PHYSICAL AND CHEMICAL ANALYSIS OF TURMERIC POWDER AND RED CHILLI POWDER (STRAIGHT SPICES)

A DISSERTATION

SUBMITTED IN THE PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE AWARD OF THE DEGREE
OF

MASTER OF TECHNOLOGY

IN

INDUSTRIAL BIOTECHNOLOGY

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CANDIDATE'S DECLARATION

I, Sneha Malik, Roll No. **2K21/IBT/10** of M.Tech (Industrial Biotechnology), hereby declare that the Project Dissertation titled **"Physical and Chemical Analysis of Turmeric Powder And Red Chili Powder"** which is submitted by me to the Department of Biotechnology, Delhi Technological University, Delhi in partial fulfilment of the requirement for the award of the Degree of Master of Technology, is original and not copied from any source without proper citation. The work has not been previously formed the basis for award of any Degree, Diploma Associateship, Fellowship or other similar title or recognition.

Place: Delhi **SNEHA MALIK**

Date: 29.05.2023

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CERTIFICATE

I hereby certify that the Project Dissertation titled **"Physical and Chemical Analysis of Turmeric Powder And Red Chilli Powder"** which is submitted by Sneha Malik, Roll no. 2K21/IBT/10 Department of Biotechnology, Delhi Technological University, Delhi in partial fulfilment of requirement for the award of Degree of Master of Technology, is a record of the project work carried out by the student under my supervision. To the best of my knowledge this work has not been submitted in part of full for any Degree or diploma to this University or elsewhere.

29/05/2023

PROF. PRAVIR KUMAR

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ABSTRACT

This thesis report focuses on the quality testing of red chilli and turmeric in the Quality Assurance (QA) department of a spice manufacturing company. The objective of this study is to evaluate the quality control measures in place for these spices and to identify any areas for improvement. The study consists of a literature review on quality testing methods for spices, an analysis of the company's current quality control measures, and a comparison of the results obtained from different testing methods. The study concludes that the current quality control measures are effective in ensuring the quality of the spices, but there is scope for improvement in terms of standardizing the testing methods and increasing the frequency of testing. Overall, this study provides valuable insights into the quality testing of spices and makes recommendations for enhancing the quality control measures in the QA department. Spices have been associated with India since time immemorial. India, the “home of spices' ' is the largest producer, consumer and exporter of spices. India alone accounts for 70% of the world’s spice production. As per the UN Food & Agriculture Organization, the country produced 1,525,000 metric tons of spice in 2011. According to the Spice board, as many as 52 different species of spices are grown in India. The Indian Spice Board’s (ISB) spice definition goes as “in various forms; fresh, ripe, dried, broken, powdered, etc. that contributes aroma, taste, flavor, color and pungency to food.” Spices are obtained from different parts of the plant like leaves, stem, bark, fruits, flower, and seeds. Apart from imparting flavor, spices are also used as flavor disguisers to mask off flavors, as antioxidants, antimicrobials and as a preservation aid. Spices have also been reported to impart medicinal and physiological benefits. The flavor compounds of spices are trapped in the essential oils present in them, also known as oleoresins. Flavors are imparted by a combination of different components like terpenes, alcohols, phenols, esters, resins, alkaloids, organic acids and sulfur compounds. Along with flavor compounds, spices also contain proteins, carbohydrates, fiber, minerals and tannins or polyphenols. In the case of spices, quality can be defined as “fit for the purpose intended”. ISO 9000 has defined quality control as “A part of quality management focused on fulfilling quality requirements". Quality control operations refer to the precautionary steps used to regulate the finished product by some standard. The focus should be on the major quality requirements of spice and the quality control activities associated with the same. Spices and condiments are added to foods in small amounts but they make important contribution to the sensory qualities due to presence of volatile and

fixed oils. Apart from all these, consumption of spice provides infinite health benefits. In this study, the physical and chemical analysis of Red Chili and Turmeric was reported. It is done for detection of food adulterants in chilli powder and turmeric powder. Various samples of the above-mentioned spices were tested to determine the adulteration levels and the qualitative difference between them. The tests were carried out by chemical analysis and visual inspection in above mentioned products. Visual analysis is performed by using various parameters like colour, mold contamination, damaged matter, broken matter, rodent contamination, sieve size, etc. Chemical analysis is performed by some specific tests like moisture determination, Total ash determination Acid insoluble ash, crude fiber, non – volatile ether extract, colour value, etc.

