FORMULATION OF FUNCTIONAL FOOD PRODUCTS FROM ANNONA MURICATA LEAVES

DISSERTATION SUBMITTED

In partial fulfillment of requirement for the award of the degree of

MASTER'S PROGRAMME IN
CLINICAL NUTRITION AND DIETETICS

By

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ERNAKULAM

APRIL 2025

CERTIFIED AS BONAFIDE RESEARCH WORK

Signature of Internal Examiner **Signature of External Examiner**

DECLARATION

I hereby declare that the project entitled **" FORMULATION OF FUNCTIONAL FOOD PRODUCTS FROM ANNONA MURICATA LEAVES"** submitted in partial fulfilment of the requirement for the award of the degree of Master's Programme in Clinical Nutrition and Dietetics is a record of original research work done by me under the supervision and guidance of **Ms. Surya. M. Kottaram,** Head of the department, Department of Clinical Nutrition and Dietetics, Women'sStudy Centre, St. Teresa's College (Autonomous), Ernakulam and has not been submitted in part or full of any other degree/diploma/fellowship or the similar titles to any candidate of any other university.

Place: ERNAKULAM Devi Jayasing

Date:28-04-2025

CERTIFICATE

I here certify that the dissertation entitled **" FORMULATION OF FUNCTIONAL FOOD PRODUCTS FROM ANNONA MURICATA LEAVES"** submitted in partial fulfilment of the requirement for the award of the degree of Master's Programme in Clinical Nutrition and Dietetics is a record of original work done by Ms. **Devi Jayasing** during the period of the study under my guidance and supervision.

Signature of the HOD

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ACKNOWLEDGEMENT

First and foremost, I offer my humble love and prayers to God Almighty for his grace, which sustained me throughout the study, because I strongly believe that God will be the inspiration behind all successful endeavors. And the project would never be finished without the individuals who have supported, encouraged and been there for me through thick and thin.

I would like to express my deep gratitude to Rev Dr. Sr. Nilima, Manager, and Prof, Dr. Alphonsa Vijaya Joseph, Principal, St Teresa's College, Ernakulam for supporting me in entire academic Endeavour. I express my sincere thanks to Dr. Lekha Sreenivas, Centre Co-Ordinator of Women's Study Centre, St Teresa's College, Ernakulum for her constant encouragement and advice. I extend my sincere gratitude to Ms. Surya M. Kottaram, Head of the Department of Clinical Nutrition and Dietetics for the timely suggestions and support.

I express a lot of gratitude to my guide, Ms. Surya .M. Kottaram, Head of the Department of Clinical Nutrition and Dietetics at St. Teresa's college, Ernakulam, for giving me this chance. Throughout my thesis, she constantly encouraged and motivated me and I could not have completed it without her help. Her informative criticism, sound advice and personal guidance helped with development of scientific thinking and skills.

I want to express my gratitude to each and every teacher at the Department of Clinical Nutrition and Dietetics for their valuable advice and sincere support. Without their help, I would never been able to start all of this.

I want to express my sincere gratitude to all of those involved in the study for their unwavering support and cooperation, without which this work would not have been possible.

I am unable to conclude without without expressing my gratitude to my family, especially my parents, whose unwavering love, support and encouragement I relied throughout my thesis. I shall always be inspired by their unwavering bravery and determination.

I will always be grateful to my friends and well – wishers for their prompt assistance and unwavering support. Lastly I want to express my gratitude to everyone who helped to make this thesis a reality.

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ABSTRACT

Medicinal plants also called medicinal herbs, it have been discovered and used in traditional medicine practices since prehistoric times. Annona muricata is a tropical plant species belonging to Annonaceae family and known for its many medicinal uses. A.muricata extracts have been identified in tropical regions to traditionally treat diverse conditions ranging from fever to diabetes and cancer. More than two hundred chemical compounds have been identified and isolated from this plant. The most important being alkaloids, phenols and acetogenins. The objectives of the study entitled " FORMULATION OF FUNCTIONAL FOOD PRODUCTS FROM ANNONA MURICATA LEAVES", were to estimate the nutrient content of the formulated products, To process the leaves for the development of food products, Formulation of the food products, to conduct organoleptic evaluation of the formulated products, Nutritional evaluation of the developed products and to examine the shelf life of the formulated food products. The products are green tea, chutney powder, soup powder and health mix powder. The shelf life study of the prepared A. muricata leaves powder products were kept in the room temperature shows that there is no significant changes in the samples for about 60 days. The acceptability of the formulated products was good, It is also good for blood disorders.The products was also be preferred to diabetes and cancer patients. The nutritive value of Annona muricata leaves powder is 366.7 ± 0 40g/kcal of energy, 24.3 ± 0.10 g of protein , 61.7 ± 0.17 g of carbohydrate, 6.17 ± 0.30g of fiber, 11183.50mg of calcium, 139.50mg of iron, 363.05mg of potassium. It is concluded from the present study that the formulated product contain various health benefits. The product was rich in various nutrients. It helps to cure various type of diseases such as anticancer, antispasmodic, anti – inflammatory, antiallergic, antibacterial and antiviral agent as well as fever, pain and diarrhea.

INTRODUCTION

1. INTRODUCTION

Medicinal plants are considered as the cornerstone for preserving and promoting health all throughout the world. Among the medicinal herbs A.muricata belongs to the family Annonaceae. The family's trees, shrubs and woody climbers are mostly found in tropical areas while some species have expanded into temperate zones. Annonaceae are distinguished by its fibrous, fragrant bark and wood with fine tangential bands of parenchyma. They also have ruminating endosperm, a trimerous, perianth and alternating and distichous leaves. Some Annonaceae are important in the pharmaceutical business because of their bacteriostatic, antifungal and especially cytotoxic chemical components found in their leaves and bark. **(Focho,2010).**

A.muricata can survive poor soil and prefers low-lying areas between 0 meters(0 ft) to 1,200 meters(3,900 ft). It cannot survive freezing temperatures. Its exact origin is unknown, although it is unique to the tropical parts of America and is extensively distributed. Across all continents with temperatures but especially in subtropical regions, it is an introduced species. **(EEB Greenhouse Staff, University of Calicut,2008).**

The plant is grown for its 20 – 30 cm(7.9 – 11.8 in) long, pricky , green fruit, which can have a mass of up to 6.8 kg (15 lb), making it probably the second biggest Annona after the jungle sop. Away from its native area , some limited production occurs as far as north as southern Florida within USDA zone 10; however these are mostly garden plantings for local consumption. It is also grown in parts of Southeast Asia and abundant on the islands of Mauritius **(Julia F. Morton,2018).**

Numerous medical conditions, including fever, respiratory disorders, malaria and infections of the liver, heart and kidneys can be treated with this herb. Antimicrobial, antiprotozoan, antioxidant, insecticide, larvicide, selective cytotoxicity to tumoral cells, anxiolytic, anti-stress, anti – ulceric, wound healing, anti – icteric, hepatoprotective and hypoglycemia are some of A.muricata pharmacological properties. It has been used extensively to treat cancer in recent years**. (Magana, M.A, 2010).**

Two hundred and twelve bioactive compounds found in A.muricata have been reported. The majority are acetogenins which are followed by phenols, alkaloids and other compounds. (**Tellez and Monotalvo-Gonazalez,2016).**

More than 200 chemical compounds have been identified and isolated from this plant; the most important being alkaloids, phenols and acetogenins**.(Badrie and Schauss, 2010).**

The annonaceous acetogenins found in the soursop leaf showed strong inhibitory effects against human cancers such as airways, breast, small intestine, liver and renal cancers.

Medicinal herbs can be a beneficial or complementary addition to standard cancer treatments**.(Afzaal, Saeed, Asghar, Shah, Ikram, Ateeq, Hussain, Ofoedu, Chacha, et al.,2022)**

According to reports, A.muricata has 37 phenolic compounds. Two significant phenolic chemicals present in A.muricata leaves are gallic acid and quercetin**. (J.Correa – Gordillo.2012).**

It has also been discovered that A.muricata leaves contain other compounds like cyclopeptides, amides, carotenoids and vitamins. Additionally, 80 essential oils – mostly sesquiterpene derivatives – have been discovered to be present in the leaves. **(Thang and Dai,2013).**

The plant has great benefits for human life which is full with nutrition. The leaves contain flavonoid, tannin, alkaloid, saponin, carbohydrate, vitamin a, b and c, phytosterol and calcium oxalate. It also has potassium, calcium, zinc, phosphorous and calcium. **(Rethinam and Sundararaj,2016).**

The phytochemicals and mineral composition of the leaves of Annona muricata obtained from Benin City. The mineral analysis was done using Atomic Absorption Spectrophotometric analysis method while phytochemical screening was determined using standard methods. The result of the phytochemical analysis shows the following : saponins(3.50%), alkaloids (1.20%), flavonoids (9.67%), tannins(0.18%) beta – carotene (6.60 mg/100g), ascorbic acid (38.16 mg/100g) and reducing sugars (48.33%) . The result also shows that the mineral concentrations are as follows: potassium (363.05 mg/kg), calcium (11183.50 mg/kg), sodium (694.86 mg/kg), magnesium(9619 mg/kg), iron (139.50mg/kg), zinc (8.34 mg/kg), manganese(8.25.00mg/kg), chromium(3.75mg/kg), copper(14.25mg/kg), cadmium(5.49 mg/kg). The results obtained from the analysis shows that the leaves of Annona muricata are medicinal and could be good source of drugs for anemia because of the high contents of iron and calcium. **(Usunomena and Paulins,2016).**

A number of medicinal uses have been reported across the globe ranging from the use of leaves, bark, roots, fruits and seeds of A.muricata . **(Badrie and Schauss,2010).**

The most common preparation in traditional medicine is the decoction of bark, root, seed or leaf despite the fact that it has various applications. All parts are utilized in Uganda and other tropical sub-Sharan countries to treat malaria, diabetes, cancer, parasite infections and stomachaches. **(Namulindwa and Gavamukulya,2014).**

In recent years, A.muricata leaves have been used to treat hypertension, diabetes and cancer. Tropical insect repellents, bioinsecticides are also made from unripe fruit sees, leaves and roots. Aphids, thrips and lepidoperan larvae are just a few of the pests that can be controlled with A.muricata aqueous extract, according to the pesticide action and alternatives for Latin America edition**. (Leatemia and Isman,2004 & 2007).**

Drying is one of the oldest food preservation methods to reduce moisture content to inhibit bacterial growth and spoilage. It enhances food stability by lowering water activity, reducing weight and bulk and decreasing transportation costs. Leaves contain high moisture content ;

drying extends their shelf life and minimizes postharvest losses by reducing moisture content. Effective dehydration is crucial to preserving active nutrients while removing moisture to prevent biochemical reactions**.(Lekjing, Venkatachalam, Charoenphun, Noonim, et al., 2024).**

SIGNIFICANCE OF THE STUDY

Soursop leaves are traditionally consumed by infusion in medicine as an anticancer, analgesic and antispasmodic agent. It is internationally marketed for therapeutic purposes and can be used with herbal mixtures.

The aqueous leaf extracts contain the following phytochemicals: alkaloids, saponins, tannins, phenols, phytosterols, terpenoids and anthraquinones in high amounts as well as cardiac glycosides, coumarins, lactones and flavonoids thereby justifying its traditional use as a medicine.

The aqueous extracts of the soursop leaves have antioxidant capacity due to their phytochemical constituents and pharmacological properties which are also commonly used in infusions as a soothing, anti – inflammatory, antiallergic, antibacterial and antiviral agent as well as for fever, pain and diarrhea.

