

DEVELOPMENT AND STORAGE OF GINGER (*Zingiber officinale*)

BLEND WITH LIME (*Citrus aurantifolia*)

READY-TO-SERVE (RTS) FUNCTIONAL BEVERAGE,

SWEETENED BY PALMYRA SUGAR CANDY.



BY

GANESHAMOORTHY HARIHARAN



FAG410



Project Report
Library - EUSL

DEPARTMENT OF AGRICULTURAL CHEMISTRY

FACULTY OF AGRICULTURE

EASTERN UNIVERSITY

SRI LANKA

2015

PROCESSED
Main Library, EUSL

ABSTRACT

In this modern world, there has been growing recognition of the key role of foods and beverages in disease hindrance and treatment. Thus, the production and consumption of functional beverages has gained much importance as they provide a health benefit apart the basic nutritional functions. Therefore, a study was conducted to develop a functional RTS beverage by exploiting the medicinal, nutritional and organoleptic properties of ginger juice, lime juice and palmyra sugar candy.

Local and Chinese varieties of ginger rhizomes were taken and their physico-chemical and organoleptic parameters were analysed to select the best variety of ginger for RTS beverage formulation. Considering the findings of several preliminary studies, six formulations of the functional RTS blends were prepared by blending different percentages of ginger juice and lime juice including a control (where only ginger juice was added). The freshly prepared formulations were subjected to physico-chemical and sensory analysis and most preferred formulations (four formulations including a control) were selected for storage studies. The formulations were stored at 30°C room temperature and 70-75% of RH for 12 weeks. Physico-chemical parameters such as pH, TSS, titrable acidity, ascorbic acid content and total sugar, organoleptic qualities such as colour, aroma, pungency, taste and overall acceptability and microbial analysis (total plate count) were analysed after formulation and during storage period.

The study on comparison of physico-chemical and sensory qualities of selected varieties of ginger rhizomes revealed that Local variety was more preferred than the Chinese variety. The nutritional analysis of the freshly prepared RTS beverage shown increasing trend in titrable acidity (from 0.22 to 0.52%, as % of citric acid), TSS (from

12.6 to 16.8 °Brix), ascorbic acid content (from 12.4 to 56.9 mg/100 ml) and total sugar (from 16.6 to 20.39%) with increase in lime juice extract from 2 to 10%. The pH was reduced when lime juice concentration is increased. Seven point hedonic scale was used to evaluate the organoleptic characters. According to Friedman's test, the mean scores for all the assessed sensory characters varied significantly ($p < 0.05$) in the freshly made RTS beverages formulations.

The declining trends in pH, TSS and ascorbic acid and an increasing trend in titrable acidity and total sugar was noted with advancement of storage period of 12 weeks. The results of chemical analysis showed that, there were significance differences ($p < 0.05$) between the tested formulations. The sensory analysis also showed that there were significant differences ($p < 0.05$) for organoleptic characters between RTS beverage formulations. The highest overall acceptability was observed in formulation with 12% of ginger juice with 8% of lime juice and the all formulations were microbiologically safe for consumption.

Based on the results of physico-chemical characteristics, sensory attributes and microbial test, the RTS functional beverage with 12% of ginger juice with 8% of lime juice was selected as best formulation and could be stored for 12 weeks without any significant changes in the quality characteristics.

TABLE OF CONTENT

ABSTRACT	i
ACKNOWLEDGEMENTS	iii
TABLE OF CONTENT	iv
LIST OF TABLES	xii
LIST OF FIGURES	xiii
LIST OF PLATES	xiv
CHAPTER 01	1
1.0 INTRODUCTION.....	1
CHAPTER 2	6
2.0 LITERATURE REVIEW	6
2.1 Functional foods.....	6
2.1.1 Concept of functional foods.....	6
2.1.2 Definition of functional food	7
2.1.3 Functional food categories.....	7
2.1.3.1 Functional beverage	8
2.1.4 Criteria for formulation of functional beverage.....	10
2.1.5 Optimization of the production and formulation of novel functional beverages.....	11
2.2 Ginger	12

2.2.1 Taxonomy	12
2.2.2 Origin and distribution.....	12
2.2.3 Plant description.....	12
2.2.4 Varieties	13
2.2.4.1 Local ginger	13
2.2.4.2 Rangoon ginger.....	13
2.2.4.3 Chinese ginger	14
2.2.5 Cultivation and production of ginger.....	14
2.2.5.1 World cultivation and production of ginger.....	14
2.2.5.2 Cultivation and production of Ginger in Sri Lanka.	14
2.2.6 Economic importance and Uses of Ginger	15
2.2.6.1 Culinary uses of Ginger	15
2.2.6.2 Commercial uses of ginger	16
2.2.6.3 Medicinal uses of Ginger	16
2.2.7 Maturity Indices and Harvest and storage of ginger.....	20
2.2.7.1 Maturity Indices and Harvest.....	20
2.2.7.4 Storage of Fresh ginger.....	21
2.2.8 Ginger composition.....	21
2.2.9 Chemical components in ginger.....	22
2.2.10 Juice extraction methods of ginger	22
2.3 Lime	23