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LIST OF SYMBOLS, ABBREVATIONS, NOMENCLATURE

Name	**Abbreviation Used**
Round Bottom	RB.
Hot Air Oven	HAO
Hours	Hrs./ hrs.
Weight	Wt./wt.
Gram	g
Operational Prerequisite Program	oPRP
Critical Control Points	CCP
Gram Per Square Meter	GSM
Color Value	CV
Scovile Heat Unit	SHU
Maximum	Max.
Minimum	Min.
Total soluble solute	TSS
Dry Basis	DB.
Sulfite Reducing Clostridia	SRC
Non Volatile Ether Extract	NVEE
High Density polyethylene	HDPE
Normality	N
Moisture	M

CHAPTER 1

1.1 INTRODUCTION

It has also been reported that spices have positive effects on health and the body. Spices' essential oils, also known as oleo resins, trap the flavor compounds in them. Avariety of components, including terpenes, alcohols, phenol, esters, resins, alkaloids, organic acids, and sulphur compounds, are combined to produce flavors. Spices contain proteins, carbohydrates, fiber, minerals, tannin, or polyphenols, in addition to flavor compounds. Spice quality can be defined as "fit for the purpose intended" inthis context. "A part of quality management focused on meeting quality requirements" is how ISO 9000 defines quality control. The preventative measures taken to ensure that the finished product meets a certain standard are referred to as quality control operations. The following are the benefits of quality control:

i. Enhancement in the standard of goods and services.
ii. Persistent assessment and adjustment of the framework to meet the changing purchaser needs.
iii. An increase in productivity Decrease in costs over the long haul. We will zero in on the significant quality prerequisites and the quality control exercises related with them.

Isn't it strange that we haven't paid attention to where and how the spices we use in our kitchen come from up until this point? Even though we are aware that spices come to us naturally, the question of whether or not we can directly incorporate them into our food was raised when the processing of these spices became apparent. As a food technology enthusiast these question came in my mind and fortunately I got a chance to do my Internship training as a part of my course curriculum for a period of six month starting from January 2, 2023 to July 3, 2023 at **DS SPICECO PVT LTD** in the department of Quality Assurance. I have been reporting to Ms. Mukta Bhargavathroughout my training and was under the guidance of Shiv Prabhat Sir and Bineet Sir. I have been assigned the work on Analysis of **Red Chilli Powder** and **Turmeric Powder** including all physical, chemical aspects. By the guidance of mymentors I got to know about various parameters such as moisture content, volatile oil content, ash content of the samples. Learn about the

Packaging, labeling, composite sample preparation, way of using different equipment, significance of various chemical compounds and chemical test methods. All of the above I got to know the practical wisdom of food analysis, Packaging and professional working skill throughout my training.

In our daily lives, we use a variety of spices, including ajwain, amchur, ginger, cardamom, kalonji, black pepper, kasoori, fenugreek, curry leaves, cumin, black cumin, cinnamon, coconut, black salt, rock salt, bay leaf, mint chili, red chili, green chili, white chili, black mustard, and turmeric. Even after a considerable amount of time, packaged spices maintain their original flavor and aroma because they are packaged in the appropriate manner for each brand. However, the unpacked spices lose their natural flavor and aroma as a result of being exposed to moisture and local temperatures. Loose spices are made from poor-quality raw materials and harmful additives. Spices that are packaged are made without any additives from high-quality raw materials. As a result, packaged spices offer superior quality and purity.

Powdered spices are packaged in bulk with multi wall paper, textile, and HDPE woven sacks. As a tertiary package, BOPP laminate pouches are placed in a corrugated box. Additionally, ground spices are packaged in aluminum pouches before being placed in paperboard cartons. Blended spices play a crucial role in enhancing the flavor, aroma, and taste of various cuisines worldwide. This project report provides an overview of the blended spices industry, including its significance, market trends, and production process. Blended spices are an integral part of the culinary world, adding depth, flavor, and aroma to a wide range of dishes. Blending different spices together creates unique combinations that enhance the taste profile of various cuisines. The purpose of this project report is to provide an overview of the blended spices industry, including its significance, market trends, and production process.

