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Development and quality evaluation of "Ardrak Laddu" (Sweet Ginger Balls): A Potent Immune Enhancer

Prof (Dr) Abhijit Joshi[1], Dr. Manoja Joshi[2], Mrunmayee Dixit[3], Dr. Arun Gurav[4], Dr. Rasika Kolhe[5], Dr. M. Srinivasan[6]

[1]Professor, Department of Ayurveda & Yoga, Tilak Maharashtra Vidyapeeth, Pune, Maharashtra, India-411037.
[2]Associate Professor, Department of Ayurveda & Yoga, Tilak Maharashtra Vidyapeeth, Pune, Maharashtra, India-411037.
[3]Assistant Professor, Department of Ayurveda & Yoga, Tilak Maharashtra Vidyapeeth, Pune, Maharashtra, India-411037.
[4] Assistant Director In-charge, Regional Ayurveda Research Institute, Kothrud, Nehru Garden, Pune.-411038.
[5] Research Officer (Ayurveda), Regional Ayurveda Research Institute, Kothrud, Nehru Garden, Pune, Maharashtra, India- 411038.
[6] Research Officer (Biochemistry), Regional Ayurveda Research Institute, Kothrud, Nehru Garden, Pune, Maharashtra, India- 411038.

Abstract

Ardrak Laddu, a traditional dietary formulation infused with the base of ginger, holds a significant role in culinary traditions. This paper presents a comprehensive investigation into the development, sensory evaluation, nutritional analysis and physicochemical properties of *Ardrak Laddu*. The product was developed systematically as per the standard protocol mentioned in the *Ksemakutuhalam* (ancient classical text of *Ayurveda*). The research methodology encompasses the systematic development of the therapeutic product, considering variations in ingredients and processing techniques. Subsequently, sensory evaluation was carried out by a panel of 20 semi-trained panelists on a 5-point hedonic scale to determine the overall acceptability of the product. Proximate analysis was conducted to quantify the essential nutritional components such as carbohydrates, proteins, fats, and moisture content, shedding light on the dietary profile of *Ardrak Laddu*. Additionally, physicochemical analysis elucidates the moisture sorption behavior, pH levels, and other relevant parameters to understand its stability and shelf-life. The findings of this study contributed to a deeper understanding of *Ardrak Laddu*, bridging the gap between traditional culinary practices and modern scientific inquiry. Insights gained from the experimental research approach offer valuable information for food technologists, nutritionists, and culinary professionals, facilitating further exploration, innovation, and appreciation of this culturally significant delicacy.

Keywords: *Ayurveda, antioxidant, food, ginger, immunity, ojas, therapeutic.*

1. Introduction

Optimum health is the ultimate aim of every living being. Human health is a manifestation of healthy and balanced life style which includes right food and right behavioral pattern. Natural living or using pure and natural resources plays a key role in health maintenance.

Food as a basis of life has a significant impact on one's health. Ayurveda focuses on

many therapeutic dietary formulations which can be used as an effective measure for preventing and treating diseases. Ayurveda's classical texts, emphasizes on the importance of healthy dietary and therapeutic dietary practices which help boost immune power. It can be observed that, the traditional dietary formulations prepared from natural foods can prove beneficial in minimizing symptoms and providing relief from the ailment.

Traditional wisdom about processing of food, its preservation techniques, and their therapeutic effects has been established for many generations in India. Food systems can deliver numerous biological functions through dietary components in the human body. Indian traditional foods are also recognized as functional foods because of the presence of functional components such as body-healing compounds, antioxidants, dietary fibers, and probiotics. These functional molecules help in weight management, blood sugar level balance and also support immunity of the body [(1)].

Aahara (food) is the base of life which provides strength, growth and complexion to the body [(2)]. Ayurveda, the science of life, suggests many principles, one of the most important being the three factors that are: *Aahara* (diet), *Nidra* (sleep) and *Brahmacharya* (celibacy). These are mentioned as three *Upastambha* (sub-supporting pillars) for health maintenance. [(3)]

A meal that includes all six tastes—sweet, sour, salty, spicy, pungent, and astringent—is often referred to as a "balanced diet" in the context of Ayurvedic principles. This approach emphasizes harmony in flavors, which can contribute to overall health and well-being. Each *rasa* is believed to provide different benefits and can help balance the body's *doshas* (energetic forces).

