Indian Curry Leaf

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A member of the natural order of *Rutaceae, Murraya Koenigii* (Linn) Spreng, the "Indian curry tree," is a pretty, small shrub or tree up to 6 m in height and 15 to 40 cm in diameter.[1] It occurs along the outer Himalayas, from the Ravi eastwards ascending to 1500-1655 m, in Assam, Chittagong, upper and lower Burma and Andaman islands. It also is found in Maharashtra and Tamil Nadu and abundantly in the high forests of Western Ghats in Karnataka.[1-4] Propagation is by seeds which germinate freely under partial shade;[1] rich soil is preferred.[2]

Small, glossy and green in color, with its tip usually notched, the curry leaf is lanceolate or somewhat rhomboid, irregularly crenatedentate, acuminate, obtuse or acute, base usually oblique, almost glabrous above, pubescent beneath, gland-dotted.[1,5] The leaf is fragrant,[6] strongly aromatic,[1] spicy,[7] and bitter, acrid, cooling, alexeteric, anthelmintic and analgesic.[5]

Heath[6] describes the sensory character of curry leaf as "distinctly curry-like, spicy." The flavour enhancing qualities of this spice harmonize with South Indian cooking—especially suited to curries, vegetable, fish and meat dishes, soups (rasams), pickles, butter milk preparations, chutneys, scrambled eggs, *uppuma,* mixtures, curry powder blends, etc.

Curry leaves contain moisture, 66.3%; protein, 6.1%, fat, (other extr.) 1.0%; carbohydrate, 16.0%; fibre, 6.4% and mineral matter, 4.2%. 100 grams of the leaf contain calcium, 810 mg; phosphorus, 600 mg; and iron, 3.1 mg; carotene, (as vitamin A), 12600 i.u.; nicotinic acid, 2.3 mg; and vitamin C, 4 mg.[1] The proximate composition of tender, medium and mature leaves indicates that the concentration of total N, crude protein, fat, total sugars, starch, and crude fibre are of the order: tender < medium < mature.[9] The leaves are a fair source of vitamin A and a rich source of calcium.[1] Oxalates are also present: total oxalates, 1.352%; soluble oxalates, 1.155%[10] unfortunately the high concentration of oxalic acid reduces its nutritional availability;[1,10] leaves and twigs contain 0.8% potash.[1] Asparagine, glycine, serine, aspartic acid, glutamic acid, threonine, alanine, proline, tyrosine, tryptophan, α-aminobutyric acid, phenylalanine, leucine, isoleucine and traces of ornithine, lysine, arginine and histidine are the free amino acids identified in the leaves.[11] A crystalline glucoside designated as "koenigin," resin and volatile oil are also ingredients of the leaves.[1,8]

Different methods of drying sorted curry leaves and changes in the color registered are recorded—sun-drying (33°C), drying by cross-flow (55-58°C; air velocity 1.5-2.0 m/sec.), through-flow (55-58°C; air velocity 3.5-4.5 m/sec.) and vacuum shelf (50°C), with tray load 59 g/93 sq. cm.[9] Sun-drying is fairly fast but it creates a very dark material.[9] Other methods give leaves a light to medium green color, with the vacuum shelf material exhibiting better green color.[9] From an organoleptic point of view, the cross-flow and vacuum-dried leaves are marked by superior flavor qualities.[12]

Reference was made that curry leaf contains a volatile oil. Simonsen and Penfold[4] judged that this oil is not an article fit for economic exploitation since it is obtained in poor yield with high concentration of sesquiterpenes. A suggestion was made that unless the leaves are steam distilled immediately after collection, decomposition occurs with loss of volatiles. However, by subjecting curry leaves just after plucking to steam distillation at 30 lbs pressure, the yield of oil amounts to only 0.04%. On the other hand, simple hydrodistillation of fresh leaves harvested from young plants affords a slightly better yield of about 1%.[13] Dutt[8] secured 2.6% yield by steam distillation of fresh leaves at 90 lbs psi and an initial temperature of 146-148°C. The physicochemical properties of the oil, e.g., color and acid value, betray modifications of the components;

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sesquiterpenes are augmented at the expense of monocyclic terpenes. Nevertheless, if available on a commercial scale, the oil may serve as an odor principle in fixative of a moderately heavy (spicy) type soap perfume.[8] Perhaps the optimum yield of about 3% of curry leaf oil is reported from the Forest Research Institute[3] but details on this achievement are lacking.