Blended spices have been used for centuries in traditional cooking, and their popularity continues to grow as people explore diverse flavors and cuisines. They offer a convenient and efficient way to incorporate multiple spices into a dish without the need to measure and mix individual ingredients. Blended spices save time and effort while ensuring a consistent and balanced flavor profile. The market for blended spices has witnessed steady growth due to the rising demand for flavorful and convenient food products. Consumers are increasingly seeking unique taste experiences and exploring international

cuisines, both at home and in restaurants. Blended spices provide an opportunity to replicate authentic flavors and experiment with new taste combinations.

The production process of blended spices involves careful selection of high-quality ingredients, followed by grinding and mixing to achieve the desired blend. The choice of ingredients depends on the flavor profile and regional preferences. Maintaining strict quality control measures is crucial to ensure the freshness, purity, and safety of blended spices. The packaging of blended spices plays a vital role in preserving their flavor and extending shelf life. Airtight containers and proper labeling with ingredient information and usage instructions are essential for consumer convenience and regulatory compliance. To succeed in the blended spices industry, businesses need to implement effective marketing strategies. Branding and positioning efforts should highlight the unique flavor profiles, quality sourcing, and any health benefits associated with the blended spice products. Distribution channels should be carefully chosen to reach the target market effectively. In conclusion, blended spices are a vital component of the culinary world, offering convenience, flavor enhancement, and exploration of diverse tastes. This project report aims to provide a comprehensive understanding of the blended spices industry, from market trends to production processes, to help entrepreneurs and businesses navigate this flavorful sector successfully.

1.2 ABOUT THE COMPANY

Dharampal Satyapal Group is a global conglomerate company founded in 1929 in Chandni Chowk, New Delhi by Lala Dharampal Sugandhi. Dharampal's son, Satyapal, took over the company after his father. The company is named after the father-son duo.The company has a turnover of over Rs 6500 crore.The main brands owned by DS Group are Catch, Pulse, FRU, Maze, Pass Pass, Rajnigandha, Rajnigandha Pearls, BABA, Tulsi, Ksheer, Snack Factory, Birthright, The Manu Maharani, Namah, L'Opera, Le Marche and Nature's Miracle. Dharampal Satyapal Limited (DSL) is the flagship company of the Dharampal Satyapal Group. The company has a diversified presence across various industries such as FMCG, Food and Beverage, Mouth Fresheners, Confectionery, Tobacco, Luxury Retail, Hospitality, Hotels, Packaging, Infrastructure, Rubber Thread, and Agribusiness. DS Group’s Vision & Mission is To be a leading quality & innovation driven global conglomerate and constantly striving to achieve excellence in all our endeavors to create sustainable value for our stakeholders and the

community at large respectively.

The Multi-Business Corporation DS Group's **DS Spiceco** which includes the well- known brands Catch, Kewal, and Not Just Nuts. Catch Salts & Spices has been at the forefront of the Indian spice market for more than three decades, adapting traditionand introducing innovation at every turn. **The Catch brand** has an impressive selection of sprinklers and pastes made of whole, pure, and blended spices; over **263 SKUs** and more than **131 variants** across eight categories. Catch spices adhere to the highest quality standards, which include the most effective processes for production, packaging, and delivery to customers. They are full of aroma and are fresh. Get made its presentation in 1987 with a send off of way breaking tabletop salt and Pepper gadget and the brand has since developed to embody the actual pith of cooking that reaches from entire, straight flavors to horde mixes that entangle the fascinating smells and render the fundamental flavors to the culinary works of art. **Kewal spices** cater to the growing popular segment of consumers by promising purity and traditional flavor with high-quality ingredients. Pure cooking spices and a variety of well-liked blends make up the current Kewal spice portfolio. Not Simply Nuts is a scope of solid bites that incorporate salted Peanuts, Simmered Cashews and Cooked Almonds with masala variations in Peanuts and Cashews. The salted varieties contain rock salt, and the masala varieties possess the distinctive flavor of Dilli 6, makingthem flavorful and delectable.