AIM OF THE STUDY

The aim of the study is to develop new products from soursop leaves (Annona muricata), focusing on their nutritional and medicinal properties The study aims to evaluate the feasibility, safety of using soursop leaves in the formulation of functional food items.

OBJECTIVES

The present study **"FORMULATION OF FUNCTIONAL PRODUCTS USING ANNONA MURIATA LEAVES".**

- **To process the leaves for the development of food products**
- **To formulate the food products**
- **To conduct organoleptic evaluation of the formulated product**
- **Nutritional evaluation of the developed products**
- **To examine the shelf life of the formulated food products**

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

The review of literature pertaining to the study **" FORMULATION OF FUNCTIONAL FOOD PRODUCTS FROM ANNONA MURICATA LEAVES"** is presented under the following headings.

2.1. ANNONA MURICATA LEAF – GENERAL OUTLINE

2.2 NUTRITIONAL IMPORTANCE

2.3. NUTRITIVE VALUE OF A.MURICATA LEAVES

2.4. HEALTH BENEFITS OF A.MURICATA LEAVES

2.5. PHYTOCHEMICALS PRESENT IN LEAVES

2.6. ANTIOXIDANTS IN A.MURICATA

2.7. TOXICITY OF SOURSOP LEAVES

2.1. ANNONA MURICATA LEAF – GENERAL OUTLINE

Annona muricata, also known as guanabanana in Spanish , is a species of the genus Annona, which belongs to the Annonaceae family of the custard apple trees and produces edible fruit. Because of its mildly acidic flavor when ripe, the fruit is commonly referred to as soursop. Originally from the Caribbean and central America, the Annona muricata bar is now widely cultivated and in some places is spreading throughout tropical and subtropical regions of the world. (**Julia F. Morton,2018**).

The short, straight, evergreen tree Annona muricata can reach a height of roughly thirty feet (9.1 meters). The leaves of its young branches are hairy and measures 8 cm(3.1 in) to 16 cm (6.3 in) in length and 3 cm (1.2 in) to 7cm (2.8 in) in width. They have a pale, somewhat hairy to hairless underside and a glossy, dark green, hairless top. The leaf stalks are hairless and range in length from 4 millimeters (0.6 in) to 13 millimeters (0.51 in).(**e.Floras.org.,2008-4-18).**

Kingdom	:	Plantae
Subkingdom	:	Tracheobionata
Superdivision	:	Spermatopyta
Division	:	Magnoliophyta
Class	:	Magnoliopsida
Subclass	:	Magnolliales
Order	:	Magnoliales
Family	:	Annonaceae
Genus	:	Annona L.
Species	:	Annona muricata L.

2.2. NUTRITIONAL IMPORTANCE

A number of medicinal uses have been reported across the globe ranging from the use of leaves, bark, roots, fruits and seeds of A.muricata. **(Badrie,2010).**

The most widely used preparation in traditional medicines in the decotion of bark, root, seed or leaf applications are varied. In a number of tropical sub saharon countries such as Uganda, all parts are used to treat malaria, stomach ache, parasitic infection, diabetes and cancer. **(Namulindwa and Gavamukulya, 2014 & 2015).**

The soursop leaf was identified to be useful in inhibiting the cancer cells by inducing apoptosis, improving immune response, decreasing glucose concentration in blood, reducing depression,

stimulating digestion and dilating blood vessels. The annonaceous acetogenins found in the soursop leaf showed strong inhibitory effects against human cancers such as airways, breast, small intestine, liver and renal cancers. The soursop leaves are used in traditional medicine to treat a variety of aliments. **(Afzaal, Asghar, Shah, Ikram, Ateeq, Hussain, Ofoedu, Chacha, et al.,2022)**

2.3. NUTRITIVE VALUE OF ANNONA MURICATA LEAVES

Table – I

Mineral composition of leaves of Annona muricata**(Usunomena and Paulinus,2016).**

Nutrients	Per 100 g
Potassium (mg)	363.05
Calcium (mg)	11183.50
Sodium (mg)	694.86
Magnesium (mg)	9619
Iron (mg)	139.50
Zinc (mg)	8.34
Manganese (mg)	8.25
Chromium (mg)	3.75
Copper (mg)	14.25
Cadmium (mg)	5.49

Table – II

Proximate composition and energy content of leaves of Annona muricata **(Uchegbu,Ukpai,Iwu,Akalazu et al., 1-7-2017).**

Nutrients	Per 100g
Carbohydrates(g)	61.7 ± 0.17
Proteins(g)	24.3 ± 0.10
Fats (g)	2.52 ± 0.15
Fibre (g)	6.17 ± 0.30
Food energy g/cal	366.7 ± 0 40

2.4. HEALTH BENEFITS OF ANNONA MURICATA LEAVES

In mouse models, muricata leaves exhibited more anti – tumor efficacy than curcumin, a well-known natural chemopreventive. In induced colorectal carcinogensis, this extract has demonstrated a preventive impact on both biochemical processes and morphological alterations. Rats treated with A.muricata fruit extract for five weeks developed breast tumors. In mouse models, an aqueous extract of commercial powder capsules containing A.muricata leaves and stems also shown anti- tumorigenic and anti – metastasis properties on pancreatic cancers. **(Dani and Torres, 2012).**

A.muricata leaf aqueous extract demonstrated hepatoprotective action, acting similarly to silymarin(Silybum marianum) in preventing hyperbilirubinemia or jaundice. When a hepatotoxin like paracetamol(Acetoaminophen), which is commonly used as an analgesic and antipyretic but can damage the liver, the extract lessened its negative effects and conserved the hepatic physiological mechanism. The glucosides in A.muricata extract lower bilirubin levels because they may be converted to glucuronic acid and conjugate with bilirubin for excretion or because the extract's active regulators boost enzyme activity, transporator synthesis and bilirubin clearance pathway step. **(Arthur and Woode, 2012).**

A.muricata bark and leaf extracts increased wound contraction as compared to untreated wounds. Coagulation, inflammation, proliferation and maturation are the four intricate stages pf wound healing. Some of these phases have been demonstrated to be accelerated by A.muricata**.** In wound tissues, the inflammatory phase of A.muricata cell growth causes an increase of Hsp 70. Collagen accumulated and fibroblasts proliferated throughout the maturation period. Extracts from A.muricata increased the amount of collagen fibers that were deposited in the wound. **(Moghadamatous and Karimian, 2015).**

Crude extracts of A.muricata(AMCE) white blood cell, T- cell and natural killer cell populations were all up. **(Romli and Alitheen,2016).**

Hemorrhoids, inflammatory bowel disease and autoimmune diseases can all be treated using plants high in phenolic compounds, such as flavonoids, tannins, stillbenoids, catechins, lignins and phenolic acids. Numerous studies have demonstrated that flavonoids and phenolic compounds increase the antioxidant capacity of natural substances. It is believed that the phytochemicals found in A.muricata including acetogenins, alkaloids, megastigmanes and phenolic compunds including gallic acid and quercetin have anti – inflammatory and antioxidant qualities. Soursop leaf extract can be used to prevent bleeding because it contains

anti – inflammatory qualities. A natural blend of bioactive substances with a biogenesis. (**Afzaal, Saeed, Asghar, Shah, Ikram, Ateeq ,Hussain, Ofoedu, Chacha, et al, 2022).**

A.muricata's flavanoidsnhave anti – diabetic effects. This action results from its capacity to suppress the activity of α-glucosidase, an enzyme that catalyzes the conversion of starch to simple sugars. Blood sugar levels rise as a result of these enzymes assistance in the breakdown of carbohydrates and starches in the meal, which produces glucose for intestinal absorption. **(Zubaidi, Nani, Kamal, Qayyum, Maarof, Afzan, Misnan, Hamezah, Baharum, Mediani, et al., 2023).**

The hypotensive activity of A.muricata lowers blood pressure by blocking calcium ion channels instead of using mechanisms that depend on the endothelium and nitric oxide. Through this mechanism, ca+ antagonism reduces the excessive K+ activity that can cause contractions. The alkaloid chemicals in the leaves of A.muricata may be responsible for the plant's hypotensive effects. It has been demonstrated that the alkaloids isoquinoline, coreximine and anomurine temporarily lower blood pressure. **(Zubaidi, Nani, Kamal, Qayyum, Maarof, Afzan, Misnan, Hamezah, Baharum, Mediani, et al., 2023).**

2.5. PHYTOCHEMICALS PRESENT IN A.MURICATA LEAVES

According to reports. A.muricata has two hundred and twelve bioactive chemicals. Acetogenins predominate, followed by alkaloids, phenols and other substances. **(Yahia and Obledovazquez,2016).**

The phytochemicals present in Annona muricata are alkaloids, flavonoids, carbohydrates, cardiac glycosides, saponins, tannins, phytosterols, terpenoids and proteins. **(Agu and Okolie,2017).**

The aqueous leaf extract of the soursop leaves have antioxidant capacity due to their phytochemical constituents and pharmacological properties, which are also commonly used in infusions as soothing, anti – inflammatory, antiallergic, antibacterial and antiviral agent, as well as for fever, pain and diarrhea. The alkaloids are one of those constituents responsible for such characteristics. The presence of alkaloids widely used in medical science justifies the

pharmacological effects experienced by people after consumption. **(Santos, Rodriques, Amante, Meller, 2023).**

According to reports, A.muricata has 37 phenolic chemicals. Quercetin and gallic acid are the two significant phenolic chemicals present in A.muricata leaves**.(J. Correa – Gordillo,2012).**

A.muricata leaves have also been found to contain other substances such as vitamins, carotenoids, amides and cyclopeptides. Furthermore, it has been determined that the leaves contain 80 essential oils, primarily esquiterprene derivatives**. (Thang and Dai, 2013).**

2.6. ANTIOXIDANTS PRESENT IN A.MURICATA LEAVES.

Antioxidants do not exhibit high activity or concentration in the plant's leaves, juice or wine. On A.muricata, numerous antioxidant assays have been carried out. Natural antioxidants obtained from plant species have drawn attention because of their ability to defend against oxygen derived from free radicals, which are implicated in the development of numerous disease including cancer, heart disease, arthritis and degenerative illnesses like Parkinson's and Alzheimer's. **(Almedis and Arriaga,2011).**

An antioxidant is a substance that can prevent molecular oxidation, thereby shielding biological molecules from free radicals or reactive oxygen species. **(Gordillo,2012).**

2.7. TOXICITY OF SOURSOP LEAVES.

The leaves of soursop contain substances with the potential to be cytotoxic such as phenols and annonaceous acetogenins. Numerous variables including geographic location, climatic conditions and pest or disease disturbance factors might impact a compounds phenol levels and toxicity.