The intention behind this study was to explore indigenous knowledge through the application of Nutrition Science. '*Ksemakutuhalam'*, a classical Ayurvedic manuscript of culinary science is an encyclopedia of different food preparations with their therapeutic significance. The study focused on comprehensive collection of dietary formulations containing immune-modulating properties and then selection of such recipes that highlight the significance of these in treating severe health problems.

Ardrak Laddu is a traditional dietary formulation, was identified from the ancient classical text *Ksemakutuhalam*. This recipe is reported with various health benefits in diseases like *Shwas* (dyspnoea) , *Kasa* (cough) and helps increase metabolism by enhancing *Agni* (digestive power). As the name suggest, *Ardrak* (ginger) is one of the main and essential ingredient of this recipe responsible for its medicinal property. The research was undertaken to standardize the preparatory method on the basis of the steps mentioned in manuscript and to repurpose it as immune enhancer through various laboratory tests and sensory analysis.

Ayurvedic texts have vividly described the factor of immunity in terms of '*vyadhiksamatva*,' which is considered as the natural or acquired biological power of an individual, which protects him /her from disease[(4)]. Factors which contribute for *vyadhikshamatva* are- normal *dosha*, (three regulatory functional factors) equilibrium state of *dhatu* (seven fundamental structural component), normal *agni* (digestive and metabolic factors), potency of *srotas* (pathway or channels for transportation of substances) etc. or factors

which supports the equilibrium state of all physiological parameters. Also *Ahara* (food), *Nidra* (sleep), *Vyayama* (physical activity/exercise), *Satva* (mental stability), and *Rasayana* (rejuvenators) plays important role in maintenance of *Vyadhikshamatva*. Immunity can also refer to *Bala* (strength) and *Ojas* (essence of all seven *dhatu*) [5].

2. Aim

The aim of the study was to develop and standardize a therapeutic food product *Ardrak laddu* and to conduct its quality evaluation by laboratory analysis to repurpose it as immune enhancer.

3. Objectives

The objectives of this study were-

- To identify the recipes with immune enhancing properties from traditional classical Ayurved text *Kshemkutuhalam.*
- To study the concept of *Vyadhikshamatva (Immunity)* according to Ayurveda and contemporary science.

4. Materials & Methods

4.1 Methodology

As per aim and objectives of the study, the methodology was designed as follows:

4.1.1 Screening of the classical text- *'Ksemakutuhalam'* is a classic ancient text that deals with the food preparations and their therapeutic properties. It has extensively elaborated on the method of preparation and the medicinal properties of a number of traditional food stuffs. Authored by *Ksemasarma,* an Ayurvedic physician of the 16th century, it contains information on more than 200 ancient Indian traditional food preparations. The book is divided into twelve chapters known as *Utsavas.*

The text was thoroughly screened for immune enhancing recipes by using Ayurvedic and modern parameters of immunity boosting properties.

There are total 202 vegetarian recipes and 64 non vegetarian recipes in *Kshemkutuhalam* out of which 11 recipes were shortlisted depending upon below criteria:

a) Inclusion Criteria:

- Vegetarian recipes alone for overall acceptability and plant based diet aspect.
- Recipes that are supposed to increase *Ojas* (vitality), *Balya* (strength), *Agni* (digestive fire).
- Recipes containing foods that are rich in antioxidants, polyphenols & immune enhancing nutrients like Vitamin C, Vitamin D, Vitamin E, essential fatty acids, calcium, iron, selenium and zinc.

b) Exclusion Criteria:

- Certain non-vegetarian recipes were excluded due to the unavailability & non- acceptance of certain food ingredients in the current time & their non-preference by the community.
- Recipes that only help increase strength i.e. *balya.*

Out of all these recipes, those who have any one of the following characteristics- *Agnideepan, Ojavardhak, Balya, Tridoshashamaka* & are found to be rich in immune-modulating nutrients such as polyunsaturated fats (PUFA), monounsaturated fats, short chain fatty acids (SCFA), Vitamin-C, Vitamin-D, Calcium, Iron, Zinc, phyto-chemicals, probiotics, etc. were shortlisted. The future scope of developing these recipes into products was also considered taking their shelf life into account.

Out of 11 recipes, *Ardrak Laddu* was superior in terms of Ayurvedic and modern parameters as this recipe is acknowledged with its various health benefits in *Shwas, Kasa* and increasing metabolism by enhancing *Agni*. As the name suggests, *Ardrak* (ginger) is one of the main and essential ingredient of this recipe responsible for immune enhancing property of this product.