1.3 PRODUCT PORTFOLIO

KITCHEN RANGE

Fig.1.1 Single/Straight Spices

Fig.1.2 Mixed Spices/ Blends

Fig.1.3 Whole Spices

Fig.1.4 Cooking Pastes

Fig.1.5 Hing (Asafoetida)

TABLE TOP RANGE

Fig.1.6 Sprinklers

Fig.1.7 Grinders

Chapter – 2

About Red Chilli and Turmeric

2.1 Red Chilli

Names in Hindi – Lal Mirch, Mirchi Powder

Binomial Name – *Capsicum Annuum*

This powder has a significant impact on Indian cuisine and recipes. The chilli powder's spicy flavour truly improves the recipes. Rarely are dishes offered that don't contain red chilli powder. Red chilli powder is readily available in supermarket stores. Red chillies often come in two varieties: one with a light red hue and a lot of heat, and the other with a dark red tint and less spice. When purchasing, always choose chilli powder of the highest calibre. It would be wise to study the labels of commercial products to ensure that the chilli powder does not contain any additional preservatives or free-flowing agents.

2.1.1 Uses of Red Chilli Powder

1. Chilli powder is the base for making any flavoured, hot and spicy food.
2. Chilli powder is greatly used for various types of veg and non – veg marinades.
3. It is highly incorporated in various salads and tomato-based sauces.
4. The flavour and heat blend of the chilli powder is primarily added to the ethnic dishes.
5. It is a crucial element that gives any dish a nice and wonderful red hue and a sharp flavour.
6. A small quantity of these fiery, spicy, and colourful components can readily improve bland and insipid recipes.

2.1.2 Storage of Red Chilli Powder

1. Red chili powder can be kept for 10 to 12 months in storage.
2. It must be kept in a dry, cool environment.
3. It should never be exposed to heat or direct sunshine.

4. Red chili powder should be kept in airtight jars or containers.
5. You can add a piece of asafoetida to it to keep it fresh for a long period.

2.1.3 Biochemical Importance of Red Chilli Powder

1. Red chillies contain large levels of valuable nutrients like provitamin A and vitamin C.
2. Red chillies have a significant amount of capsaicin, which increases metabolism.
3. Capsaicin has been shown to be an excellent remedy for disorders of the sensory nerve fibers.
4. Red peppers are renowned as a painkiller.
5. It also aids in clearing out congestion in the lungs and a stuffy nose.
6. Red chilies are very beneficial for persons who are overweight and suffer from obesity since they help the body's immunity.
7. It is a successful method of preventing stomach ulcers.

2.2 Turmeric Powder

Name in Hindi – Haldi

Binomial Name – *Curcuma longa*

Turmeric is generally responsible for lending its bright yellow color to a wide variety of Indian, Thai, and other Asian meals as well as spice blends. Because it is native to India and gives the same color as saffron, it is also referred to as Indian saffron. This is due to the fact that the spice carries the same name. In culinary applications, both fresh turmeric root and dried, ground turmeric powder are utilized. In addition to its widespread application throughout Asia, it is also present in the cuisine of the Middle East. Roots and powdered form of turmeric can be purchased at any time.

The root of the turmeric plant is ground up and used to make the spice known as turmeric. This blooming plant is a member of the ginger family and can be found in its natural habitat in Southeast Asia as well as the Indian subcontinent. In culinary applications, the plant's roots are the component that is utilized. The fresh root resembles ginger root in appearance; it is oblong and thorny. Turmeric, once dried and powdered, produces a powder that is yellow in color and, depending on the variety, can range from a dark yellow-orange to a very bright yellow. Curry powder typically includes turmeric as an

ingredient because it is so commonly used in curry dishes. It is ideal for gluten-free, vegan, vegetarian, and paleo diets.

2.2.1 Uses of Turmeric Powder

1. Turmeric is a staple ingredient in almost all curries and gravy meals found in India. The cuisine is given a distinctive flavor in addition to its deep color by using it.
2. Turmeric is a fantastic insecticide. To prevent insects, ants, and termites from entering your home, sprinkle water mixed with turmeric near all of the entry points.
3. A traditional Indian wedding will typically include the use of turmeric in some capacity. As part of the haldi ceremony, which takes place just before the wedding, a paste made of turmeric is given to the bride and groom. This is done to give them fresh, bright skin and to protect them from the evil eye.
4. Purity, prosperity, and fertility are all associated with the use of turmeric as a symbol.
5. During the Abhishekam portion of the Hindu ceremony, turmeric water is spilled or donated to the gods that are worshiped in the temples.