2.3.1 Taxonomy	23
2.3.2 Plant description.....	23
2.3.3 Origin and distribution.....	23
2.3.4 Uses of lime	24
2.3.4.1 Culinary uses.....	24
2.3.4.2 Health benefits of lime.....	24
2.4 Palmyra	25
2.4.1 Taxonomy	25
2.4.3 Plant description.....	26
2.4.4 Uses of Palmyra	26
2.4.4.1 Common use of Palmyra.....	26
2.4.4.1.1 Sap based products of Palmyra.....	27
2.4.4.1.2 Palmyra sugar candy.....	28
2.4.4.1.3 Palmyra sugar candy as a sweetener.....	28
2.4.4.2 Medicinal use of Palmyra	29
2.5 Blending.....	30
2.5.1 Definition of blending.....	30
2.5.2 Importance of blending.....	30
2.5.3 Logical reasons for blending.....	31
2.5.4 Blending of ginger with fruits.....	31
2.6 Ready-To-Serve (RTS) Fruit Beverages.....	32

2.6.1 Definition	32
2.6.2 Ingredients of RTS Beverages	32
2.6.3 Sri Lanka Standards Institute Specification for RTS Beverages	32
2.6.4 Specification of RTS Fruit Beverages	33
2.7 Sensory evaluation	33
2.7.1 Concept and definition of sensory evaluation.....	33
2.7.2 Principles of Sensory Evaluation.....	33
2.7.3 Sensory evaluation methods	34
2.7.3.1 Difference tests	34
2.7.3.2 Descriptive sensory analysis	34
2.7.3.3 Consumer acceptance tests	35
2.7.3.3.1 Hedonic rating test.....	35
2.7.4 Properties assessed by sensory tests	36
2.7.5 Requirements in order to conduct a successful sensory evaluation	36
2.8 Microbiology of Fruit beverages	37
CHAPTER 03	39
3.0 MATERIALS AND METHODS	39
3.1 Materials	39
3.1.1 Materials Used for the study	39
3.1.2 Materials Collection.....	40
3.2 Comparison of physico-chemical properties and sensory qualities of selected varieties of ginger rhizomes.....	40

3.2.1 Physical characteristics of selected varieties of ginger rhizomes	40
3.2.2 Chemical composition of extracted juices of selected varieties of ginger rhizomes	41
3.2.3 Sensory evaluation of ginger juices	41
3.3 Preliminary studies and development of ginger blend with lime RTS Beverage recipes	41
3.3.1 Preparation of materials	42
3.3.1.1 Sterilization of Glass Bottles	42
3.3.1.2 Sterilization of Equipments and Materials.....	42
3.3.1.3 Extraction of Ginger juice.....	42
3.3.1.4 Extraction of lime juice.....	42
3.3.2 Preparation of Ginger blend with lime RTS functional beverage and sweetened by palmyra sugar candy	43
3.4. Sensory Evaluation	44
3.4.1 Materials for Sensory Evaluation.....	45
3.4.2 Coding and serving the Samples.....	45
3.5 Chemical Analysis of freshly made ginger blend with lime RTS Beverages....	46
3.5.1 Determination of Total Soluble Solids	46
3.5.1.1 Materials	46
3.5.1.2 Procedure	46
3.5.2.1 Principle	46
3.5.2.2 Materials	47

3.5.2.3 Procedure	47
3.5.3 Determination of Titrable acidity.....	47
3.5.3.1 Principle	47
3.5.3.2 Material	47
3.5.3.3 Procedure	48
3.5.3.4 Calculations.....	48
3.5.4 Determination of Total Sugar (Lane-Eynon method).....	49
3.5.4.1 Principle	49
3.5.4.2 Materials	49
3.5.4.3 Procedure	49
3.5.4.4 Calculation	50
3.5.5 Determination of Ascorbic Acid.....	50
3.5.5.1 Principle	50
3.5.5.2 Materials	50
3.5.5.3 Procedure	51
3.5.5.4 Calculation	51
3.6 Storage studies of selected formulations.....	52
3.7 Microbiological Test.....	52
3.7.1 Preparation of Nutrient Agar	52
3.7.2 Preparation and Dilution Series of the RTS functional beverage	53
3.7.3 Inoculation and identification	53

3.8 Statistical Analysis.....	53
CHAPTER 04.....	54
4.0 RESULTS AND DISCUSSION.....	54
4.1 Comparison of physico-chemical properties and sensory qualities of selected varieties of ginger rhizomes	54
4.1.1 Physical characteristics of selected varieties of ginger rhizomes	54
4.1.2 Chemical composition of extracted juices of selected varieties of ginger rhizomes	54
4.1.3 Sensory evaluation of ginger juices	55
4.2 Preliminary studies.....	56
4.3 Quality Characteristics of Freshly Made RTS functional Beverages	57
4.3.1 Chemical Qualities of Freshly Made RTS Beverages	57
4.3.1.1 pH.....	57
4.3.1.2 Total Soluble Solids (TSS)	58
4.3.1.3 Titrable Acidity	59
4.3.1.4 Ascorbic Acid	60
4.3.1.5 Total Sugar	61
4.3.2 Sensory qualities of Freshly Made RTS Beverages.....	62
4.3.2.1 Colour	62
4.3.2.2 Pungency.....	62
4.3.2.3 Aroma	64
4.3.2.4 Taste.....	64

4.3.2.5 Overall acceptability	64
4.4 Storage studies of selected functional RTS beverage formulations.....	65
4.4.1.1 pH.....	65
4.4.1.3 Titrable acidity	67
4.4.1.4 Ascorbic acid	69
4.4.1.5 Total sugar	70
4.4.2 Sensory qualities of ginger blend with lime RTS Beverages during Storage	71
4.4.2.1 Colour	71
4.4.2.2 Aroma	72
4.4.2.3 Pungency.....	72
4.4.2.4 Taste.....	73
4.4.2.5 Overall acceptability	73
CHAPTER 5	77
5.0 CONCLUSIONS	77
SUGGESTIONS FOR FUTURE RESEARCH.....	79
CHAPTER 06.....	80
6.0 REFERENCES.....	80