4.1.2 Preparation of *Ardrak Laddu*

In classical texts, the method of preparation and its therapeutic application are presented solely in verse form. Therefore, it was essential to interpret this verse, identify its components, and further develop and standardize the method of preparation considering parameters of culinary practices. This paper presents the method for standardizing the preparation of *Ardrak laddu*, along with its nutritional analysis.

To prepare *Ardrak laddu*, the ingredients listed in the verse were documented. Since there was no ambiguity in the specified ingredients, all necessary items for the recipe were sourced from local vendors. As *laddu* is typically sweet in taste, the measurements of the ingredients were adjusted accordingly, with some variations included during preparation. Tamarind leaves were collected from a plant grown in the institute's herbal garden, with the species confirmed by a botanist. Fresh cow's milk and freshly made cow's ghee were procured from local suppliers, while rice flour, cardamom, and candied sugar were bought from nearby shops. Ginger was also obtained from local vendors. All ingredients were inspected for their packaging date, expiry date, and sensory qualities. They were of good quality and free from impurities.

- **Initial recipe preparation-**

The ginger was washed in running tap water, peeled and grated. Tamarind leaves were also washed in the running tap water. *Kwathan* (cooking) of ginger and tamarind was done by boiling 5 gm of tamarind leaves and 70 gm of grated ginger in 280 ml of drinking water until grated ginger got softened. Then, the water was removed by straining and tamarind leaves are separated from ginger manually. Afterwards, the ginger was boiled with 100 ml of milk until it cooked completely *(Vinikwathan*). Once the mixture got cooled at room temperature, 50 gm rice flour was added in the mixture and kneaded into dough. The dough was shaped into medium-sized balls (18 no of laddu each weighing 33.3 gm) known as *Modaka*. They were

then deep fried in hot ghee until golden brown. On the other hand, sugar syrup was prepared by boiling 100 gm candied sugar in 100 ml of water for 5 min until the sugar melted completely. To it, 1.25 gm of cardamom powder was added for flavor. At last, the fried *modakas* (cooled at room temp) were immersed in it and steeped overnight. The *Ardrak ladoo* was then ready to be consumed.

Three trials of the product (T1, T2& T3) consisting of different proportions of ingredients were conducted. All 3 trials were subjected to sensory analysis by 20 semi trained panelists. T1 trial product was found to be excellent in terms of overall acceptability; hence the proportion of ingredients of T1 trial was finalized for final trial.

Table 1: Experimental Trials- Quantity of ingredients

Ingredients	T1	T2	T3
Water (ml)	280	300	320
Cow's milk (ml)	100	120	150
Candied /rock sugar (g)	100	125	150
Fresh ginger (g)	70	100	120
Rice flour (g)	50	70	100
Cow's ghee (g)	20	20	20
Tamarind leaves (g)	5	5	5
Cardamom powder (g)	1.25	1.25	1.25

- **Final recipe preparation-**

The final recipe was prepared by using following quantity of ingredients:

Table 2: Final product quantity of ingredients

Ingredients	Weight
Water (ml)	280
Cow's milk (ml)	100
Candied /rock sugar (g)	100
Fresh ginger (g)	70
Rice flour (g)	50
Cow's ghee (g)	20
Tamarind leaves (g)	5
Cardamom powder (g)	1.25

- **Nutritional Analysis-** The final product was subjected to laboratory analysis. Physicochemical and nutritional analysis methods were done by using the standard methods in government accredited laboratory as follows:

Various methods used for physicochemical analysis

Acidity- FHHL/SOP/CHEM/F/39, pH at 25°C (10% solution) - IS 11918, Moisture- IS 4684, Ash -IS 4684, Reducing sugar- FHHL/SOP/CHEM/F/78

Various methods used for Proximate analysis

Energy- FHHLSOP/CHEM/F/20(f), Carbohydrates (available)- IS 1656, Protein- IS 7219-

Modified method by FOSS Kjeltec, Fat- IS 4684, Total fiber- FHHL/SOP/CHEM/F/38.