The study toxicity activity and total phenolic content of soursop leaves from three reions in south Sulawesi, Indonesia aims to investigate whether there are variations in the phenolic content and toxicity of the ethanol extract of soursop leaves that are grown in Gowa, Takalar and Pinrang, three distinct regions in South Sulawesi, Indonesia. The Folin – Ciocalteu reagent was used to evaluate the total phenolic content, whereas Artemia Salina Leach Larvae were used for the BSLT method of the toxicity leaves from Gowa, Pinrang and Takalar had total phenolic contents of 3.7588% mg GAE/g, 0.9686% mg GAE/g and 1.3832% mg GAE/g respectively. Gowa, Pinrang and Takalar have LC50 values of 38.19 µg/ml, 34.35 µg/ml and 70.95 µg/ml respectively indicating their toxicity. There were differences in the phenolic content and toxicity level of the ethanol extract of soursop leaves. All of these areas could

source raw materials of soursop for the development of herbal medicines with cytotoxicity, ie, amticancer , because they have LC50›1,000µg/ml. **(Cindy Artika Sari, 2023).**

A.muricata including its fruit contains annonacin, the most abundant acetogenin, which has been experimentally demonstrated to be toxic in vitro and in vivo to dopaminergic and other neurons. Epidemiological evidence in several regions of the world has linked consumption of the fruit to an increased risk of developing atypical parkinsonism and the cross – ethnic origins found among islands around the world led to the suggestion that consumption of soursop fruit and other consumables derived from this plant places those who consume the fruit at possible risk. Risk associated with cross – interactions with compounds found in other foods, is suggested by the continued consumption of soursop in places like the North Marianna Islands and the virtual disappearance of atypical parkinsonism in recent decades. A clearer understanding of the risks associated with chronic intake of soursop is warranted given the presence of acetogenins and other alkaloids in the fruit so that the competent and reliable dietary advice can be given**. (Badrie and Schauss, 2010).**

Annona muricata has been widely utilised for the treatment of a range of cancers. The aim of this systematic review was to summarise the available literature that reports on factors related to the safety and tolerability of A.muricata leaf extract and its acetogenins.

In- vitro, preclinical animal and human studies, the study, safety and tolerability of Annona muricata leaf extract evaluated that A.muricata leaf extract and its constituents were searched through the databases, pubmed, medline and Embase from inception to April, 2019. The elaborated item 4 of consolidated standards of reporting trials statement and animals in research : Reporting In - vivo experiments guidelines were used to evaluate the quality of the studies.

The results suggest that A.muricata and its constituents have hepatoprotective, neurotoxic, antinociceptive, anti- ulcerative and chemoprotective effects, The dose and duration used in animal studies demonstrating toxicity may not directly translate into the effects in humans. Studies included in this review were judged to be of medium to high quality.

The overall outcome of the current review suggests that A. muricata has a favourable safety and tolerability profile**. (Chan, McLachLan,Hanrahan,Harnett,et al.,2020).**

METHODOLOGY

3. METHODOLOGY

The methodology of the present study entitled **" FORMULATION OF FUNCTIONAL FOOD PRODUCTS FROM ANNONA MURICATA LEAVES"** is as follows .

PHASE – 1

3.1. Selection of samples

3.2. collection of samples

3.3. Materials used

3.4. Processing of the sample (Annona muricata)

PHASE – 2

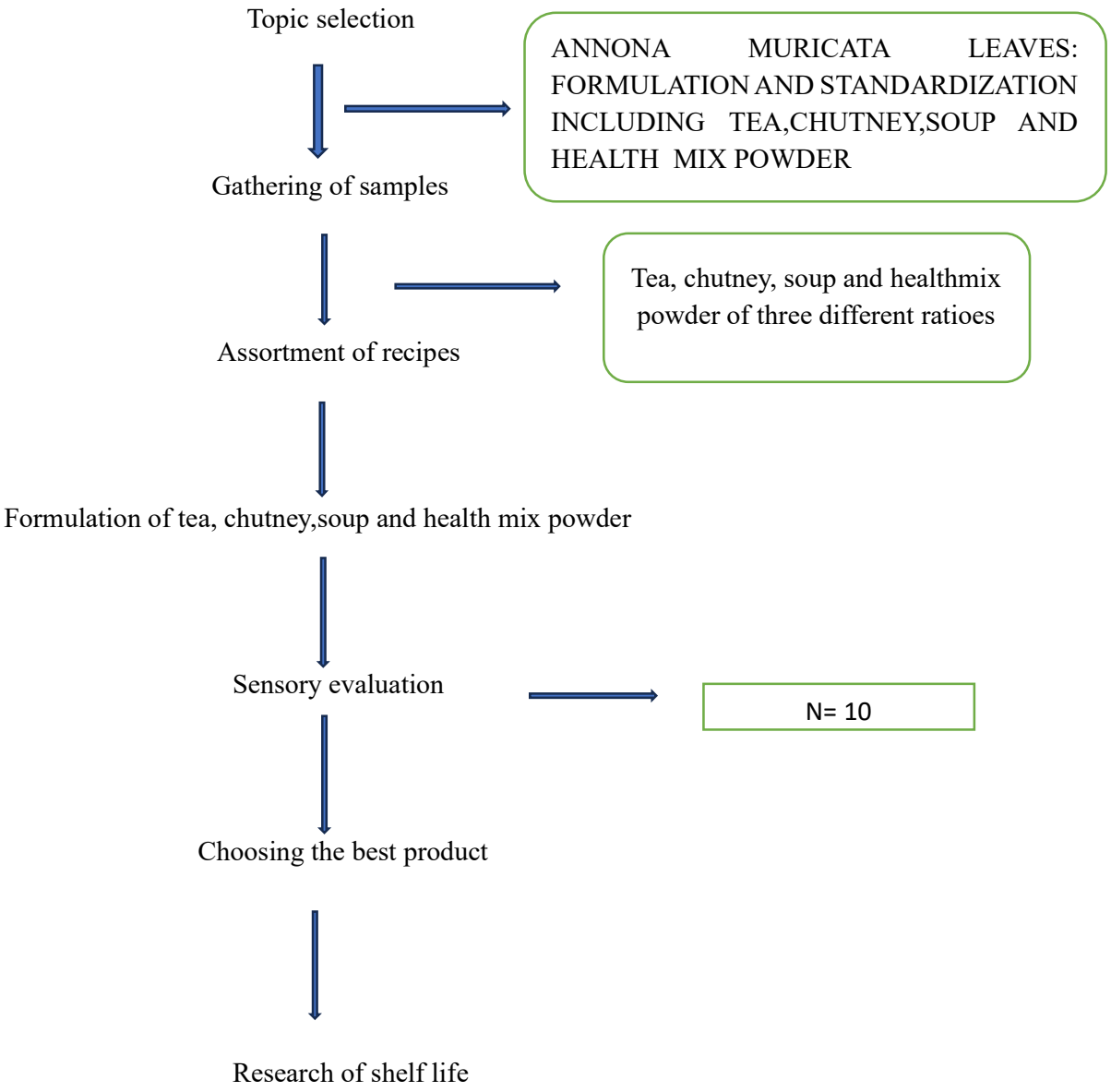
3.5. Formulation of the product

3.6. Sensory evaluation

3.7. Nutrient evaluation of the developed tea, chutney, soup and health mix powder.

3.8. Shelf life of the developed tea, chutney, soup and health mix powder.

DESIGN OF RESEARCH



PHASE – 1

Creating an appropriate approach is crucial to conducting a meaningful examination of any issue. The nature of the investigation is experimental.

3.1. Selection of samples

For the investigation, fresh samples of Annona muricata leaves were used.

3.2. Collection of samples

Fresh sample of Annona muricata leaves were procured from Pathanapuram village of Kollam district.

The other ingredients such as toor dal ,split chickpeas , moong dal , roasted chana dal, pumpkin seeds, flax seed, chia seed, peanut, black gram dal, maida, corn flour, onion powder, tomato powder, corn, garlic, sugar, tarmarind, asafoetida, pepper, turmeric powder and salt from nearby supermarket in pathanapuram , kollam district.

3.3. Material used

3.3.1. Electronic weighing balance

Electronic compact scale of SF – 400A was used to weigh the samples in grams.

3.3.2. Mixer

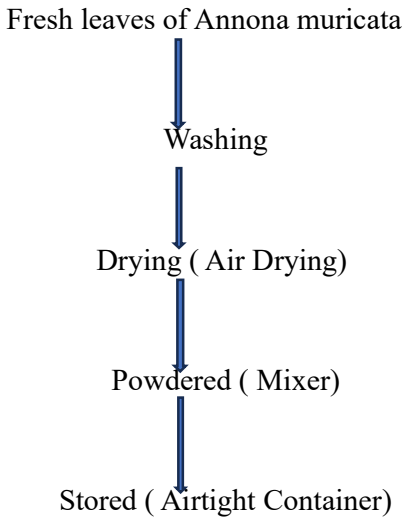
Mixer model of Dynamix Dx was used to grind the samples for mixing.

3.4. Processing of the sample(Annona muricata leaves)

The sample was properly cleaned two or three times under running water. To get rid of the foreign particles, the samples were cleaned. After that, it was dried using conventional air drying method, with special attention paid to the dried leaves, which were then ground into a fine powder with a regular mixer. For additional examination, the samples were placed in airtight container and kept at room temperature.

Flow chart for the preparation of Annona muricata leaves powder

Figure - I



PHASE – 2

3.5. Formulation of the product

Tea, chutney, soup and health mix powder were made from the leaves of the powdered Annona muricata.

The chosen tea, chutney, soup and health mix powder recipes were made with different percentages of inclusion, including 5%, 10% and 15%.

3.5.1 Preparation of tea powder

The preparation of tea powder using various proportions such as 5%, 10% and 15% of incorporation compared with standards were shown in Table – 3

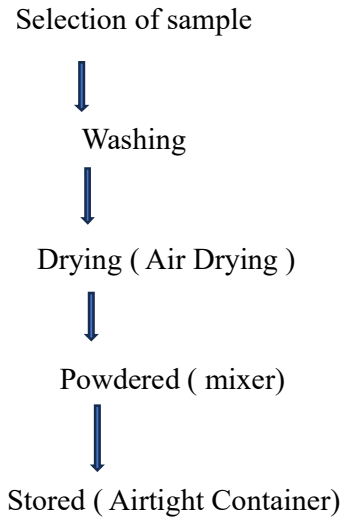
Table – III

Ingredients needed to make tea powder

Sl No.	Ingredients	Amount (g)			
		AMTPS (Standard)	AMTP1 (5%)	AMTP2 (10%)	AMTP3 (15%)
1	Annona muricata leaves powder	-	5	10	15

Figure – II

Flow chart for preparing tea powder



3.5.2. Preparation of chutney powder

The preparation of chutney powder using various proportions such as 5%, 10% and 15% of incorporation compared with standards were shown in Table – 4

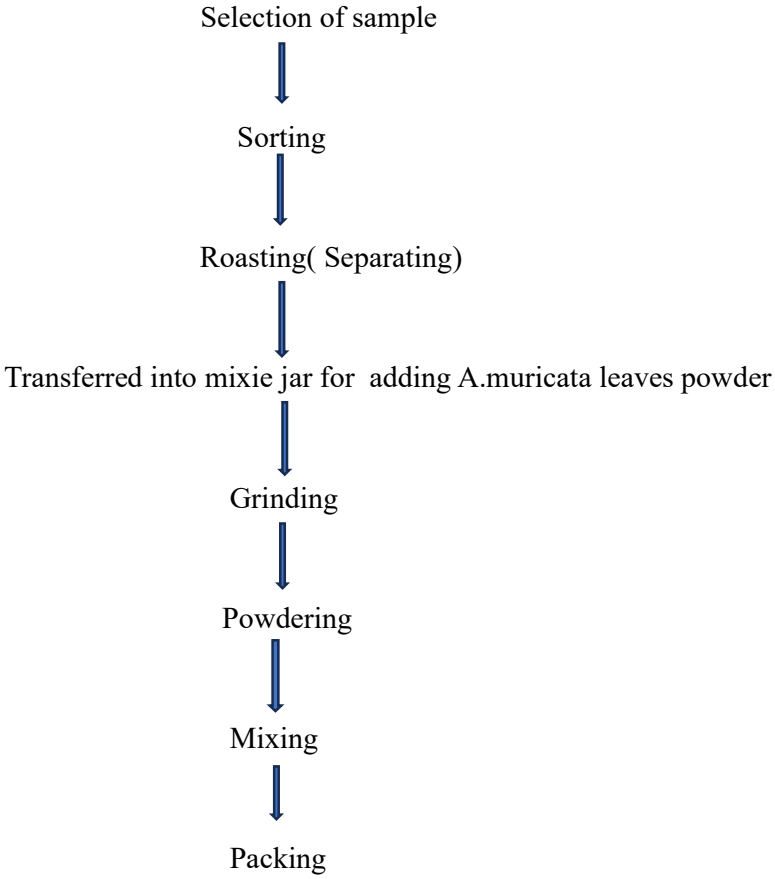
Table – IV

Ingredients needed to make chutney powder

SL No.	Ingredients	Amount (g)			
		AMCPS (Standard)	AMCP1 (5%)	AMCP2 (10%)	AMCP3 (15%)
1	Toor dal	15	15	15	15
2	Split chickpeas	15	13	13	11
3	Moong dal	13	13	13	11
4	Roasted chana dal	14	13	11	11
5	Peanut	14	12	10	10
6	Black gram	14	14	13	12
7	Chilli Flakes	3	3	3	3
8	Curry Leaves	2	2	2	2
9	Tamarind	2	2	2	2
10	Asafoetida	2	2	2	2
11	Pepper	4	4	4	4
12	Salt	2	2	2	2
13	Annona muricata leaves powder	-	5	10	15

