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SENSORY CONTRIBUTION FROM EXTRACTS OF BOTANICALS TO DISTILLED ALCOHOLIC BEVERAGES

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Abstract : Extracts from botanicals were examined by sensory evaluation for their ability to improve the flavour of 15% aqueous ethanol as an alcoholic beverage. More than 75% of the 35% aqueous ethanol extractable constituents were extracted from the powdered botanicals on refluxing in Soxhlet for 2 h. The extracts from cloves, cinnamon, "ingurupiyali", ginger, cardomum, nutmeg and mace improved the flavour of 15% aqueous ethanol at concentrations of 8.2, 1.9, 3.3, 6.7, 2.5, 22.5, and 26.3 ppm respectively. The extracts of cummin seeds, coffee beans and pepper did not contribute positively to flavour of 15% aqueous ethanol at their most acceptable concentrations. The extracts of coriander, dill seed, fenugreek, mustard and "valmee" did not contribute a regular flavour pattern when assessed at a series of concentration and hence were eliminated. Cinnamon, cloves and cardomum provided the most preferred flavour contributions individually as well as in combinations of two at a time, at several concentrations.

1. Introduction

Flavouring of aqueous ethanol (spirits) with botanicals is practised to produce alcoholic beverages in the liquor industries today, avoiding the maturation treatment. In Sri Lanka, the production of alcoholic beverages from silent spirits is expanding in view of the decline in production of spirits from fermented palm saps, coconut (*Cocos nucifera* L.) and palmyrah (*Borassus flabellifer* L.).

In this study extracts from locally available botanicals were added to silent spirits. The concentrations at which the extracts from botanicals rendered the spirits more acceptable, and their presence recognized were established by a sensory evaluation panel.

The order of preference of individual and combined botanicals, that rendered the spirits most acceptable was established.

2. Materials and Methods

2.1 Botanicals

The botanicals cardomum (*Elettaria cardomomum*), cinnamon bark (*Cinnamomum zeylanicum*), clove buds (*Syzyngium aromaticum*), coffee bean

(*Coffea arabica*), coriander seed (*Coriandrum sativum*), cummin seed (*Cuminum cyminum*), dill seed (*Anethum graveolens*), fenugreek (*Trigonella foenum graceum*), ginger (*Zingiber officinale*), "ingurupiyali" (*Kaempferia galanga*), mace and kernel of nutmeg (*Myristica fragrans*) mustard seed (*Brassica juncea*), black pepper (*Piper nigrum*) and stems of "valmee" (*Glycorrhiza glabra*) were used to extract flavour constituents.

2.2 Test Solutions

The ethanol test solutions were prepared by diluting potable spirit containing 96%(v/v) ethanol with glass distilled water to 35% ethanol for the extraction of botanicals and 15% ethanol for sensory evaluation. All test samples were brought to the same colour by adding caramel. The potable spirits used in this study was purchased from State Sugar Corporation, Kantalai. The GLC trace of the spirits on a BP 20 capillary column and flame ionization detector gave only one peak (ethanol) and the estimated purity was 100%.

2.3 Sensory Evaluation

Panel: From a pool of 100 volunteers employed at the State Distilleries Corporation, Kandy, 30 volunteers were selected based on their ability to judge alcoholic beverages as examined by "Tringle Test" and the "Duo—trio test". [1] These volunteers who formed the panel were divided into 6 groups, so that each group consisted of sensory evaluators of different age, health status, education, smoking habits, type of employment and living area.

In sensory evaluation, the judges of the panel were required to rank the samples in a 'hedonic scale' indicating their preferences as : 1—like extremely : 2—like very much : 3—like moderately : 4—like slightly : 5—neither like nor dislike : 6 -dislike slightly : 7—dislike moderately : 8—dislike very much and 9—dislike extremely.[1] The duplicate and triplicate samples submitted in the preliminary experiments showed up to 5% variations in judgements.

All sensory evaluation experiments were carried out in late mornings, between 9.00 a.m. to 11.00 a.m. and early evenings, between 2.00 p.m. to 3.30 p.m. on week days avoiding Monday mornings and Friday evenings. Samples were served in clean 50ml clear glasses of the same type, in a quiet room with comfortable seats, artificial lighting from fluorescent tubes and containing air free from destructive odours. Between 6—9 samples were tested by a judge in a given sitting. Boiled water and facilities were provided to rinse the mouth prior to tasting each sample.

2.4 Extraction of Flavour Constituents from Botanicals

The botanicals were ground to pass through 500 mμ sieve, in a Stein mill model M—2 for 3 min. at a speed of 7. The moisture was estimated by drying 1g samples at 105^0C for 2 h.[3] The powdered botanicals equivalent to 5g on dry weight basis, were extracted with 100 ml 35% aqueous ethanol in

Soxhlet at a siphon rate of 8—10 cycles per h for 1h. The residue was re-extracted thrice under similar conditions. A fraction from each extract (10 ml) was evaporated to dryness over a water bath and then in a vacuum oven at 70^0 C to estimate the dry weight.