4.2 Materials

- **Property of each ingredient as per Ayurveda**

4.2.1. *Amlikapatra* (Tamarind leaves/ *Tamarindus Indica*)

Tamarind is sour in taste, heavy, mitigates *vata*, increases *pitta, kapha* & blood. Ripened fruit is digestive, dry, mobile, hot, reduces *kapha & vata*. [6]

4.2.2 *Ardrak* (Fresh ginger/ *Zingiber officinale*)

Fresh ginger has *Dipan* (appetizer) and *Pachan* (Digestive) properties which help improve metabolism. It is hot and of has a *madhura* (sweet) *vipaka* (post-metabolic effect) after its digestion. It is spicy and has a sharp taste. It balances the *vata* and *kapha dosha* hence beneficial in the disease caused due to *vata* and *kapha dosha* imbalance. [7]

4.2.3 *Kshir* (Milk)

Milk is an aphrodisiac, cool, sweet in taste. It provides nourishment, strength and rejuvenation. Increases intellectual capacity & virility. Due to its cool and sweet properties, it balances *pitta* and *vata*, and prevents aggravation of *pitta.* [8]

4.2.4 *Tandul Pishti* (Rice flour /flour of grains of *Oryza sativa*)

Rice is sweet, astringent, cool, unctuous, light to digest, aphrodisiac, imparts appetite & enhances voice. It provides strength & nourishment. [9]

4.2.5 *Goghruta* (Cows ghee)

Freshly prepared cow's ghee helps imparting wisdom, memory, retentive power, complexion, strength & is nourishing. It helps alleviate *vata* & *kapha*, reduces fatigue, treats vitiated *pitta* & cleanses the system. It has a sweet post-metabolic effect, is aphrodisiac, stimulates digestive power & provides stabilization to the body. [10]

4.2.6 *Khandsharkara/ Sitakhanda* (Rock/ candied sugar)

It is extremely sweet, beneficial for eye health, treats vomiting, skin diseases, wounds, *kapha* vitiation, dyspnoea, hiccups, and cures vitiations of *pitta* & blood. [11]

4.2.7 *Ela (Elettaria cardamomum)*

It is pungent in taste, bitter & hot in potency, light to digest, helps treat dyspnoea, bodyache, heartburn, painful urination & toxicity; alleviates *vata* & *kapha*. It helps stimulate digestive fire, promotes food digestion, is an aphrodisiac, enhances intellect, helps treat wounds, hemorrhoids, itching & cough. [12]

Table 3: Antioxidant components

Raw Ingredient	Major Bioactive compounds present in them
Fresh ginger	Gingerols, shogaols, zingiberene, paradol, and zingerone [13]
Tamarind Leaves	Luteolin 7-o-glycosides, luteolin, apigenin, isorientin, orientin, vitexin, caffeic acid, limonene, naringin, Caryophyllene, p-cymene, ß-sitosterol, vitexin, isovitexin,

	orientin, isoorientin and vitamin C [14]
Cardamom	Alpha-ionone, Eucalyptol, 1,6-octadiene-3-ol, Cinnamaldehyde, Terpinen-4-ol, 1,6,10-Dodecatrien-3-ol, etc. [15]
Bovine milk	Lactoze and oligosaccharides, Bioactive lipids, bioactive peptides, Enzymes, Immunoglobulins, Growth factors and cytokines[16]

- **Stepwise execution of the research**

Comprehensive literature review and collection of the therapeutic dietary formulations from ancient classical texts of Ayurved *(Ksemakutuhalam)*.

↓

Identification and short listing of immune-modulating therapeutic dietary formulations.

↓

Selection of *Ardrak laddu* from the *Bhakshya* category.

↓

Procurement of authentic raw materials required for *Ardrak laddu* preparation from the local vendors of Pune.

↓

Conduction of physicochemical and proximate analysis of the raw ingredients.

↓

Standardization of therapeutic product *(Ardrak Laddu)* as per the standard protocol mentioned in the (*Ksemakutuhalam*) with slight modifications as per practical application.

↓

Sensory evaluation of the trial products on 5 point Hedonic Scale with the help of 20 semi trained panelists and finalization of final product ingredient proportion.

↓

Conduction of sensory, physicochemical and nutritional analysis of the product.

Figure 1: Cleaning & grating of ginger

Figure 2: Cooking ginger with tamarind leaves in water *(Kwathika preparation)*

Figure 3: Cooking ginger pieces in milk

Figure 4: Addition of Rice flour

Figure 5: *Modaka* Preparation

Figure 6: Rolled *Modaka*

Figure 7: Fried balls ready to be immersed

Figure 8: Final product "Ardrak Laddu″ in sugar syrup

5. Result and Discussion

5.1 Analysis of the raw ingredients utilized for *Ardrak Ladoo* preparation:

The raw materials used in the making of *Ardrak Laddu* were investigated for their proximate & physicochemical properties in a government authorized laboratory (except cow's milk & tamarind leaves). Please refer table 4 & 5.