Figure – III

Flow chart for preparing chutney powder



3.5.3. Preparation of soup powder

The preparation of soup powder using various proportions such as 5%, 10% and 15% of incorporation compared with standards were shown in Table – 5

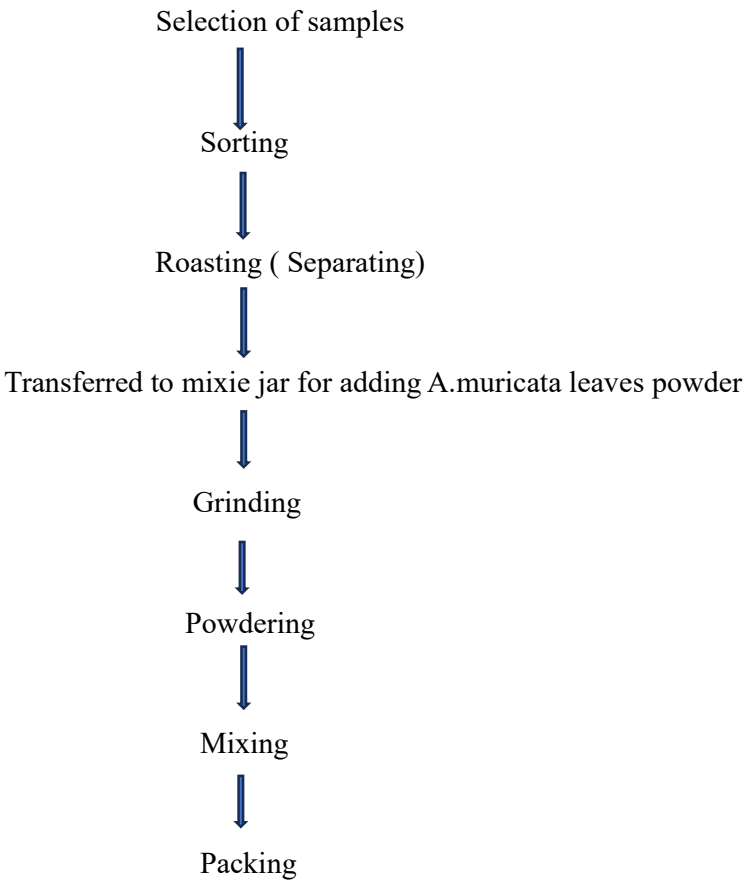
Table – V

Ingredients needed to make soup powder

SL No.	Ingredients	Amount (g)			
		AMSPS (Standard)	AMSP1 (5%)	AMSP2 (10%)	AMSP3 (15%)
1	Yellow split peas	15	15	15	15
2	Green peas	15	14	13	13
3	Corn	13	13	12	12
4	Carrot	12	12	11	11
5	Cabbage	12	10	10	9
6	Turmeric Powder	5	5	3	3
7	Garlic	8	8	8	6
8	Asafoetida	2	2	2	2
9	Pepper	8	7	7	6
10	Tamarind	3	3	3	2
11	Salt	2	2	2	2
12	Fennel seed	5	4	4	4
13	Annona muricata leaves powder	-	5	10	15

Figure – IV

Flow chart for preparing soup powder



3.5.4. Preparation of health mix

The preparation of health mix powder using various proportions such as 5%, 10% and 15% of incorporation compared with standards were shown in Table – 6

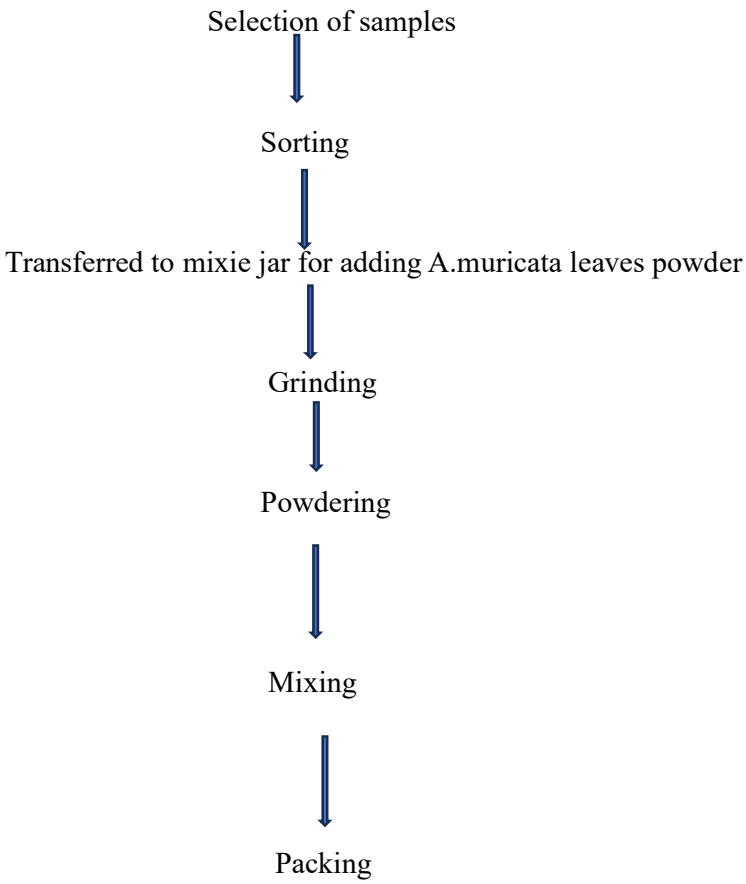
Table – VI

Ingredients needed to make health mix powder

SL No.	Ingredients	Amount(g)			
		AMHMPS (Standard)	AMHMP1 (5%)	AMHMP2 (10%)	AMHMP3 (15%)
1.	Pumpkin seed	20	20	20	20
2.	Chia seed	15	15	10	15
3.	Flax seed	15	15	15	10
4.	Peanut	10	10	10	5
5.	Cashew	15	10	10	10
6.	Pista	10	10	10	10
7.	Almond	10	10	10	10
8.	Turmeric powder	5	5	5	5
9.	Annona muricata leaves powder	-	5	10	15

Figure – V

Flow chart for preparing health mix powder



3.6. Sensory Evaluation

The term "Sensory Evaluation or Organoleptic Evaluation" refers to the process of evaluating the manufactured items quality using sense organs. This assessment is a useful tool for resolving issues with food acceptability. It helps in market research and product development. It is dependent on the resources provided by many sense organs, including the tongues's taste buds, eyes and the mouth's lobes. **(Manoranjankalia, 2002).**

3.6.1. Conduct of Sensory analysis

The environment used for sensory analysis was undistributed and clean. After being coded, the produced products were shown to the panel members along with a score card that qualified the quality parameters. Plate - V provided the prepared product's sensory evaluation.

3.6.2. Preparation of Score Card

An crucial instrument for organoleptic evaluation is the score card, which should be straightforward, spelled accurately and have clear terminology. The score card was created by the 9 point Hedonic scale also known as degree of liking scale with consideration for appearance, colour, taste, flavor, texture and overall acceptability. The range of sensory qualities is Like extremely, Like very much , Like moderately, Like slightly, Neither like nor dislike , Dislike slightly, Dislike moderately, Dislike very much, Dislike extremely. In appendix 11, the score card was provided.

3.6.3. Selection of Panel Members

To determine their acceptability, prepared goods were put through a sensory analysis process. Ten untrained panel members from the department of Nutrition and Dietetics at St Teresa's college, Ernakulam evaluated the prepared products organoleptically using a numerical score card. Using a score card, the panelists were asked to rate the product's overall acceptability as well as its appearance, colour, flavor, taste, texture.

3.7. Nutrient evaluation of the developed Tea, Chutney, Soup and Healthmix powder.

(Longvah, Ananthan, Bhaskarachary, Venkaiah, et al., 2017) used the reference value from the nutritive value of the Indian Food National Institute of Nutrition, Indian Council of Medical Research, Hyderabad, to calculate the macro and micronutrient content of processed foods. The nutritional value of the powder was determined along with the nutritional content of each item in each dish.

3.8. Shelf life of the selected Tea, Chutney, Soup and Health mix powder

For the chosen products, every sample's quality was maintained. The samples were collected and stored in two distinct containers at different temperatures such as room temperature and refrigerator storage. The products were stored in this manner for two months in order to determine the storage behaviour. Every fifteen days, these containers were inspected for the emergence of any off flavours and discolouration in the mix.

PLATE – 1

Collection of sample

PLATE – II

Processing of Annona muricata leaves

Drying(Air Drying)

Powdering

Weighing

PLATE - III

A.muricata leaves powder

PLATE – IV

Ingredients needed to make recipes

Tea Powder

Ingredients needed to make recipes

Chutney Powder

Ingredients needed to make recipes

Soup Powder

Ingredients needed to make recipes

Health mix Powder

PLATE – V

Sensory evaluation of Annona muricata Tea, Chutney, Soup and Health mix powder

RESULT AND DISCUSSION

4. RESULTS AND DISCUSSION

Under the following headings, the findings of the study "**FORMULATION OF FUNCTIONAL PRODUCTS FROM ANNONA MURICATA LEAVES".**

