

A process for the extraction of ginger oleoresin with optimum quality

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A counter current percolation method for the extraction of ginger oleoresin is described. Sequential soxlet and overnight (lab) percolation methods are compared with this method. Three solvent combinations, viz. acetone, alcohol, and acetone:alcohol (50v/v) were tried for the oleoresin extraction. Solvent spice ratio is minimum in the counter current extraction and maximum in the lab method. Gingerol and essential oil levels of the oleoresin by counter current extraction is comparable to other methods. Aroma quality of the essential oil obtained by counter current extraction using alcohol is superior to other solvent combinations.

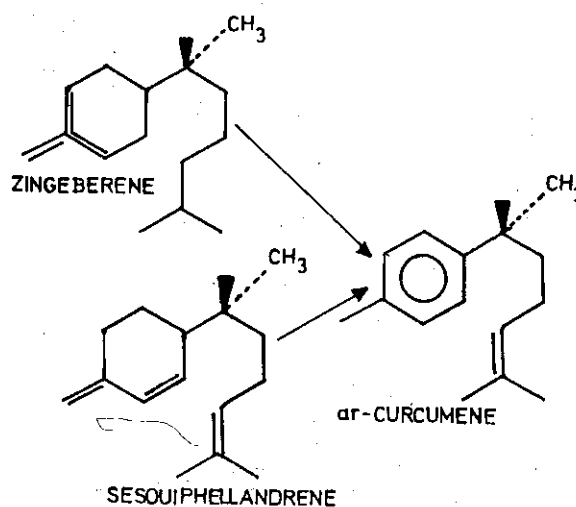
A concentrated form of ginger, which contains not only its aromatic and odorous constituents but also the non-volatile pungent principles, is the oleoresin of ginger often called commercially as gingerin. In preference to natural spice, usage of oleoresin is gaining ground due to its high flavour intensity low microbial contamination and economy in use. Adamsan¹ elaborated the problem relating to the production of ginger oleoresin and emphasised to have a planned extraction of oleoresin with appropriate solvent or solvent combinations. A need for the specific solvent which extracts only aroma and pungent constituents prohibiting the admixing of non-flavour constituents like organic acids, sugars, soluble oligo saccharides, and colouring matter is long felt. The sequence of operations in processing ginger for oleoresin include selection of raw materials, combination of the spice, choice of solvent and extracting conditions, solvent recovery and residual solvents in the oleoresin, besides the overall quality are the factors that determine the efficiency of the process^{7,10}. Earlier reports^{6,10} on the oleoresin extraction give only brief summary and not the technical details of the process. A comprehensive account of continuous extraction process amenable to automation and control and quality of the oleoresin thus obtained are presented in this paper.

Materials and methods

Dried ginger samples used in this study were procured from the wholesale market of Calicut. They were powdered using a pestle and mortar and sieved through 20 mm mesh. Oleoresin was extracted by

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counter current, sequential, soxlet and cold solvent percolation methods⁹.

Counter current extraction—A step-wise working pattern of counter current extraction is presented in Fig. 1. Three glass columns 45 × 4 cm were taken and filled with the solvent (125 ml). After 6 hours contact soluble from column I is taken to column II and from II to column III there by solvent from step I comes in contact with spice from step II and eluate from step II comes in contact with the spent spice of the successive step.

Sequential extraction—Sequential extraction adopted in this study is as follows. Three 45 × 4 cm columns are filled with 20 g spice and 75 ml of the solvent. After 6 hours spice solvent contact the eluate from A is transferred to column B, from B to C and from C to A. This is repeated after 6 hours without either changing the solvent or spice. After operating this for 4 cycles the eluates are pooled up, solvent stripped under vacuum and thick viscous oleoresin is separated.