Table 4: Nutritional Analysis of raw ingredients used in *Ardrak Ladoo*

Sr.No.	Ingredient	Proximate Analysis parameters				
		Energy (Kcal/100g)	Carbohydrate (g/100g)	Protein (g/100g)	Fat (g/100g)	Dietary Fiber (g/100g)
1.	Cow's ghee	897.93	<1.0	<0.1	99.77	<0.5
2.	Rice flour	380.74	82.23	9.96	0.84	2.21

3.	Rock sugar	397.36	99.34	<0.1	<0.1	<0.5
4.	Fresh ginger	30.22	5.14	1.23	<0.1	2.19
5.	Cardamom powder	388.12	62.93	11.65	3.92	27.26

Table 5: Physicochemical Analysis of raw ingredients used in *Ardrak Ladoo*

Sr.No.	Ingredient	Proximate Analysis parameters				
		Acidity (g/100g)	Moisture (g/100g)	Ash (g/100g)	pH at 25°C	Reducing sugar (g/100g)
1.	Cow's ghee	0.59	0.23	<0.1	5.1	<0.5
2.	Rice flour	0.10	6.61	10.36	6.5	<0.5
3.	Rock sugar	<0.1	0.60	<0.1	6.9	<0.5
4.	Fresh ginger	0.10	92.24	0.57	5.0	<0.5
5.	Cardamom powder	0.76	8.04	6.55	5.9	<0.5

5.2 Analysis of *Ardrak Ladoo*:

5.2.1 Sensory analysis of *Ardrak Ladoo*: Three trials of the product (T_1, T_2 & T_3) were evaluated for sensory characteristics (appearance, aroma, texture, taste, and overall acceptability). It was carried out by 20 semi trained panelists on 5 point hedonic scale. Among the three trials T_1 sample exhibited excellent for its all sensory attributes and further underwent physicochemical and nutritional analysis in government authorized laboratory.

Table 6: Comparative analysis of the trials conducted

Name of Sample	Appearance	Aroma	Taste	Texture	Overall Acceptability
T1	**4.5**	**4.6**	**4.75**	**4.65**	**4.65**
T_2	3.55	3.9	3.75	3.55	3.5
T_3	3.2	3.45	3.5	3.15	3.2