4.1. ORGANOLEPTIC EVALUATION

4.2. NUTRIENT EVALUATION OF THE PRODUCTS

4.2.1. Nutrients composition of chutney powder

4.2.2. Nutrients composition of soup powder

4.2.3. Nutrients composition of health mix powder

4.3. KEEPING QUALITY OF THE FORMULATED ANNONA MURICATA LEAVES POWDER PRODUCTS

4.1. ORGANOLEPTIC EVALUATION OF THE RECEIPES

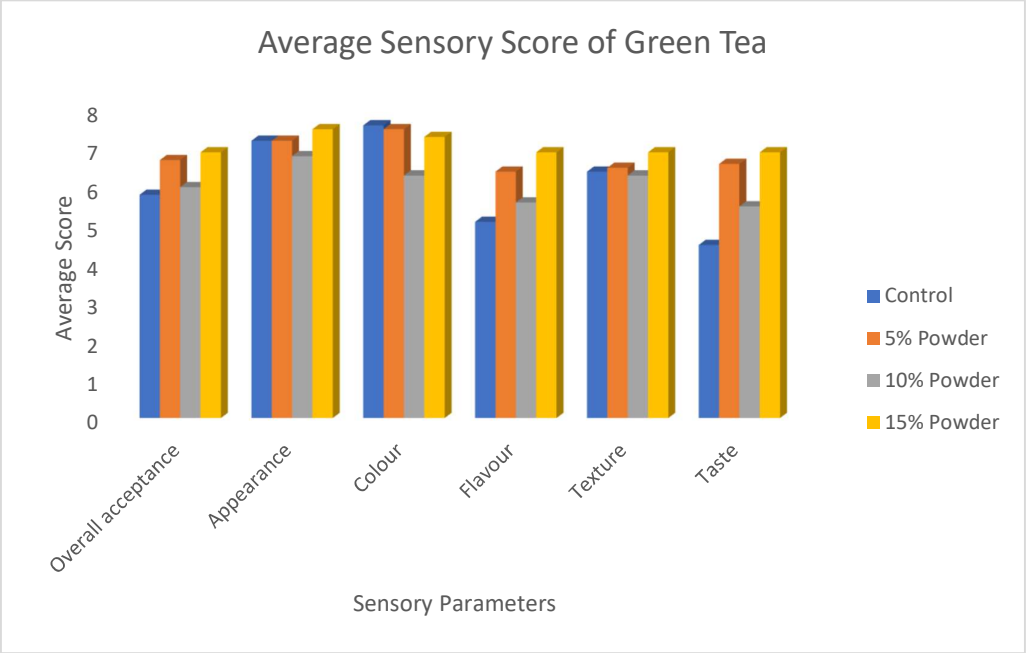
1. GREEN TEA

Table – VII

AVERAGE MEAN SENSORY SCORE OF GREEN TEA

VARIATIONS	ATTRIBUTES					
	APPEARANCE	COLOUR	FLAVOUR	TEXTURE	TASTE	OVERALL ACCEPTABILITY
T1(5%)	7.2±2.04	7.5±1.78	6.4±1.26	6.5±1.78	6.6±1.95	6.7±1.8
T2(10%)	6.8±2.04	6.3±1.94	5.6±1.77	6.3±1.88	5.5±1.84	6±1.7
T3(15%)	6.8±2.04	7.3±1.16	6.9±1.59	6.9±1.72	6.9±1.59	6.9±1.59
T0(Control)	7.2±1.54	7.6±1.57	5.1±1.59	6.4±1.57	4.5±1.78	5.8±1.47
P Value	0.842	0.283	0.065	0.877	0.020	0.398

Figure - VI



Among the 4 samples kept for evaluation, T3(15%) was the most acceptable among 4 different variations. T3(15%) possessed the highest score in overall acceptability.

Among the 4 samples kept for evaluation, T3(15%) was the most acceptable among 4 different variations. T3(15%) possessed the highest score in appearance.

Among the 4 samples kept for evaluation, T0(Control) was the most acceptable among 4 different variations. T0(Control) possessed the highest score in colour.

Among the 4 samples kept for evaluation, T3(15%) was the most acceptable among 4 different variations. T3(15%) possessed the highest score in flavour.

Among the 4 samples kept for evaluation, T3(15%) was the most acceptable among 4 different variations. T3(15%) possessed the highest score in texture.

Among the 4 samples kept for evaluation, T3(15%) was the most acceptable among 4 different variations. T3(15%) possessed the highest score in taste.

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Among the 4 samples kept for evaluation, T3(15%) was the most acceptable among 4 different variations. T3 possessed the highest score in the organoleptic parameters such as appearance, flavour, texture , taste except the taste. T0 possessed the highest score in colour

ANOVA test reveals that there is no statistically significant difference in the average scores in the overall acceptance, appearance, colour, flavour, texture for green tea. Green tea shows a statistically significant difference only in the average score of taste between its different concentrations.

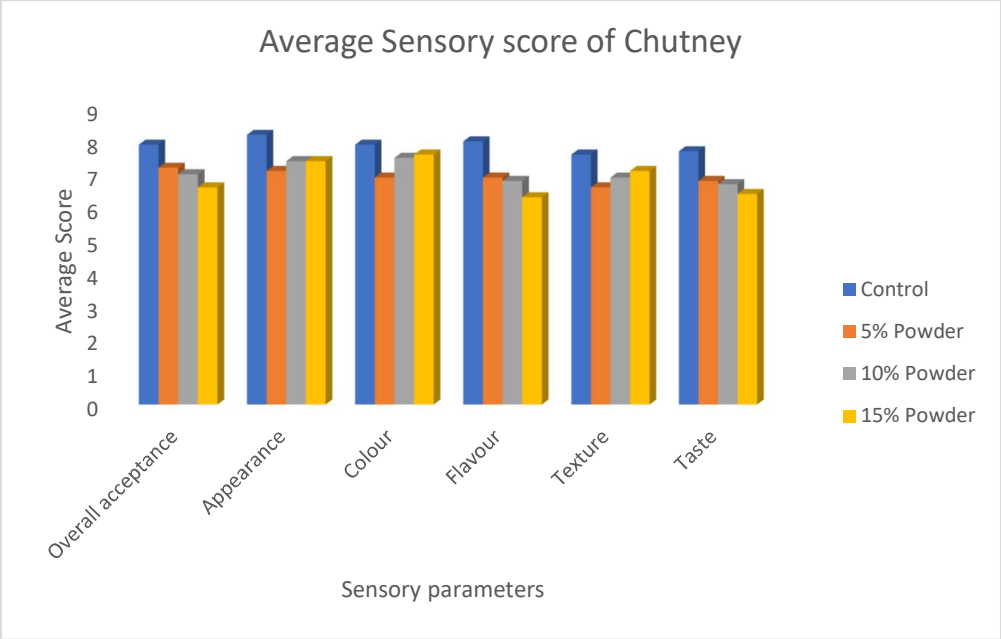
2. CHUTNEY POWDER

Table – VIII

AVERAGE MEAN SENSORY SCORE OF CHUTNEY POWDER

VARIATIONS	ATTRIBUTES					
	APPEARANCE	COLOUR	FLAVOUR	TEXTURE	TASTE	OVERALL ACCEPTABILITY
T1(5%)	7.10±1.72	6.9±2.13	6.9±2.02	7.6±1.64	7.7±1.56	7.2±1.75
T2(10%)	7.4±1.17	7.5±1.17	6.8±2.15	6.9±2.18	6.8±1.75	7±2.0
T3(15%)	7.4±1.17	7.6±1.17	6.3±1.70	7.1±1.59	6.7±2.11	6.6±1.26
T0(Control)	8.2±0.78	7.9±1.37	8±1.15	7.6±1.64	6.4±1.35	7.9±0.99
P Value	0.230	0.521	0.210	0.693	0.377	0.315

Figure – VII



Among the 4 samples kept for evaluation, T0(Control) was the most acceptable among the 4 different variations. T0 possessed the highest score in overall acceptability

Among the 4 samples kept for evaluation, T0(Control) was the most acceptable among the 4 different variations. T0 possessed the highest score in appearance.

Among the 4 samples kept for evaluation, T0 (Control) was the most acceptable among the 4 different variations. T0 possessed the highest score in colour.

Among the 4 samples kept for evaluation, T0(Control) was the most acceptable among the 4 different variations. T0 possessed the highest score in flavour.

Among the 4 samples kept for evaluation, T0(Control) was the most acceptable among the 4 different variations. T0 possessed the highest score in texture.

Among the 4 samples kept for evaluation, T0(Control) was the most acceptable among the 4 different variations. T0 possessed the highest score in taste.

Among the 4 samples kept for evaluation, T0 was the most acceptable among the 4 different variations for all the organoleptic parameters.

ANOVA test reveals that there is no statistically significant difference in the average scores in the overall acceptance, appearance, colour, flavour, texture and taste for chutney powder.

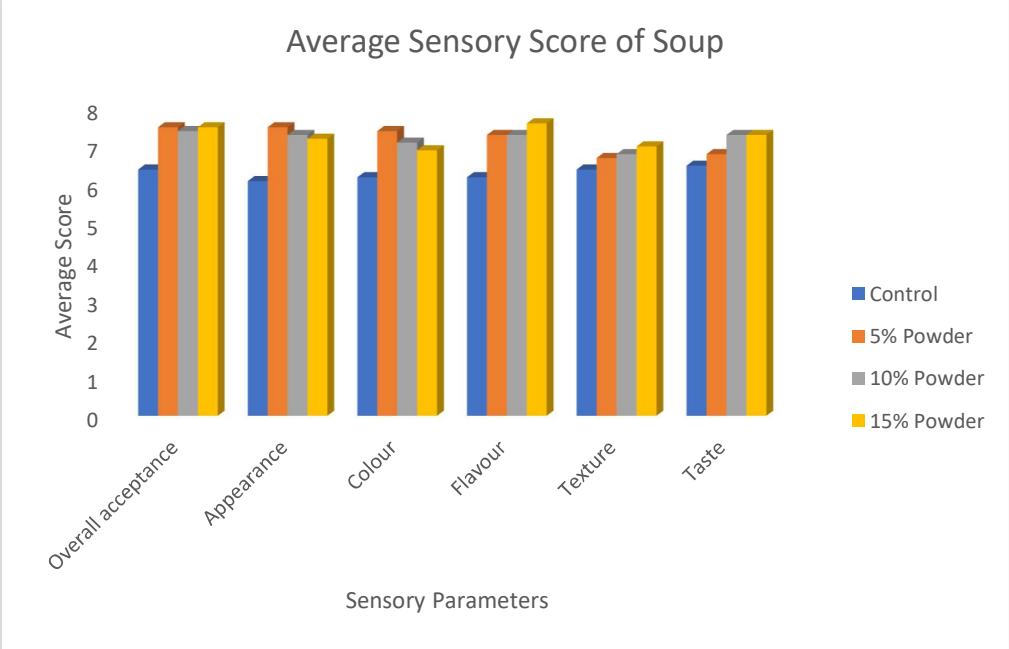
3. SOUP POWDER

Table – IX

AVERAGE MEAN SENSORY SCORE OF SOUP POWDER

VARIATIONS	ATTRIBUTES					
	APPEARANCE	COLOUR	FLAVOUR	TEXTURE	TASTE	OVERALL ACCEPTABILITY
T1(5%)	7.5±1.43	7.4±1.43	7.3±1.63	6.7±1.82	6.89±1.90	7.5±1.26
T2(10%)	7.3±1.56	7.1±1.59	7.3±1.41	6.8±1.87	7.3±1.33	7.4±1.17
T3(15%)	7.2±1.68	6.9±1.44	7.6±1.07	7±1.15	7.3±1.33	7.5±1.17
T0(Control)	6.1±2.13	6.2±2.04	6.2±1.93	6.4±1.71	6.5±2.01	6.4±1.83
P Value	0.280	0.423	0.209	0.879	0.666	0.237

Figure – VIII



Among the 4 samples kept for evaluation, T1(5%) and T3(15%) shows acceptance among the 4 different variations. T1(5%) and T3(15%) possessed the highest score in overall acceptability.

Among the 4 samples kept for evaluation, T1(5%) was the most acceptable among the 4 different variations. T1 possessed the highest score in appearance.

Among the 4 samples kept for evaluation, T1(5%) was the most acceptable among the 4 different variations. T1 possessed the highest score in colour.

Among the 4 samples kept for evaluation, T3(15%) was the most acceptable among the 4 different variations. T3 possessed the highest score in flavour.

Among the 4 samples kept for evaluation, T3(15%) was the most acceptable among the 4 different variations. T3 possessed the highest score in texture.

Among the 4 samples kept for evaluation, T2 and T3 shows acceptance among the 4 different variations. T2 and T3 possessed the highest score in taste.