Solutions of botanical extracts were prepared by pooling the Soxhlet extracts from first and second extractions and making to 200 ml with 35% aqueous ethanol. The resulting solutions, were diluted 10 fold with 35% aqueous ethanol and stored at 4^0 C pending evaluation.

2.5 Establishment of Unpleasant and Detection Thresholds

A series of test samples of 15% ethanol containing the extracts of each of the botanicals in the order of increasing concentration was submitted to the judges in the six groups to assess the concentrations of individual botanicals at which the spirits become unpleasant and the concentration at which the added botanical could be identified. (The botanical used was not disclosed to the judges). The concentration at which 50% of the judges assessed spirits as unpleasant was established as unpleasant threshold. The concentration at which 50% of the judges identified the added botanical correctly was established as the detection threshold.

2.6 Establishment of Most Acceptable Concentrations

A series of nine samples for each of the botanicals, within the range decided by the unpleasant threshold and by the preliminary experiments, was submitted to the judges for ranking in the nine point hedonic scale. The samples submitted, randomized among and within the groups were coded using numbers or letters following no specific sequence. Histograms were prepared for each of the rank (1—9) and for each botanical by plotting the number of judges giving the rank against the concentration of the botanical. The most acceptable concentration was established as the concentration preferred by the highest number of judges from the mode of the frequency distribution.

2.7 Statistical Analysis

Non—parametric techniques were used for the analysis of data as application of parametric proceedures of analysis would not be valid for data based on ranks. The setting up of this study was a randomized complete block where the judges were taken as blocks and the botanical extracts as treatments. The overall significant differences among the treatments were assessed by Friedman's test.[2] In establishing the most acceptable concentrations of botanicals the data were analysed using Wilcoxon rank—sum test for comparisons in pairs.[2]

2.8 Comparison of Botanicals for Order of Acceptability at Their Most Acceptable Concentrations

The ethanol test solutions flavoured with individual botanicals at their most acceptable concentration were compared together with 15% ethanol containing no extracts and the order of preference was established based on the ranking by the judges in the nine point hedonic scale.

A second set of ethanol test solutions containing a combination of extracts from two botanicals at a time, each contributing 50% of the most acceptable concentration was prepared. The 45 different combinations of test solutions grouped into five sets were initially ranked by the judges in the hedonic scale. The most acceptable combination of extracts in the test solutions from each of these sets were next ranked together in a six point hedonic scale by the judges to select the order of preference.

A third set of ethanol test solutions containing a combination of extracts from two botanicals at a time, one contributing 25% of it's most acceptable concentration and the other contributing 75% of it's most acceptable concentration was prepared. The ninety combinations produced were grouped into 10 sets for ranking as before. The most acceptable two samples for each set, together with a control of 15% ethanol (total of 21 combinations) was divided into 3 groups of 7 each and ranked by judges in a seven point hedonic scale. The final order of preference was established based on ranking by the judges in these 3 stages.

2.9 Overall Order of Preference of Botanicals

The overall order of preference of botanical extracts in 15% ethanol solution was established by ranking the most acceptable two samples from each of the above sets, containing the individual botanicals extracts, combination of extracts from two botanicals at 50% most acceptable concentration and the combination of extracts from two botanicals at 25% and 75% most acceptable concentrations. The ranking by the judges was done in a seven point hedonic scale.

3. Results and Discussion

3.1 Extraction of Flavour Constituents

Aqueous ethanol (35%) was used in extracting the botanicals as the extracted material should be totally soluble giving a clear liquid at the market—strength of spirits. It was found that 85% of the aqueous ethanol extractable material could be obtained by extracting in Soxhlet for 2 h. except in case of ginger where only 70% was extracted. The extraction for 2 h in Soxhlet was therefore fixed as the standard. The botanicals used for extraction contained less than 10% moisture except for "valmee"(Table 1).

Table 1. The moisture percentage and the concentrations at which the botanical extracts are detectable, unpleasant and most acceptable in 15% ethanol.

botanical	moisture percentage	thresholds (mg extract/l)		
		detection	unpleasant	most acceptable
cardomum	8.6	5.10	4.68	2.55
cinnamon	7.3	4.75	3.33	1.90
cloves	5.5	11.28	10.25	8.20
coffee bean	8.3	16.80	14.40	12.00
coriander	7.5	1.68	0.56	0.00
cummin seed	6.4	8.05	4.60	3.45
dill seed	6.4	2.59	0.93	0.00
fenugreek	4.9	3.78	0.54	0.00
ginger	14.8	8.55	9.50	6.65
"ingurupiyali"	9.8	5.80	4.71	3.26
mace	3.8	n. i.	30.63	26.25
mustard	6.5	2.21	0.98	0.00
nutmeg	4.8	28.13	26.25	22.50
pepper seed	5.9	4.39	3.04	2.03
"valmee"	10.9	3.31	2.04	0.00

n. i. — not identifyable up to 70 mg/l

In establishing the sensory evaluation panel reliability was achieved as far as possible by eliminating those who failed to detect flavour differences when tested by "Triangle" and "Duo—trio" tests. The uniformity and wide range of sensory responses was maintained by grouping the judges so that each group contained people of diverse habits.