2.2.2 Storage of Turmeric Powder

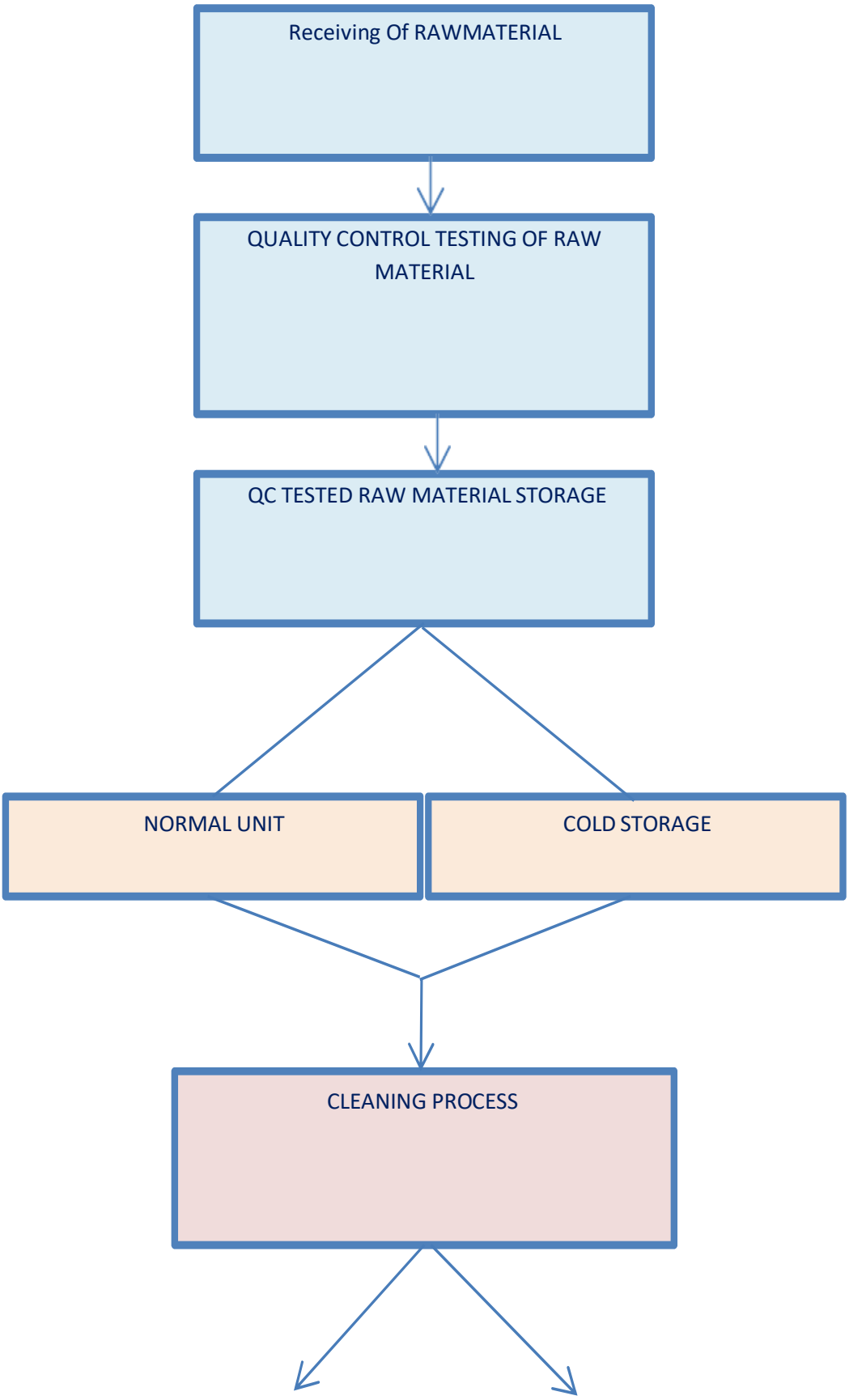
1. Turmeric powder needs to be kept in a container that can be sealed, and it needs to be kept in a cool, dark place.
2. After roughly six months, turmeric will start to lose its effectiveness; however, this process will start much sooner if it is exposed to light or heat.
3. Fresh turmeric can be stored in the refrigerator for up to two weeks if it is placed in a container that can seal off air.