Table 1—Spice solvent input and utilization, extractive yield, gingerol and essential oil contents of ginger oleoresin under counter-current, sequential, soxlet and cold solvent percolation

Method of extraction	Input		Solvent spice utilization ratio	Per cent extractive yield	Per cent gingerol	Per cent essential oil
	Spice g	Solvent ml				
Counter current	150	375	2.50	6.04	28.0	28.0
Sequential	60	225	3.75	5.71	26.0	25.0
Soxlet	30	100	3.33	6.84	27.6	25.0
Cold solvent percolation	10	125	12.50	6.31	27.0	32.0

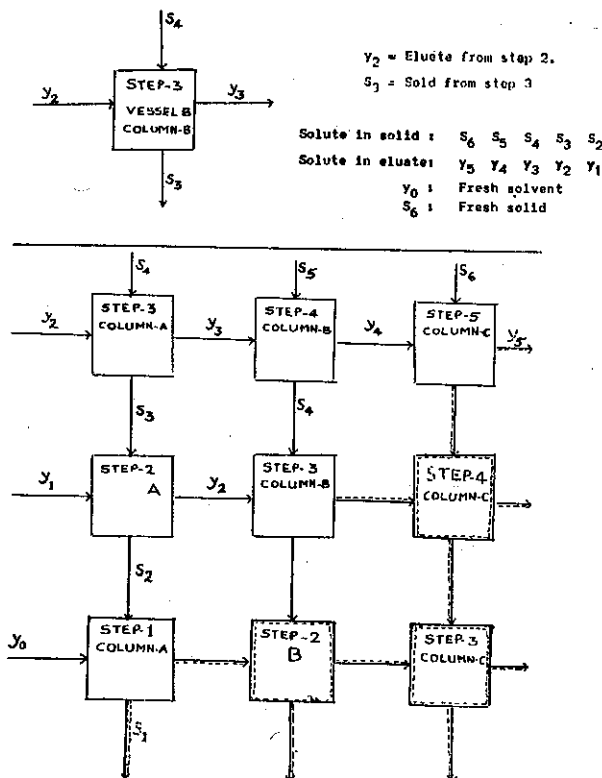


Fig. 1—Schematic representation of counter current extraction of ginger oleoresin adopted in this study

Soxlet extraction—In a soxlet extractor 30 g of the spice powder is loaded with a cotton plug on the capillary of the extractor and extracted with 100 ml of the solvent for 3 hours at 90°C. Spice solvent in this process is ensured for 10 cycles then extract is removed, stripped of the solvent under vacuum and a thick mass is separated.

Cold solvent percolation method—10 g of the spice powder is loaded in a glass column 45 × 1.5 cm and 125 ml of the solvent is percolated after overnight contact. The percolate is stripped of the solvent and viscous mass is separated for further analysis.

Gingerol and essential oil contents are estimated as per the ISI and AOAC methods^{2,5} respectively. Hydrodistilled oil is evaluated for the aroma quality

by gas chromatography as per the method of Narayanan and Mathew⁸.

Results and discussion

The input of spice, solvent, the ratio of solvent to spice, oleoresin yield, gingerol and essential oil contents under counter current, sequential soxlet and cold solvent percolation methods are presented in Table 1. The spice holding capacity in the counter current extraction is maximum 2.5, 5 and 15 times more as compared to sequential, soxlet and lab methods respectively. Spice solvent utilization in counter current extraction is minimum and maximum in lab method. Even though extractive yield is maximum by soxlet method but it is comparable to lab and counter current methods. Similar trend is observed in case of essential oil contents. A heat treatment beyond 100°C is not desirable and is likely to remove some of the volatile constituents¹⁰ and soxlet extraction employing high temperature evidently reduce the volatile oil. A slight increase in the oleoresin content may be due to influx of resinous matter. Gingerol content do not appreciably change due to various extraction methods. In the process designing an ideal situation would be to reach the laboratory method of extraction in terms of efficiency which is noticed in case of counter current extraction.

Yield of the oleoresin, gingerol and essential oil contents obtained by different solvent combinations is presented in Table 2. Alcohol extracts more oleoresin and essential oil content in the latter is also more as compared to other solvents. Gingerol content remained more or less the same.