From the study of Prakash and Natarajan,[9] it is seen that the yield of volatile oil decreases as we pass from tender, medium to mature leaves: 0.82 →0.55 →0.48%; through-flow drying of mature leaves provides maximum yield (0.87%). Also, availability of volatile oil is comparatively more from dried leaves than from fresh leaves. This implies that moisture plays a role in the release of oil from the leaves.[9]

Amma and co-workers,[12]however, give a slightly different picture. Oil yield from dried leaves varies from 0.6-0.7%, maximum being from cross-flow dried (50-60°) material. Further, oils from the cross-flow and oven-dried leaves are more or less similar to the one from fresh leaves.

The isolation of the oil by hydrodistillation of curry leaf oleoresin is of academic interest.[12]

Studies up to 1975 on the composition of curry leaf indicated the presence of the following: limonene, phellandrene, α-pinene, β-pinene, sabinene, α-terpinol, cadinol, α-caryophyllene (humulene?), β-caryophyllene, cadinene, isosafrol, lauric and palmitic acids.[4,8,9,12-14]

More recently, subjecting the oil to programmed GC/MS screening, it was found to contain 48 main components of which 27 (comprising about 83% of the sample) have been positively identified.[15] The oil is composed essentially of terpenes—8 monoterpenes (15.9%) and 17 sesquiterpenes (80.2%). The most important constituents are β-caryophyllene, β-gurjunene, β-elemene, β-phellandrene and β-thujene. Other sesquiterpenes identified are α-cubebene, α-copaene, ϵ-muurolene, β-bisabolene, γ-cadinene and α-selinene. There is no evidence of the presence of α-caryophyllene (humulene) in the oil. The intense characteristic aroma of *M. koenigii* is probably due to terpene hydrocarbons and presumably the most important contributors are β-caryophyllene, β-gurjunene, β-elemene and β-phellandrene.

A study has been made of the isolation of oleoresin by extraction of curry leaves with different solvents.[9] Using alcohol and acetone, in the 18 to 20 h runs, the oleoresins yields (on the basis of dry leaves) decrease from tender, medium to mature leaves. From medium leaves, ethylene dichloride produces the highest yield of 2.31%. With petroleum ether, the isolates obtained are respectively 3.28, 4.74 and 6.15% from tender, medium and mature leaves. The oleoresins from cross-flow dried leaves by contacting for 16 h with 6 times of its weight of petroleum ether (bp 60° to 80°C), ethyl acetate, EDC and acetone at ambient temperature amount to 3.33%, 4.66%, 4.50% and 4.30% respectively.[12] The curry leaf oleoresin derived through petroleum ether is organoleptically the best, with pronounced curry leaf smell; the EDC extract is slightly grassy and the acetone product, grassy poor.[12] By stirring tender, medium and mature leaves with cold water at 20°C for one hour and evaporating the filtrate to dryness, the extract yields are 30.28%, 28.80% and 27.33% and by corresponding treatment with water at 95°C, 35.84%, 33.90% and 37.45% respectively.[9]

For years, *Murraya koenigii* in addition to its therapeutic values, has enjoyed a unique status as a flavoring principle in Indian cuisine. For seasoning, fresh green leaves are the best; but if this is not available, the dried leaves serve the purpose. Curry leaf extractives are now available in water/oil soluble and emulsified forms.

Will the world that is embracing natural materials welcome this traditional Indian spice to create novel food flavors?

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