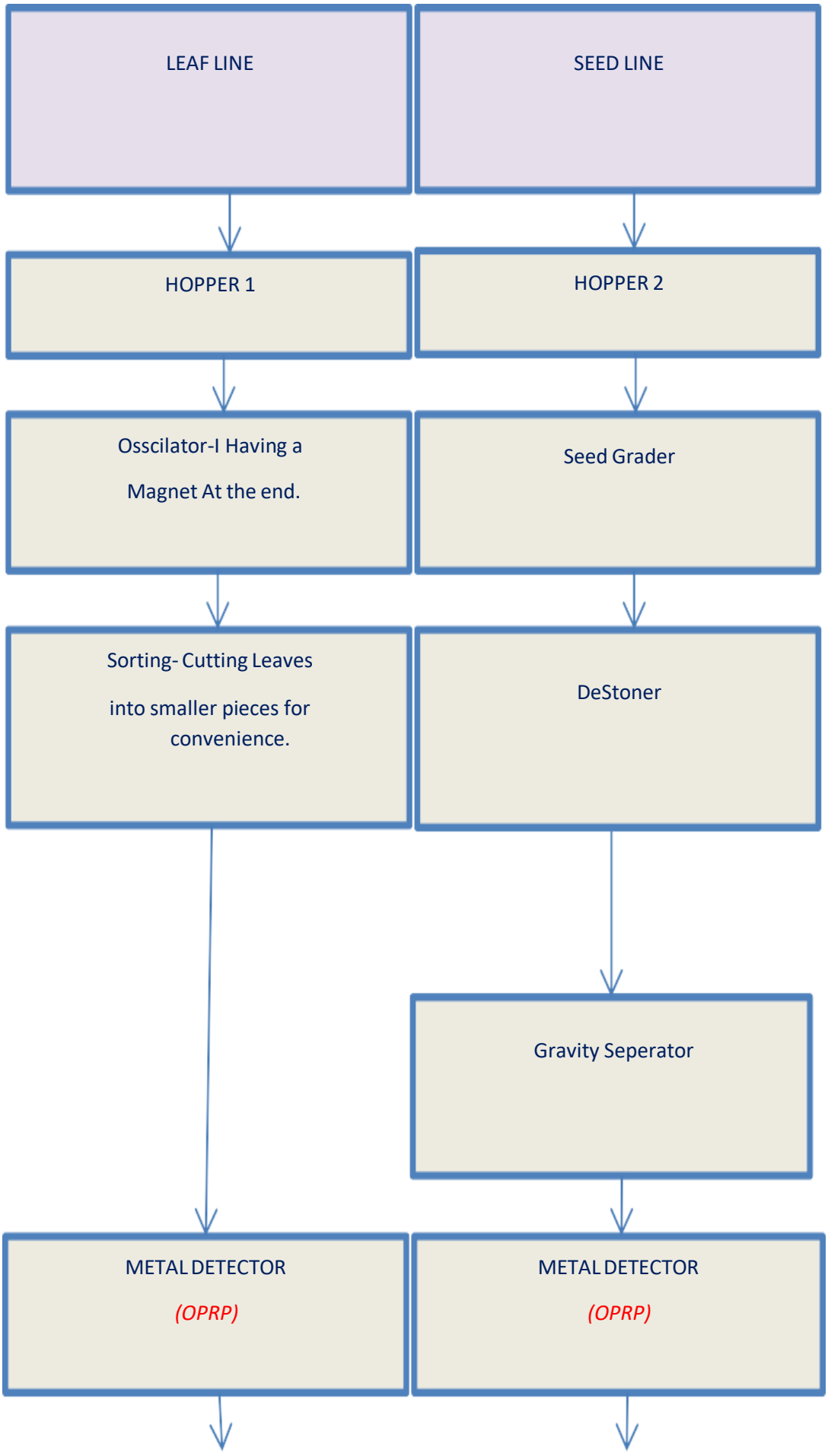
2.2.3 Biochemical Importance of Turmeric Powder

1. Since ancient times, people have taken use of the anti-inflammatory (painkiller), carminative, anti-flatulent, and anti-microbial characteristics that turmeric possesses.
2. The herb includes essential oils that are beneficial to one's health, including turmerone, zingiberene, cineole, and p-cymene.
3. The principal pigment in turmeric is called curcumin, and it is found in the root of the plant. This pigment gives turmeric its characteristic dark orange color. Curcumin has been the subject of a number of laboratory animal investigations, and the results of these studies have led researchers to hypothesize that it may possess anti-cancer, anti-arthritic, anti-amyloid, anti-ischemic, and anti-inflammatory effects.