Among the 4 samples kept for evaluation, T1 shows acceptance in the overall acceptability, appearance and colour, T2 were most acceptable in the taste, T3 shows acceptance in the overall acceptability, flavour, texture, taste.

ANOVA test reveals that there is no statistically difference in the average scores in the overall acceptance, appearance, colour, flavour, texture and taste for soup powder

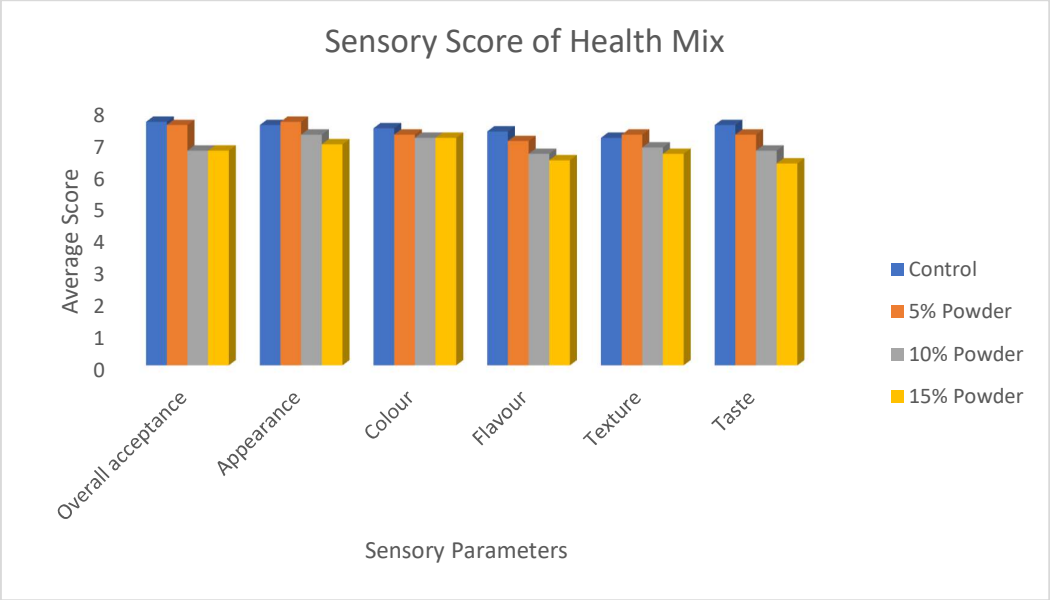
4. HEALTH MIX POWDER

Table – X

AVERAGE MEAN SENSORY SCORE OF HEALTHMIX POWDER

VARIATIONS	ATTRIBUTES					
	APPEARANCE	COLOUR	FLAVOUR	TEXTURE	TASTE	OVERALL ACCEPTABILITY
T1(5%)	7.6±1.07	7.2±1.22	7±1.49	7.2±1.68	7.2±0.91	7.5±1.26
T2(10%)	7.2±1.39	7.1±1.10	6.6±1.71	6.8±1.87	6.7±1.16	6.7±1.05
T3(15%)	6.9±2.13	7.1±1.44	6.4±2.17	6.6±2.01	6.3±1.70	6.7±1.56
T0(Control)	7.5±1.26	7.4±1.17	7.3±1.56	7.1±1.52	7.5±1.35	7.6±1.17
P Value	0.732	0.942	0.666	0.869	0.199	0.237

Figure – IX



Among the 4 samples kept for evaluation, T0(Control) was the most acceptable among 4 different variations. T0 possessed the highest score in overall acceptability**.**

Among the 4 samples kept for evaluation, T1(5%) was the most acceptable among 4 different variations. TI possessed the highest score in appearance.

Among the 4 samples kept for evaluation, T0(Control) was the most acceptable among 4 different variations. T0 possessed the highest score in colour**.**

Among the 4 samples kept for evaluation, T0(Control) was the most acceptable among 4 different variations. T0 possessed the highest score in flavour**.**

Among the 4 samples kept for evaluation, T1(5%) was the most acceptable among 4 different variation. T1(5%) possessed the highest score in texture.

Among the 4 samples kept for evaluation, T0 (Control) was the most acceptable among 4 different variations. T0 possessed the highest score in taste**.**

Among the 4 samples kept for evaluation, T0 shows more acceptance in overall acceptability, colour, flavour and taste. T1 shows acceptance in the appearance and texture.

ANOVA test reveals that there is no statistically significant difference in the average scores in the overall acceptance, appearance, colour, flavour, texture and taste for health mix powder.

Table – XI

AVERAGE MEAN SCORE OF THE ANNONA MURICATA LEAVES PRODUCTS

	Control	5% Powder	10% Powder	15% Powder	p value
Overall Acceptance (Mean ±SD)					
Green Tea	5.8±1.47	6.7±1.8	6±1.7	6.9±1.59	0.398
Chutney	7.9±0.99	7.2±1.75	7±2.0	6.6±1.26	0.315
Soup	6.4±1.83	7.5±1.26	7.4±1.17	7.5±1.17	0.237
Health Mix	7.6±1.17	7.5±1.26	6.7±1.05	6.7±1.56	0.237
Appearance (Mean ±SD)					
Green Tea	7.2±1.54	7.2±2.04	6.8±2.04	7.5±1.08	0.842
Chutney	8.2±0.78	7.10±1.72	7.4±1.17	7.4±0.966	0.230
Soup	6.1±2.13	7.5±1.43	7.3±1.56	7.2±1.68	0.280
Health Mix	7.5±1.26	7.6±1.07	7.2±1.39	6.9±2.13	0.732
Colour (Mean ±SD)					
Green Tea	7.6±1.57	7.5±1.78	6.3±1.94	7.3±1.16	0.283
Chutney	7.9±1.37	6.9±2.13	7.5±1.17	7.6±1.17	0.521
Soup	6.2±2.04	7.4±1.43	7.1±1.59	6.9±1.44	0.423
Health Mix	7.4±1.17	7.2±1.22	7.1±1.10	7.1±1.44	0.942
Flavour (Mean ±SD)					
Green Tea	5.1±1.59	6.4±1.26	5.6±1.77	6.9±1.59	0.065
Chutney	8±1.15	6.9±2.02	6.8±2.15	6.3±1.70	0.210
Soup	6.2±1.93	7.3±1.63	7.3±1.41	7.6±1.07	0.209
Health Mix	7.3±1.56	7±1.49	6.6±1.71	6.4±2.17	0.666
Texture					
Green Tea	6.4±1.57	6.5±1.78	6.3±1.88	6.9±1.72	0.877
Chutney	7.6±1.64	6.6±2.11	6.9±2.18	7.1±1.59	0.693
Soup	6.4±1.71	6.7±1.82	6.8±1.87	7±1.15	0.879
Health Mix	7.1±1.52	7.2±1.68	6.8±1.87	6.6±2.01	0.869
Taste (Mean ±SD)					
Green Tea	4.5±1.78	6.6±1.95	5.5±1.84	6.9±1.59	**0.020**
Chutney	7.7±1.56	6.8±1.75	6.7±2.11	6.4±1.35	0.377
Soup	6.5±2.01	6.89±1.90	7.3±1.33	7.3±1.33	0.666
Health Mix	7.5±1.35	7.2±0.91	6.7±1.16	6.3±1.70	0.199

ANOVA test reveals that there is no statistically significant difference in the average scores in the overall acceptance, appearance, colour, flavour, texture and taste for green tea, chutney, soup and health mix between their different concentrations. Only green tea shows a statistically significant difference in the average score of taste between its different concentrations.

4.2. NUTRIENT EVALUATION OF THE PRODUCTS

Table – XII

4.2.1. Nutrient composition of chutney powder

SL. No	Nutrients	Amount (g)	AMLP Chutney powder mixes	
			Chutney powder	Standard
1.	Energy	100	405.76	314.22
2.	Protein	100	24.22	19.36
3.	Fibre	100	17.83	16.6
4.	Calcium	100	2341.17	240.47
5.	Iron	100	33.49	6.21
6.	Potassium	100	655.79	547.26

Figure - X

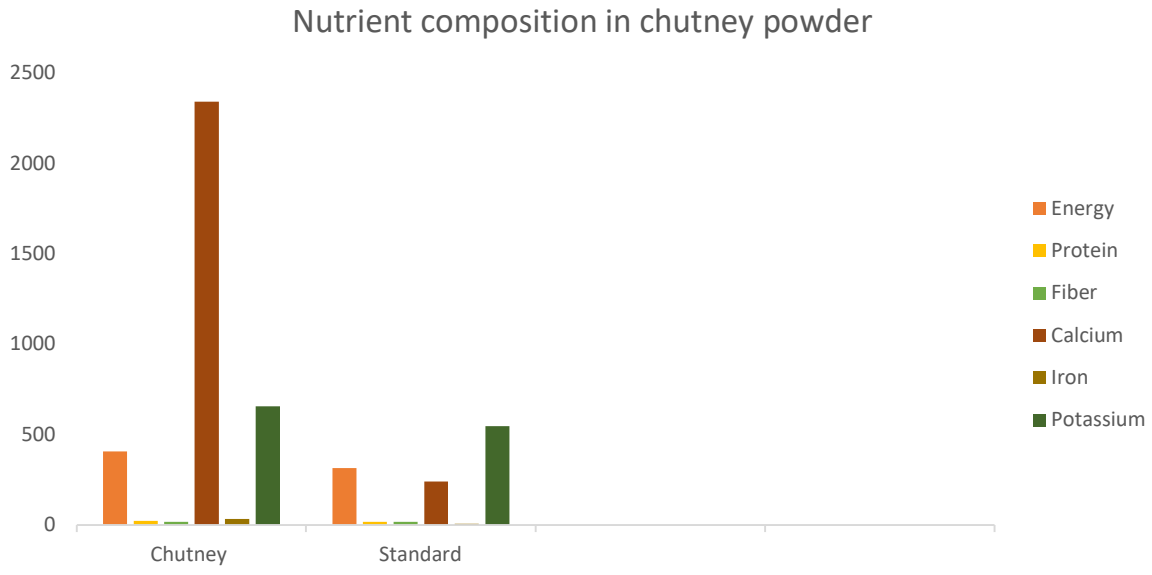


Table – XIII

4.2.2. Nutrients composition of Soup powder

SL. No	Nutrients	Amount (g)	AMLP Soup powder mixes	
			Soup powder	Standard
1.	Energy	100	224.4	17.25
2.	Protein	100	12.94	0.79
3.	Fibre	100	13.48	1.99
4.	Calcium	100	2362.53	59.8
5.	Iron	100	33.52	0.93
6.	Potassium	100	552.64	84.7