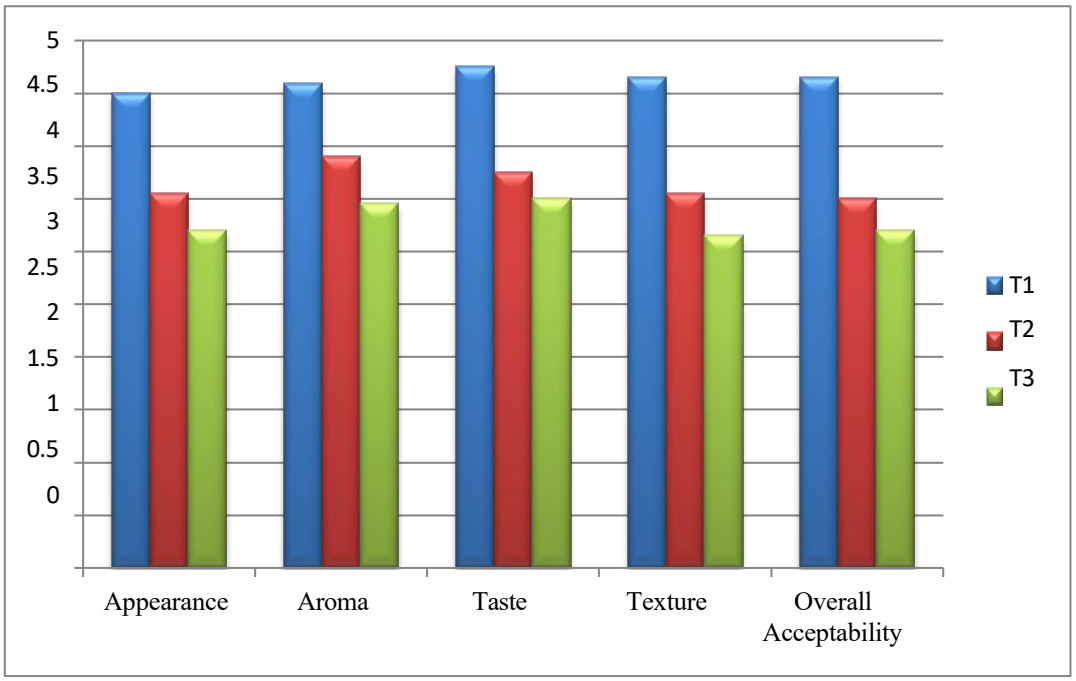

Figure 9: Mean score values of sensory analysis of the trial samples

5.2.2 Physicochemical analysis of *Ardrak Ladoo:* The product was further investigated for its physicochemical properties like ash, moisture, acidity, pH and reducing sugar to determine its quality, ensure food safety and shelf stability. (Table 7). All these parameters were analyzed under room temperature, sealed in a glass container.

Table 7: Physicochemical analysis of *Ardrak Ladoo*

Test done	**Result (g/100g)**	**Test Method**
pH at 25℃ (10% solution)	7.0	IS 11918
Acidity	<0.1	FHHL/SOP/CHEM/F/39
Moisture	36.18	IS 4684
Ash	0.46	IS 4684
Reducing sugar	1.87	FHHL/SOP/CHEM/F/78

5.2.3. Nutritional analysis of *Ardrak Ladoo*: The product was further analyzed for its detailed nutritional composition including macro-nutrients (energy, carbohydrates, proteins & fats), total fiber and micronutrients (vitamins and minerals) to determine its nutritional profile. Fatty acid profile was also analyzed.

Table 8: Proximate composition of *Ardrak Ladoo*

Test done	Result	Units	Test Method
Energy	267.31	Kcal/100g	FHHLSOP/CHEM/F/20(f)
Carbohydrates (available)	57.51	g/100g	IS 1656
Protein	3.40	g/100g	IS 7219- Modified method by FOSS Kjeltec
Fat	1.55	g/100g	IS 4684
Total fiber	4.86	g/100g	FHHL/SOP/CHEM/F/38

Table 9: Vitamin content of *Ardrak Ladoo*

Test done	Result (g/100g)	Units	Test Method
Vit C	49.69	mg/100g	IS 5838
Vit B1	<0.05	mg/100g	FHHL/SOP/CHEM/F/24
Vit B2	0.179	mg/100g	
Vit B3	0.05	mg/100g	
Vit B5	<0.05	mg/100g	
Vit B6	<0.05	mg/100g	
Vit B9	<0.05	mg/100g	
Vit B12	<0.05	mg/100g	
Vit A	<50.0	µg/100g	FHHL/SOP/CHEM/F/25
Vit D3	<0.05	mg/100g	
Vit E	0.099	mg/100g	
Vit K	<0.05	mg/100g	

Table 10: Mineral content of *Ardrak Ladoo*

Test done	Result	Units	Test Method
Iron	2.46	mg/100g	FHHL/SOP/CHEM/F/74
Calcium	55.02	mg/100g	
Magnesium	14.01	mg/100g	
Phosphorus	7.44	mg/100g	
Zinc	4.82	mg/kg	
Copper	<0.75	mg/kg	
Selenium	<0.125	mg/kg	

Table 10: Fatty acid & cholesterol composition of *Ardrak Ladoo*

Test done	Result	Units	Test Method
Saturated fat	0.79	g/100g	FHHL/SOP/CHEM/F/31
Unsaturated fat	0.76	g/100g	
Monounsaturated fat	0.37	g/100g	
Polyunsaturated fat	0.39	g/100g	
Trans fat	0.001	g/100g	
Cholesterol	<0.5	mg/100g	FHHL/SOP/CHEM/F/30

5.3 Discussion:

Ginger is pungent in taste and turns sweet post digestion (*vipaka*). It is a good appetizer and alleviates *vata* and *kapha*. The recipe will enhance the original properties of ginger. As the ginger is boiled in cow's milk, it will minimize the excess *tikshna* or penetrating property and so that it can be used to alleviate *pitta dosha*. Hence the combination will alleviate *tridosha* and as well as it will enhance the digestive capacity. Thus the recipe fulfills the criteria of *Agnidipan* & *balya*.

5.3.1. Medicinal uses of *Ardrak*/ Ginger as immune-modulator:

Family *Zingiberaceae* consists of the large number of medicinal plants and is well-known for its use in ethno medicine and plays a major role in Indian System of Medicine[17].