Gas chromatographic profile of the essential oils obtained by the hydro-distillation of the oleoresin are presented in Fig. 2 and the data presented in Table 3. Flavour of the oleoresin depends on the individual composition of the oil constituents. Pinenes, which impart turpentine odour, is highest in acetone; alcohol extractives are comparable to original oil. Camphene and propionaldehyde are high in all

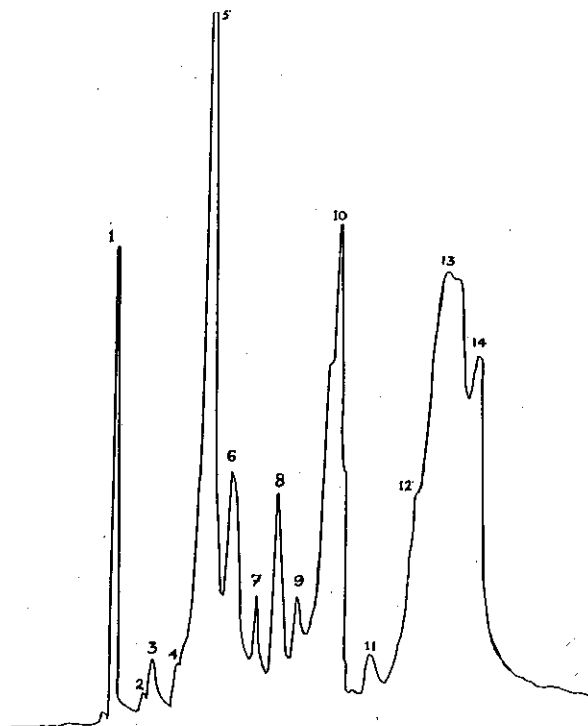
Table 2—Yield of oleoresin, % gingerol and essential oil contents with different solvents

Solvent	Extractive yield	Per cent	
		Gingerol	Essential oil
Acetone	5.8	24.5	26.0
Acetone alcohol (50 v/v)	5.4	26.0	28.0
Alcohol	6.3	27.0	32.0

Table 3—Gas chromatographic evaluation of essential oil obtained from ginger oleoresin with different solvent combinations

Constituent	% of the total constituents present in oil obtained from the oleoresin with			
	Oil direct distillation	Acetone	Acetone alcohol (50 v/v)	Alcohol
α -Pinene	0.40	0.48	0.54	0.26
β -Pinene	0.05	0.23	0.33	0.20
Camphene	0.17	0.32	1.16	0.79
Propionaldehyde	0.16	1.75	0.68	0.54
Cineole	2.35	0.69	2.99	1.26
<i>p</i> -Cymene	1.08	0.28	2.32	0.89
Linalool	0.37	0.55	0.88	3.26
Zingiberene	4.69	12.86	20.04	17.13
ar-curcumene	46.15	51.70	55.16	46.24
Sesquiphellandrene	37.87	24.20	12.28	23.57
Unidentified	6.04	6.89	4.63	5.84

the extractives than the original oil suggesting that these constituents accumulate more in the extractives oil than in direct distillation. In acetone:alcohol extract more cineole content is observed. Cineole imparts camphory note to the oil or oleoresin. Interestingly, original oil also contains high cineole; whereas in alcohol extractive it is low. Linalool, which is generally present in high concentration in fresh ginger¹¹, is more in alcohol extractive. Even though above constituents account for 6 per cent of the total composition, these minute quantities may be sufficient to alter the sensory profile of the ginger oleoresin. Zingiberene, β -sesquiphellandrene and Ar-curcumene are the most important compounds of the ginger oil³. The algebraic sum of the zingiberene and sesquiphellandrene of alcohol extractive essential oil are more and comparable to original oil. ar-curcumene is secondary product of essential oil and obtained on the conversion of β -sesquiphellandrene and zingiberene. This conversion appears to be more in acetone or acetone:alcohol extractives. The ratio of β -sesquiphellandrene and zingiberene/curcumene which is


 Fig. 2—Gas chromatogram of essential oils from ginger oleoresin peak description-1: α -pinene, 2: β -pinene, 3: camphene, 4: propionaldehyde, 5: cineole, 6: *p*-cymene, 7: linalool (peaks: 8, 9, 10, 11 are unidentified), 12: zingiberene, 13: ar-curcumene, 14: β -sesquiphellandrene

indicative of the age of oleoresin is in the order of 0.88 and 0.92 in case of essential oils of alcohol extractives and original oils respectively and are comparable⁴.

To conclude, the counter current extraction procedure described in this study is suitable for industrial upscaling as solvent: spice utilization is optimum with oleoresin yields comparable to that of laboratory method. The chemical and flavour quality of the alcohol derived oleoresin is superior to all other solvent combinations.

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