Figure - XI

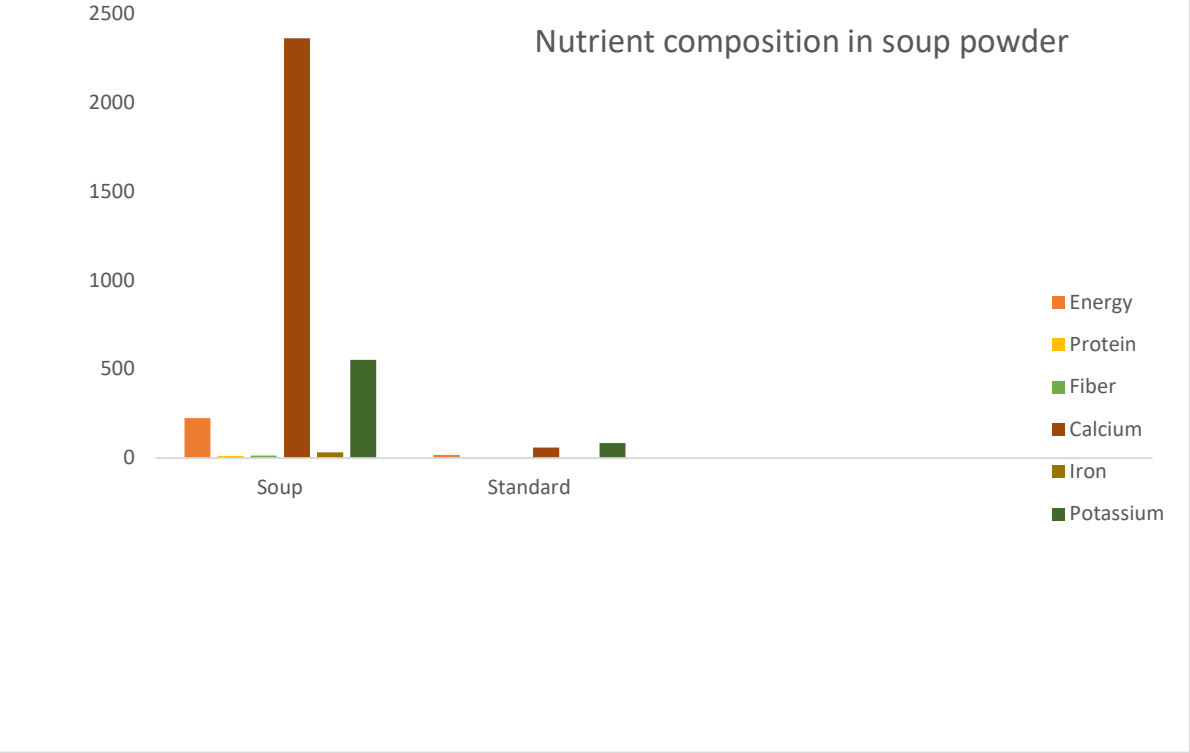
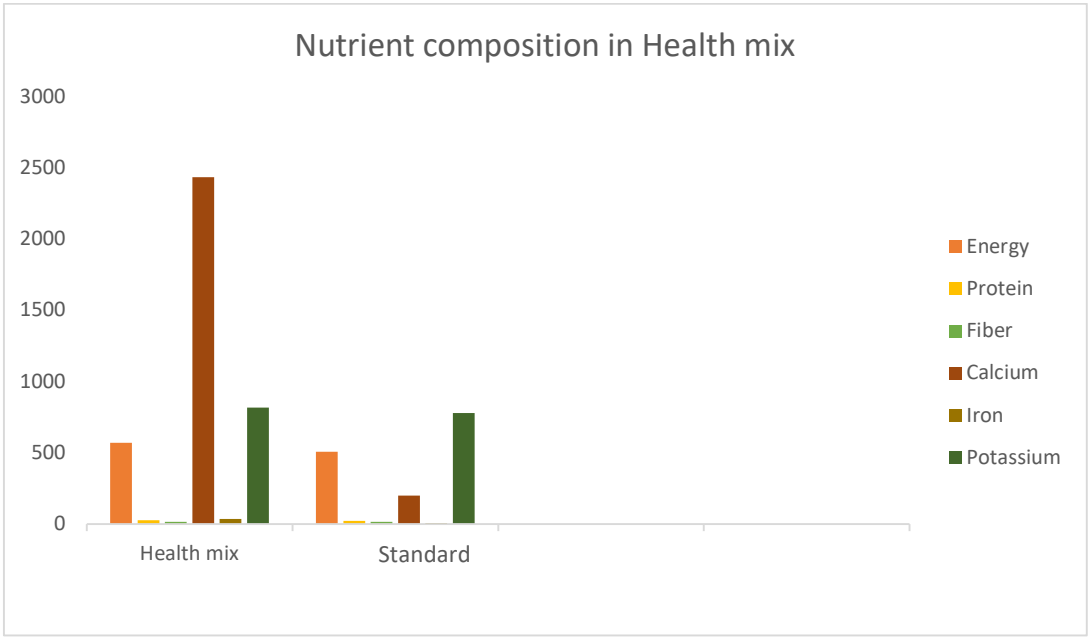


Table - XIV

4.2.3. Nutrient composition of Health mix powder

SL. No	Nutrients	Amount (g)	AMLP Health mix powder mixes	
			Health mix	Standard
1.	Energy	100	571.98	507.57
2.	Protein	100	25.77	21.85
3.	Fibre	100	16.76	15.72
4.	Calcium	100	2435.3	200.3
5.	Iron	100	35.79	8.19
6.	Potassium	100	817.91	778.05

Figure – XII



4.3.KEEPING QUALITY OF THE FORMULATED ANNONA MURICATA LEAVES POWDER PRODUCTS

Keeping quality of the samples were done for the selected mixes. To find out their storage behaviour they were kept at room temperature for 2 months in an air tight container. This containers were examined for every fifteen days to check for any growth of microorganism, colour changes, development of any off flavour and formation of insects.

Table – XV

Keeping quality of the formulated Annona muricata leaves powder products

SL. No.	AMLP MIXES	15 days	30 days	45 days	60 days
1.	AMGTPS	Excellent, there is no change in the colour, flavour and their is no growth of microorganims	There is no change in the colour, flavour and there is no growth of microorganisms	There is no change in the colour, flavour and there is no growth of microorganisms	There is no change in the colour, flavour and there is no growth of microorganisms
2.	AMGTP1	Excellent, there is no change in the colour, flavour and their is no growth of microorganims	There is no change in the colour, flavour and there is no growth of microorganisms	There is no change in the colour, flavour and there is no growth of microorganisms	There is no change in the colour, flavour and there is no growth of microorganisms
3.	AMGTP2	Excellent, there is no change in the colour, flavour and their is no growth of microorganims	There is no change in the colour, flavour and there is no growth of microorganisms	There is no change in the colour, flavour and there is no growth of microorganisms	There is no change in the colour, flavour and there is no growth of microorganisms
4.	AMGTP3	Excellent, there is no change in the colour, flavour and their is no growth of microorganims	There is no change in the colour, flavour and there is no growth of microorganisms	There is no change in the colour, flavour and there is no growth of microorganisms	There is no change in the colour, flavour and there is no growth of microorganisms

5.	AMCPS	Excellent, there is no change in the colour, flavour and their is no growth of microorganims	There is no change in the colour, flavour and there is no growth of microorganisms	There is no change in the colour, flavour and there is no growth of microorganisms	There is no change in the colour, flavour and there is no growth of microorganisms
6.	AMCP1	Excellent, there is no change in the colour, flavour and their is no growth of microorganims	There is no change in the colour, flavour and there is no growth of microorganisms	There is no change in the colour, flavour and there is no growth of microorganisms	There is no change in the colour, flavour and there is no growth of microorganisms
7.	AMCP2	Excellent, there is no change in the colour, flavour and their is no growth of microorganims	There is no change in the colour, flavour and there is no growth of microorganisms	There is no change in the colour, flavour and there is no growth of microorganisms	There is no change in the colour, flavour and there is no growth of microorganisms
8.	AMCP3	Excellent, there is no change in the colour, flavour and their is no growth of microorganims	There is no change in the colour, flavour and there is no growth of microorganisms	There is no change in the colour, flavour and there is no growth of microorganisms	There is no change in the colour, flavour and there is no growth of microorganisms
9.	AMSPS	Excellent, there is no change in the colour, flavour and their is no growth of microorganims	There is no change in the colour, flavour and there is no growth of microorganisms	There is no change in the colour, flavour and there is no growth of microorganisms	There is no change in the colour, flavour and there is no growth of microorganisms
10.	AMSP1	Excellent, there is no change in the colour, flavour and their is no growth of microorganims	There is no change in the colour, flavour and there is no growth of microorganisms	There is no change in the colour, flavour and there is no growth of microorganisms	There is no change in the colour, flavour and there is no growth of microorganisms
11.	AMSP2	Excellent, there is no change in the colour, flavour and their	There is no change in the colour, flavour and there is no	There is no change in the colour, flavour and there is no	There is no change in the colour, flavour and there is no

		is no growth of microorganims	growth of microorganisms	growth of microorganisms	growth of microorganisms
12.	AMSP3	Excellent, there is no change in the colour, flavour and their is no growth of microorganims	There is no change in the colour, flavour and there is no growth of microorganisms	There is no change in the colour, flavour and there is no growth of microorganisms	There is no change in the colour, flavour and there is no growth of microorganisms
13.	AMHMPS	Excellent, there is no change in the colour, flavour and their is no growth of microorganims	There is no change in the colour, flavour and there is no growth of microorganisms	There is no change in the colour, flavour and there is no growth of microorganisms	There is no change in the colour, flavour and there is no growth of microorganisms
14.	AMHMP1	Excellent, there is no change in the colour, flavour and their is no growth of microorganims	There is no change in the colour, flavour and there is no growth of microorganisms	There is no change in the colour, flavour and there is no growth of microorganisms	There is no change in the colour, flavour and there is no growth of microorganisms
15.	AMHMP2	Excellent, there is no change in the colour, flavour and their is no growth of microorganims	There is no change in the colour, flavour and there is no growth of microorganisms	There is no change in the colour, flavour and there is no growth of microorganisms	There is no change in the colour, flavour and there is no growth of microorganisms
16.	AMHMP3	Excellent, there is no change in the colour, flavour and their is no growth of microorganims	There is no change in the colour, flavour and there is no growth of microorganisms	There is no change in the colour, flavour and there is no growth of microorganisms	There is no change in the colour, flavour and there is no growth of microorganisms

The shelf life study of the prepared A. muricata leaves powder products in room temperature shows that there is no significant changes in the samples for about 60 days.

SUMMARY AND CONCLUSION

5. SUMMARY AND CONCLUSION

The study entitled **" FORMULATION OF FUNCTIONAL PRODUCTS FROM ANNONA MURICATA LEAVES"** was carried for improving the health status and provide more nutrient and this is good for cancer and diabetes patients.

MAJOR FINDINGS OF THE STUDY

Among the medicinal herbs A.muricata belongs to the family Annonaceae. The family's trees, shrubs and woody climbers are mostly found in tropical areas while some species have expanded into temperate zones. Annonaceae are distinguished by its fibrous, fragrant bark and wood with fine tangential bands of parenchyma. They also have ruminating endosperm, a trimerous, perianth and alternating and distichous leaves. Some Annonaceae are important in the pharmaceutical business because of their bacteriostatic, antifungal and especially cytotoxic chemical components found in their leaves and bark.

Numerous medical conditions, including fever, respiratory disorders, malaria and infections of the liver, heart and kidneys can be treated with this herb. Antimicrobial, antiprotozoan, antioxidant, insecticide, larvicide, selective cytotoxicity to tumoral cells, anxiolytic, anti-stress, anti – ulceric, wound healing, anti – icteric, hepatoprotective and hypoglycemia are some of A.muricata pharmacological properties. It has been used extensively to treat cancer in recent years**.**

The formulated product contains 100 gram The different proportions are taken to prepare A. muricata green tea, chutney powder, soup powder and health mix, for green tea the samples contains AMGTPS(Standard), AMGTP1(5%), AMGTP2(10%), AMGTP3(15%). For chutney powder, the samples contains AMCPS(Standard), AMCP1(5%), AMCP2(10%), AMCP3(15%). For soup powder, the samples contains AMSPS(Standard), AMSP1(5%), AMSP2(10%), AMSP3(15%). For health mix, the samples contains AMHMPS(Standard), AMHMP1(5%), AMHMP2(10%), AMHMP3(15%).