Ginger is one of the important medicinal plant from *Zingiberaceae* family which exhibits excellent health benefits in many disorders like loss of appetite (*Agnimandya*), asthmatic conditions (*Svasa*), bloated stomach (*Adhmana*), rheumatoid conditions (*Amavata*), anemic conditions (*Pandu*), liver associated conditions and disorders (*Udararoga*), vomitings (*Chardi*), swollen joints (*Sandhi shotha*), fatigue (*Avasada*), back pains (*Kati Shoola*), mal-digestions (*Ajeerna*), flatulence (*Koshta Vata*), malabsorption syndrome (*Grahani*), stomachache (*Udara Shoola*), piles (*Arsha*), weakness in heart functions (*Hrud-dourbalya*), heart disorders (*Hrudroga*), elephantiasis (*Sleepada*), allergies (*Sheetapitta*), throat associated disorders (*Kantaroga*), cough (*Kasa*), Hiccough (*Hikka*), common cold (*Pratishya*), injuries (*Kshata*), malnutrition (*Ksheena*), fever due to infections (*Vishamajwara*), chronic fever (*Jeernajwara*), lethargy and physical weakness (*Samanya dourbalya*), physical weakness due to delivery (*Prasavottara dourbalya*), chronic osteoarthritis conditions (*Jeerna sandhi vata*), headaches (*Shira shoola*), pain due to nervous disorders (*Vata Nadi Shoola*), diabetes (*Prameha*), loss of speech (*Swarabhanga*) and otalgia *(Karnashoola*).

Furthermore, fresh rhizome of *Z. officinale* (Ginger) has been proven with an antiviral effect against Human Respiratory Syncytial Virus (HRSV) infection via decreasing HRSV induced plaque formation in respiratory mucosal cell lines. Therefore, high concentration of *Z. officinale* (Ginger) could stimulate mucosal cells to secrete IFN-β which responsible in counteracting viral infections by reducing viral attachment and internalization. This effect is much beneficial in the management of common cold (*pratishya*) and fever associated with mucous secretions and management of complications due to cough and asthmatic conditions.

Restoration of heart functions, pain management effect and management of physical weakness and reestablishing of appetite denote anti-inflammatory activity of ginger referring Ayurveda recommendations [(18)].

5.3.2. Effect of Ginger processed in milk

Ginger proteases are used as milk coagulants in making a Chinese traditional milk product (*Jiangzhinai* or *Jiangzhuangnai*), suggesting their potential as a source of rennet substitute that might be applicable in the modern dairy industry [(19)].

When in a study, ginger, turmeric oleoresins and pomegranate peel extracts were incorporated with pasteurized milk ,with pharmacologically important active compounds, it was found that the final product was having great antimicrobial properties, high antioxidant activity and total phenolic content. Thereby this product had a considerably improved medicinal value [(20)].

Ayurveda classical text denotes ginger as a appetizer and effective in treating the digestive system ailments. It can be observed that, findings of many nutritional science studies are in accordance with traditional wisdom.

Loss of appetite is one of the major problems at high altitude faced by the Indian defense forces. Trials in army units using ginger based appetizers showed better acceptability and liking (*Premavalli, Wadikar, Nanjappa, & Bawa, 2004*). Early Chinese and Japanese research found that oral and intra-gastric applications of fresh ginger decoction produced a stimulant action on gastric secretion (*Chang & But, 1987*). German scientists have reported that chewing 9 g of crystallized ginger had a profound effect on saliva production (*Blumberger & Glatzel, 1964*). The gingerols and shogaols are the main active compounds responsible for anti-emetic properties (*Kawai, Kinoshita, Koyama, & Takahashi, 1994*). Ginger is also used for the treatment of asthma, shortness of breath, diarrhea, nausea, motion sickness and appetite loss (*Sifton, 1999, Stewart et al., 1991*).[(21)]

Thus ginger has a immune-modulation effect by virtue of its antioxidant, antiviral and antimicrobial activity and as a potent appetizer.

This ancient recipe is a blend of the right ingredients processed in natural ways during its preparation and has a tremendous medicinal value in terms of contemporary health science.

5.3.3 *Ardrak laddu* - As an immune enhancer

Overall quality of the product was excellent among all the parameters provided for the sensory & nutritional analysis. The product developed is rich in calories and has high amount of moisture due to the presence of sugar syrup. It was found to be a good source of Vit-C which has potential immune enhancing properties. Also, it is a rich source of calcium and magnesium.