4. Although this ancient herb does not contain any cholesterol, it is an excellent source of antioxidants and dietary fiber, both of which contribute to the regulation of blood LDL levels, sometimes known as "bad cholesterol."
5. It is an exceptionally abundant source of a wide variety of important vitamins, including pyridoxine (vitamin B6), choline, niacin, and riboflavin, amongst others. One hundred grams of the herb contains 1.80 milligrams of pyridoxine, which is equal to 138% of the daily required amounts.
6. The freshly harvested root is an excellent source of vitamin C. This vitamin is present at a quantity of 23.9 mg per 100 g. Vitamin C is a water-soluble vitamin that is also a potent natural antioxidant. As an antioxidant, vitamin C assists the body in developing immunity to pathogenic agents and eliminates dangerous free oxygen radicals. Vitamin C is a powerful natural antioxidant.
7. Curcuma longa is rich in a variety of minerals, including calcium, iron, potassium, manganese, copper, zinc, and magnesium in quite high concentrations.

2.3 PLANT LAYOUT




LEAF LINE
SEED LINE
HOPPER 1
HOPPER 2
Osscilator-I Having a
Magnet At the end.
Seed Grader
Sorting- Cutting Leaves
into smaller pieces for
convenience.
DeStoner
Gravity Seperator
METAL DETECTOR
(OPRP)
METAL DETECTOR
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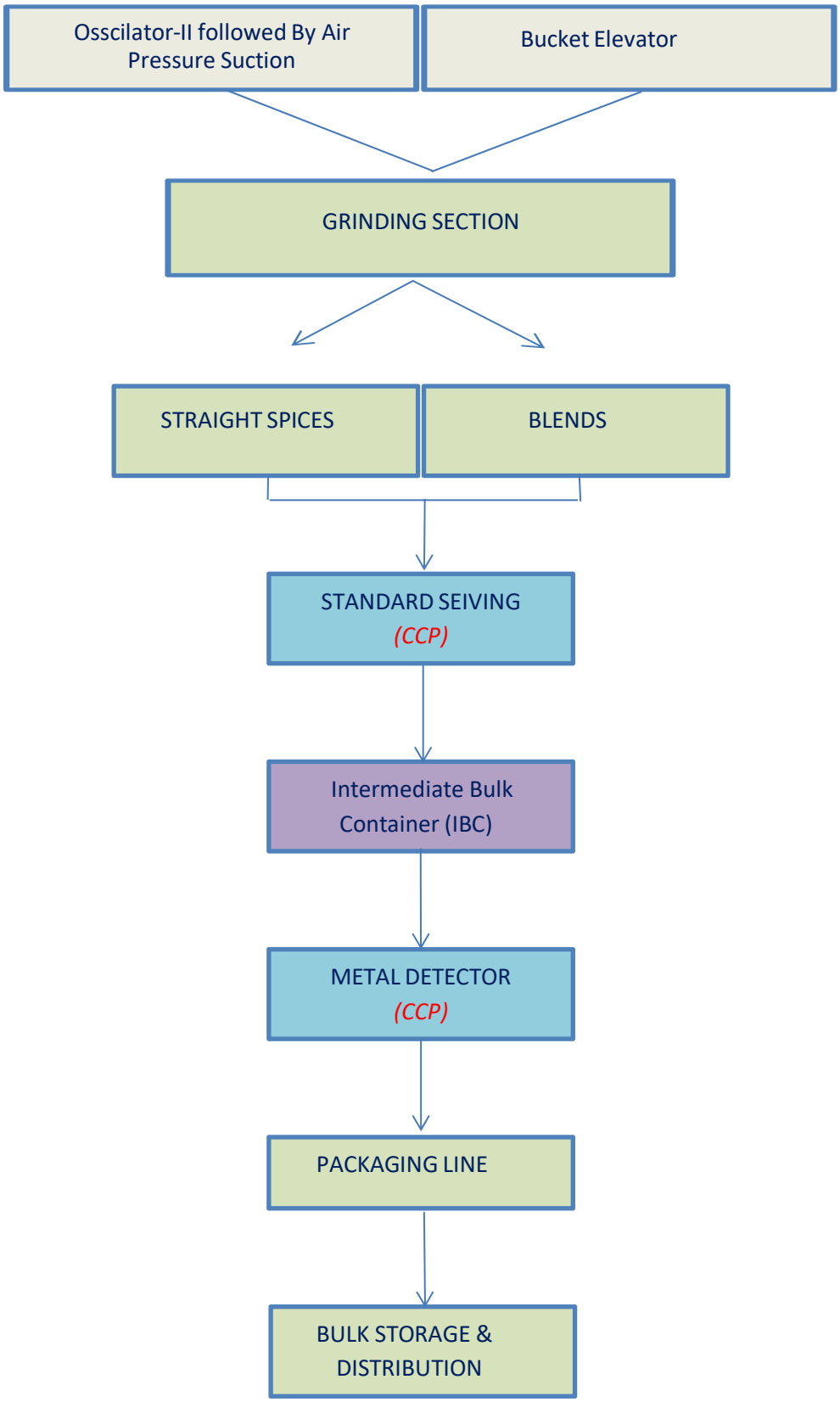
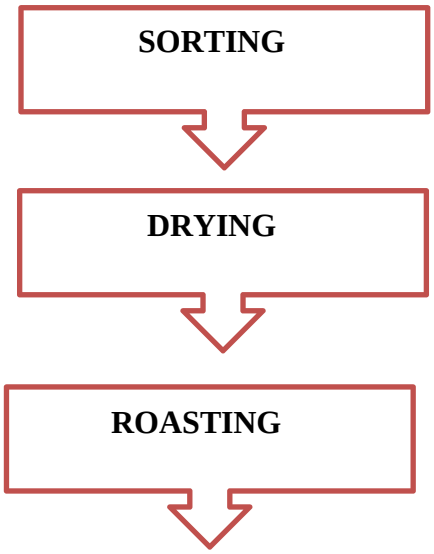
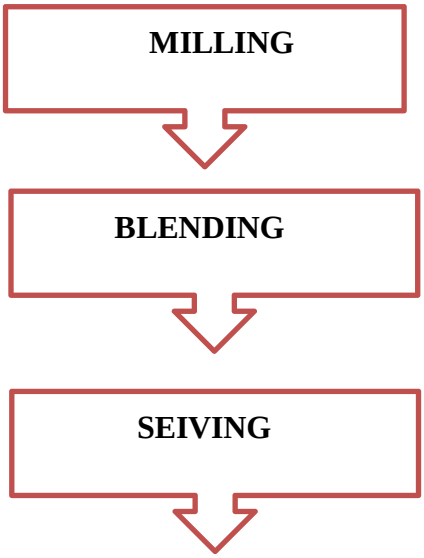