3.2 Unpleasant and Detection Thresholds

The botanical extracts in test solutions could contribute a decoction—like flavour to the spirits at certain concentrations causing a disadvantage. The recognition of the botanical added to improve the flavour may sometimes

devalue the product and discourage the consumer. The concentrations at which these features would become obvious was establised by sensory evaluation (Table 1). It is noteworthy that the concentration at which the flavoured test solutions could be detected was higher than the concentrations at which the presence of flavour constituent from the botanicals render the test solutions unpleasant except in case of ginger.

3.3 Most Acceptable Concentrations

Of the extracts from the 15 botanicals examined, the test solutions flavoured with coriander, dill seed, fenugreek, mustard and "valmee" did not show a normal distribution pattern when the number of judges giving any given rank was plotted against the concentration. They were eliminated from further tests as their most acceptable concentration cannot be established (Table 1). Of the extracts from the balance 10 botanicals evaluated cloves, cinnamon, "ingurupiyali", ginger, cardomum, nutmeg and mace were judged to improve the flavour of 15% ethanol at their most acceptable concentrations, with cloves and cinnamon providing the best flavours (Table 2).

Table 2. The decrease in order of acceptability of extracts from individual botanicals in 15% ethanol and their most acceptable concentrations. (mg extract / l).

botanical (in decreasing order of acceptability)	most acceptable concentration
cloves	8.2
cinnamon	1.9
"ingurupiyali"	3.3
ginger	6.7
cardomum	2.5
nutmeg	22.5
mace	26.3
15% ethanol (control)	--
cummin seed	3.5
coffee bean	12.0
pepper	2.0

Of the 45 combinations of spirits obtained by combining extracts from two botanicals at a time, at 50% of their most acceptable concentrations, only 5 combinations contributed to the flavour of 15% ethanol positively (Table 3). Cardomum, cinnamon and cloves between themselves were judged to provide the most preferred combinations.

Table 3. The decrease in order of acceptability of combination of extracts from botanicals at 50% of their most acceptable concentration. (mg extract / l)

botanicals		concentration	
A	B	A	B
cardomum	cinnamon	1.25	0.95
cinnamon	cloves	0.95	4.10
"ingurupiyali"	ginger	1.63	3.33
coffee	"ingurupiyali"	6.00	1.63
cloves	"ingurupiyali"	4.10	1.63
15% ethanol	–	—	—

Of the 90 possible combinations evaluated as combined extracts from two botanicals, one contributing at 25% of its most acceptable concentration, and the other contributing at 75% of the most acceptable concentration, 19 combinations were judged to provide a better flavour than the control, 15% ethanol (Table 4). Combinations of cloves, cinnamon and cardomum between themselves were judged to be the best. Extracts from these three botanicals appeared to occur more frequently in combination with others in the 19 more preferred combinations.

Table 4. The decrease in order of acceptability of combinations of extracts from botanicals at 25% (A) and 75% (B) of their most acceptable concentrations (mg extract / l).

botanical		concentration	
A	B	A	B
cloves	cinnamon	2.05	1.43
cinnamon	cardomum	0.48	1.91
cardomum	cloves	0.64	6.15
mace	cinnamon	6.56	1.43
cummin seed	ginger	0.86	4.99
"ingurupiyali"	ginger	0.82	4.99
nutmeg	cinnamon	5.63	1.43
nutmeg	cloves	5.63	6.15
cummin seed	cinnamon	0.86	1.43
"ingurupiyali"	cloves	0.82	6.15
ginger	cinnamon	1.66	1.43
ginger	cloves	1.66	6.15
pepper	ginger	0.51	4.99
mace	cardomum	6.56	1.91
cardomum	cinnamon	0.64	1.43
cloves	"ingurupiyali"	2.05	2.45
cinnamon	ginger	0.48	4.99
coffee	cinnamon	3.00	1.43
coffee	cardomum	3.00	1.91
15% ethanol	–	–	–

3.4 Overall Preference of Added Botanical Extracts

When the two most acceptable botanicals or combinations of botanicals from each of the above sets (Tables 2, 3 and 4) were compared, combination of cloves and cinnamon was judged the best (Table 5). It is noteworthy that in all experiments the extracts from the botanicals cloves, cinnamon and cardomum were judged to make the best contributions towards flavour individually as well as in the two different combinations examined.

Table 5. The most acceptable concentrations of extracts from individual botanicals and combinations of botanicals arranged in the decreasing order in 15% ethanol.

botanicals		concentration (mg /l)	
A	B	A	B
cloves	cinnamon	2.05	1.43
cinnamon	cardomum	0.48	1.91
cinnamon	cloves	0.95	4.10
cardomum	cinnamon	1.28	0.95
cinnamon	-	1.90	—
cloves	—	8.20	—
15% ethanol	—	—	—

4. Conclusion

Extracts from cloves, cinnamon and cardomum could be used in improving the flavour characteristics of silent spirits to produce a processed alcoholic beverage more acceptable than the beverages produced by using the spirits alone.

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