Hence the present study entitled,"FORMULATION OF FUNCTIONAL FOOD PRODUCTS FROM ANNONA MURICATA LEAVES" has been undertaken with the following objectives, formulation of Annona muricata leaves powder products, nutrient evaluation, conduct organoleptic evaluation, quality analysis.

Annona muricata were collected from pathanapuram village of kollam district. The leaves then washed to remove dirt and unwanted materials.

The leaves then dried by two methods, air drying and freeze drying. In freeze drying, the leaves were placed in a closed box and kept in the freezer for about 3 hrs

In air drying, the leaves were placed on a mat and allowed to dry. Drying takes about 2 days. The leaves then powdered using a blender. The leaves powder then poured into an airtight container.

Both air drying and freeze drying placed at room temperature for 60 days to estimating the shelf life. After 7 days, the freeze dried leaves colour, flavour started to change due to their moisture content, The air dried remains the same for about 60 days.

The formulated products are then evaluated by 10 untrained panel members. They evaluated the positive and negative aspects of the products such as appearance, colour, flavour, texture, taste and overall acceptability.

When evaluating the formulated green tea , the appearance of the formulated products has scored 7.2± 2.04 in T1, 6.8±2.04 in T2, 6.8±2.04 in T3 and 7.2±1.54 in control.

When evaluating the formulated green tea, the colour of the formulated products has scored

7.5±1.78 in T1, 6.3±1.94 in T2, 7.3±1.16 in T3 and 7.6±1.57 in control.

When evaluating the formulated green tea, the flavour of the formulated products has scored 6.4±1.26 in T1, 5.6±1.77 in T2, 6.9±1.59 in T3 and 5.1±1.59 in control.

When evaluating the formulated green tea, the texture of the formulated products has scored 6.5±1.78 in T1, 6.3±1.88 in T2, 6.9±1.72 in T3 and 6.4±1.57 in control.

When evaluating the formulated green tea, the taste of the formulated products has scored 6.6±1.95 in T1, 5.5±1.84 in T2, 6.9±1.59 in T3 and 4.5±1.78 in control.

When evaluating the formulated green tea, the overall acceptability of the formulated products has scored 6.7±1.8 in T1, 6±1.7 in T2, 6.9±1.59 in T3 and 5.8±1.47 in control.

When evaluating the formulated chutney powder, the appearance of the formulated products has scored 7.10±1.72 in T1, 7.4±1.17 in T2, 7.4±1.17 in T3 and 8.2±0.78 in control.

When evaluating the formulated chutney powder, the colour of the formulated products has scored 6.9±2.13 in T1, 7.5±1.17 in T2, 7.6±1.17 in T3 and 7.9±1.37 in control.

When evaluating the formulated chutney powder, the flavour of the formulated products has scored 6.9±2.02 in T1, 6.8±2.15 in T2, 6.8±2.15 in T3 and 8±1.15 in control.

When evaluating the formulated chutney powder, the texture of the formulated products has scored 7.6±1.64 in T1, 6.9±2.18 in T2, 7.1±1.59 in T3 and 7.6±1.64 in control.

When evaluating the formulated chutney powder, the taste of the formulated products has scored 7.7±1.56 in T1 , 6.8±1.75 in T2, 6.7±2.11 in T3 and 6.4±1.35 in control.

When evaluating the formulated chutney powder, the overall acceptability of the formulated products has scored 7.2±1.75 in T1, 7±2.0 in T2, 6.6±1.26 in T3 and 7.9±0.99 in control.

When evaluating the formulated soup powder, the appearance of the formulated products has scored 7.5±1.43 in T1, 7.3±1.56 in T2, 7.2±1.68 in T3 and 6.1±2.13 in control.

When evaluating the formulated soup powder, the colour of the formulated products has scored 7.4±1.43 in T1, 7.1±1.59 in T2, 6.9±1.44 in T3 and 6.2±2.04 in control.

When evaluating the formulated soup powder, the flavour of the formulated products has scored 7.3±1.63 in T1, 7.3±1.41 in T2, 7.6±1.07 in T3 and 6.2±1.93 in control.

When evaluating the formulated soup powder, the texture of the formulated products has scored 6.7±1.82 in T1, 6.8±1.87 in T2, 7±1.15 in T3 and 6.4±1.71 in control.

When evaluating the formulated soup powder, the taste of the formulated products has scored 6.89±1.90 in T1, 7.3±1.33 in T2, 7.3±1.33 in T3 and 6.5±2.01 in control.

When evaluating the formulated soup powder, the overall acceptability of the formulated products has scored 7.5±1.26 in T1, 7.4±1.17 in T2, 7.5±1.17 in T3 and 6.4±1.83 in control.

When evaluating the formulated health mix, the appearance of the formulated products has scored 7.6±1.07 in T1, 7.2±1.39 in T2, 6.9±2.13 in T3 and 7.5±1.26 in control.

When evaluating the formulated health mix, the colour of the formulated products has scored 7.2±1.22 in T1, 7.1±1.10 in T2, 7.1±1.44 in T3 and 7.4±1.17 in control.

When evaluating the formulated health mix, the flavour of the formulated products has scored 7±1.49 in T1, 6.6±1.71 in T2, 6.4±2.17 in T3 and 7.3±1.56 in control.

When evaluating the formulated health mix, the texture of the formulated products has scored 7.2±1.68 in T1, 6.8±1.87 in T2, 6.6±2.01 in T3 and 7.1±1.52 in control.

When evaluating the formulated health mix, the taste of the formulated products has scored 7.2±0.91 in T1, 6.7±1.16 in T2, 6.3±1.70 in T3 and 7.5±1.35 in control.

When evaluating the formulated health mix, the overall acceptability of the formulated products has scored 7.5±1.26 in T1, 6.7±1.05 in T2, 6.7±1.56 in T3 and 7.6±1.17 in control.

The keeping quality of the formulated A.muricata leaves powder products has good keeping quality when analyzing the samples for about 60 days.

HIGHLIGHTS OF THE STUDY

- Highly nutritious
- The acceptability of the formulated product was good.
- It is also good for blood disorders.
- The product was also be preferred to diabetes patients.

CONCLUSION

A.muricata belongs to the family Annonaceae. The family's trees, shrubs and woody climbers are mostly found in tropical areas while some species have expanded into temperate zones. Annonaceae are distinguished by its fibrous, fragrant bark and wood with fine tangential bands of parenchyma. They also have ruminating endosperm, a trimerous, perianth and alternating and distichous leaves. Some Annonaceae are important in the pharmaceutical business because of their bacteriostatic, antifungal and especially cytotoxic chemical components found in their leaves and bark. It helps to treat numerous medical conditions, including fever, respiratory disorders, malaria and infections of the liver, heart and kidneys can be treated with this herb. Antimicrobial, antiprotozoan, antioxidant, insecticide, larvicide, selective cytotoxicity to tumoral cells, anxiolytic, anti- stress, anti – ulceric, wound healing, anti – icteric, hepatoprotective and hypoglycemia are some of A.muricata pharmacological properties. It has been used extensively to treat cancer in recent years.

It is concluded from the present study that the formulated product contains various health benefits. The product was rich in various nutrients. The products has great benefits for human life which is full with nutrition . It help to cure different type of diseases such as anticancer, antispasmodic, anti – inflammatory, antiallergic, antibacterial and antiviral agent as well as fever, pain and diarrhea. The acceptability of the formulated product was good.

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APPENDIX

APPENDIX - I

APPENDIX 1 – A) METHOD OF MAKING TEA POWDER

B) METHOD OF MAKING CHUTNEY POWDER

C) METHOD OF MAKING SOUP POWDER

D) METHOD OF MAKING HEALTHMIX POWDER

APPENDIX II - SCORE CARD

APPENDIX -I

A) METHOD OF MAKING TEA POWDER

Ingredients

Table - XVI

Sl No.	Ingredients	Amount (g)			
		AMTPS (Standard)	AMTP1 (5%)	AMTP2 (10%)	AMTP3 (15%)
1	Annona muricata leaves powder	-	5	10	15

Method

- Annona muricata leaves dried and powdered to various proportions (5g, 10g, 15g).

B) METHOD OF MAKING CHUTNEY POWDER

Table - XVII

Ingredients

SL No.	Ingredients	Amount (g)			
		AMCPS (Standard)	AMCP1 (5%)	AMCP2 (10%)	AMCP3 (15%)
1	Toor dal	15	15	15	15
2	Split chickpeas	15	13	13	11
3	Moong dal	13	13	13	11
4	Roasted chana dal	14	13	11	11
5	Peanut	14	12	10	10
6	Black gram	14	14	13	12
7	Chilli Flakes	3	3	3	3
8	Curry Leaves	2	2	2	2
9	Tamarind	2	2	2	2
10	Asafoetida	2	2	2	2
11	Pepper	4	4	4	4
12	Salt	2	2	2	2
13	Annona muricata leaves powder	-	5	10	15

Method

- Roast all the ingredients separately except salt, asafoetida,tamarind, pepper and curryleaves

- Transferred to mixie jar and powdered wel
- Add A.muricata leaves powder(Dried and Powdered) to various proportions (5g, 10g, 15g).
- Finally prepared the chutney powder

C) METHOD TO MAKE SOUP POWDER

Table - XVIII

Ingredients

SL No.	Ingredients	Amount (g)			
		AMSPS (Standard)	AMSP1 (5%)	AMSP2 (10%)	AMSP3 (15%)
1	Yellow split peas	15	15	15	15
2	Green peas	15	14	13	13
3	Corn	13	13	12	12
4	Carrot	12	12	11	11
5	Cabbage	12	10	10	9
6	Turmeric Powder	5	5	3	3
7	Garlic	8	8	8	6
8	Asafoetida	2	2	2	2
9	Pepper	8	7	7	6
10	Tamarind	3	3	3	2
11	Salt	2	2	2	2
12	Fennel seed	5	4	4	4
13	Annona muricata leaves powder				

		-	5	10	15

Method

- Roast all the ingredients separately except salt, tamarind, pepper and asafoetida
- Transferred to mixie jar and powdered well
- Add A.muricata leaves powder(Dried and Powdered) to various proportions (5g, 10g, 15g)
- Finally prepared the soup powder
-

D) METHOD TO MAKE HEALTHMIX POWDER

Table - XIX

Ingredients

SL No.	Ingredients	Amount(g)			
		AMHMPS (Standard)	AMHMP1 (5%)	AMHMP2 (10%)	AMHMP3 (15%)
10.	Pumpkin seed	20	20	20	20
11.	Chia seed	15	15	10	15
12.	Flax seed	15	15	15	10
13.	Peanut	10	10	10	5
14.	Cashew	15	10	10	10
15.	Pista	10	10	10	10
16.	Almond	10	10	10	10
17.	Turmeric powder	5	5	5	5
18.	Annona muricata leaves powder	-	5	10	15

Method

- Roast all the ingredients separately.
- Transferred to mixie jar and powdered well.
- Add A.muricata leaves powder(Dried and Powdered) to various proportions (5g , 10g, 15g).
- Finally prepared healthmix powder.

APPENDIX – II

SCORE CARD

Table - XX

9 POINT HEDONIC SCALE

TREATMENTS	PARTICULATES					
	APPEARANCE	COLOUR	FLAVOUR	TEXTURE	TASTE	OVERALL ACCEPTABILITY
T1						
T2						
T3						
T4						

*Kindly indicate your rating between 1-9 (1 stands for poor and 9 stands for excellent)

Like extremely	9
Like very much	8
Like moderately	7
Like slightly	6
Neither like nor dislike	5
Dislike slightly	4
Dislike moderately	3
Dislike very much	2
Dislike extremely	1

NAME:

SIGNATURE: