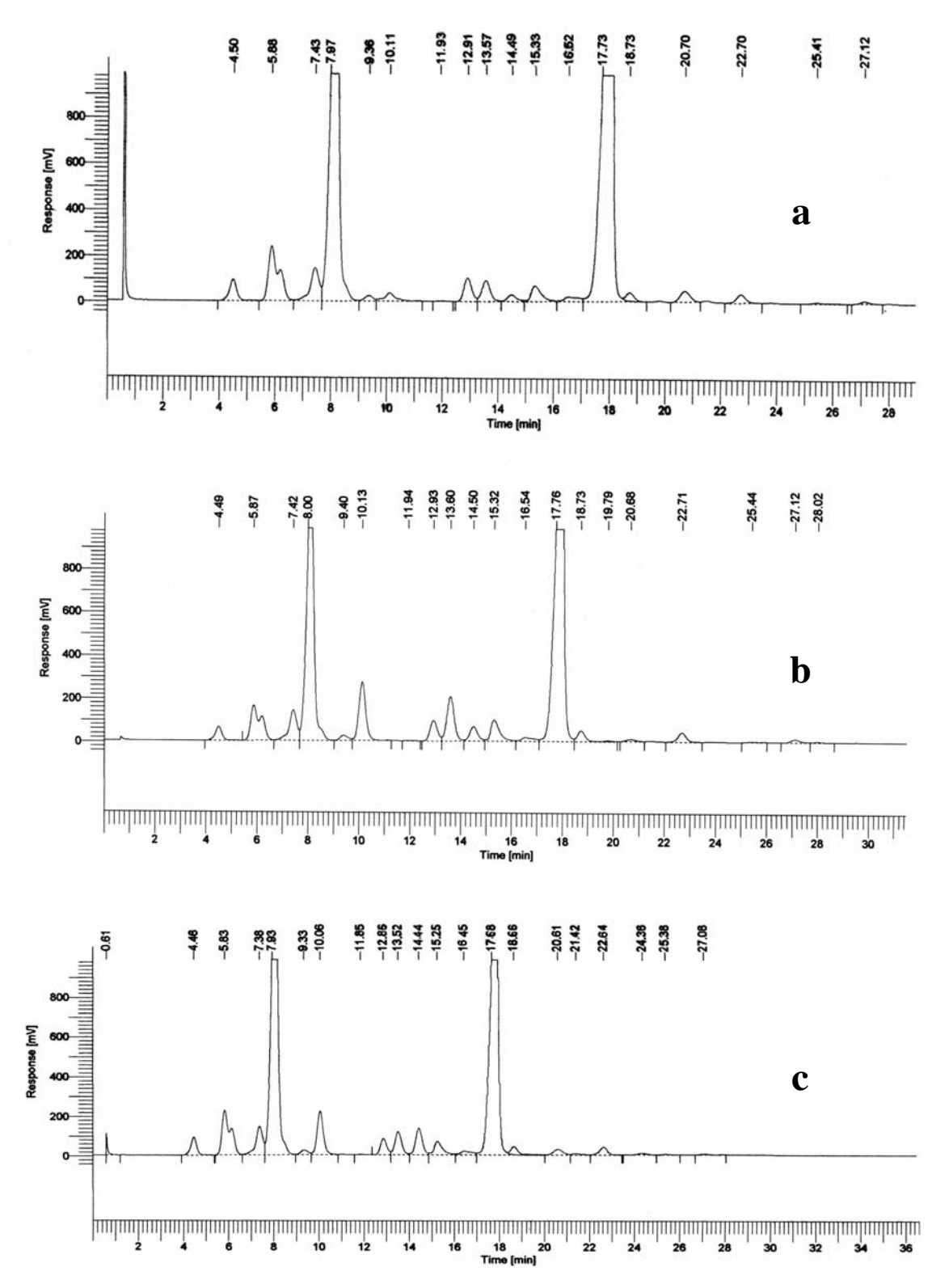

Fig. 2 : GC profile of the volatile oil of (a) Indian (b) Guatemalan (c) Sri Lankan cardamoms

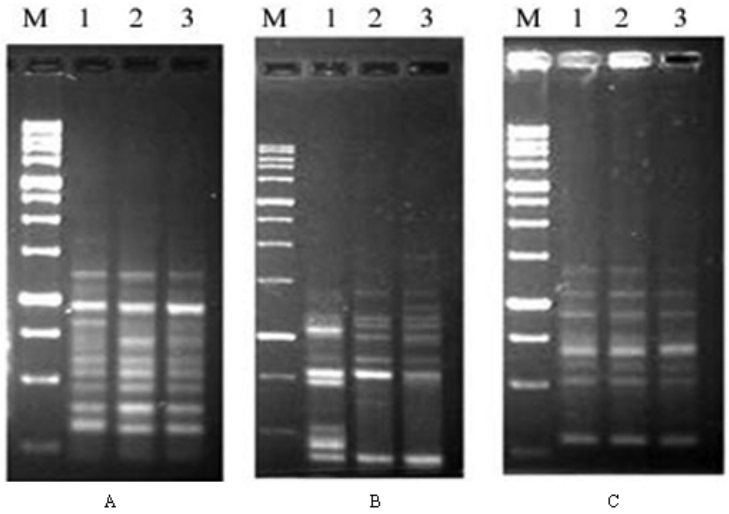

Fig. 3: RAPD profile of DNA isolated from Indian, Guatemalan and Sri Lankan cardamom capsules amplified with primer; A) OPA 10, B) OPA 19, C) OPA 20. M, 1Kb molecular size ladder. Lane 1– Indian; 2 – Guatemalan; 3 – Sri Lankan

This is reflected in the molecular profiling of the exported cardamom from the three sources[6-8].

Harvesting and post harvesting process to some extent affect the quality of the produce[9]. If cardamom is harvested at immature stage the splitting of capsules will be much less compared to ripe fruits[10]. Thus, though genetically not much variability is there in cardamoms of the different countries, there can be variation for the physical and biochemical quality characters due to variation in the post-harvest techniques. However, since Indian cardamom still originates from a broad genetic base, it can be expected to be superior to the produce coming from other countries. This is reflected in the better physical quality parameters and high 1, 8-cineole and α-terpinyl acetate of Indian cardamom in our study. In short the study indicates the superiority of the Indian cardamom in terms of physical and biochemical parameters over the Guatemalan and Sri Lankan produces.

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