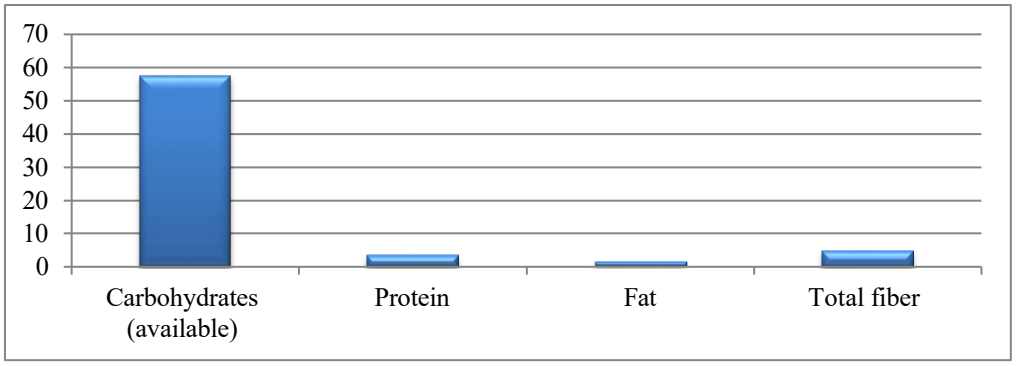

Figure 10: Macronutrient Composition of *Ardrak Ladoo* (g/100g)

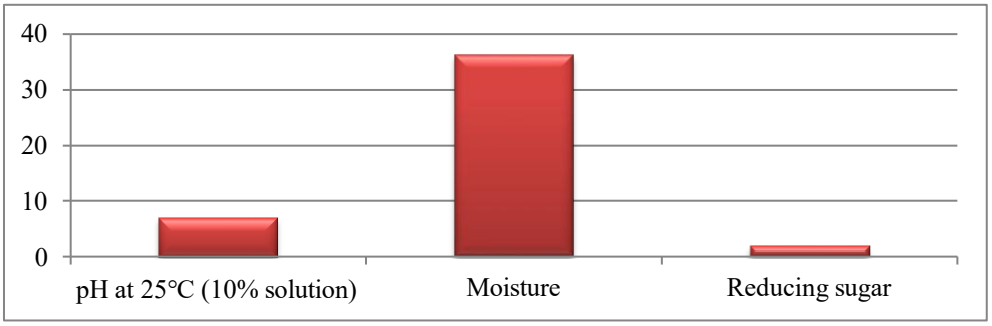

Figure 11: Physicochemical properties of *Ardrak Ladoo* (g/100g)

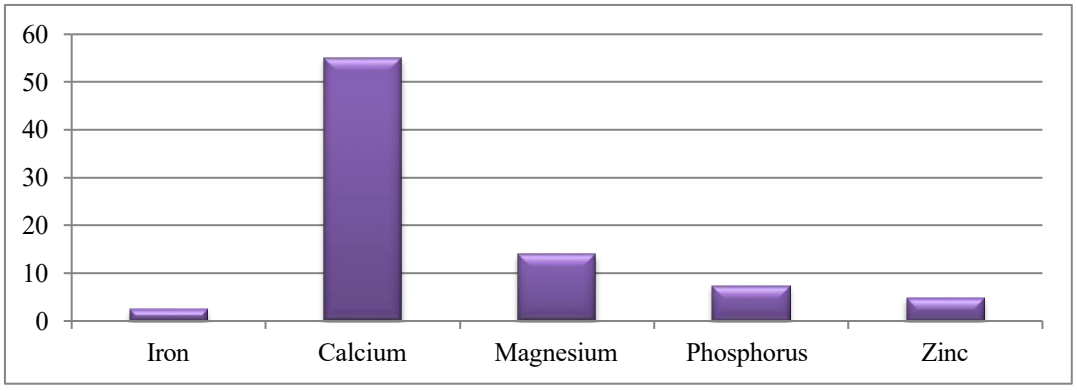

Figure 12: Mineral Content of *Ardrak Ladoo* (mg/100g)

6. Conclusion:

It can be concluded that the prepared sample was found to be excellent in all sensory attributes as well as the presence of nutrients such as calcium, magnesium and vitamin- C which can potentially help in enhancing immunity during infections. Vitamin C has been considered as a potential antioxidant in the management of oxidative stress by neutralizing the free radicals. This product can thus be used in the treatment of various infectious diseases. Detailed investigation of the product can be conducted to examine its mechanism of action to combat

infections.

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