Flowchart-2.1 Plant Layout

PROCESSING INCLUDES:



GRINDING INCLUDES:



CHAPTER-3

Review of Literature

One of the most essential components used in cuisine all around the world is spice. They add tone and flavor to food, yet they likewise fill different needs like preservation, medical advantages, nourishment, etc. With regards to flavors, quality matters over amount. Even a small quantity can serve the purpose if the spice quality is adequate.

Chemical analysis is a study to analyze the product's chemical compositions or physical properties with the use of instruments and methods, combined with other methods.

As I was assigned with three common spices namely RED CHILLI POWDER and TURMERIC POWDER which covers almost all chemical analysis are discussed below-

- ✓ Moisture Content (Dean And Stark Method/ Toluene Method and Moisture Analyzer)
- ✓ Non Volatile Ether Extract/NVEE
- ✓ Total Ash
- ✓ Lead Chromate Test
- ✓ Acid Insoluble Ash
- ✓ Curcumin Content (Only For Turmeric Powder)
- ✓ Color Value
- ✓ Scoville Heat unit/SHU (Only For Red Chilli Powder)
- ✓ Starch

We'll discuss each test methods briefly in the next chapter.

Packaging Analysis is processes to protect, distribute, after use, promote the product and most importantly increase products shelf life. Packaging can be of different types at different stages hence, the packaging materials.

Types of Packaging consist of PRIMARY, SECONDARY, and TERTIARY.

PRIMARY PACKAGING: protect the material from any kind of contamination and is in directly contact of the product

SECONDARY PACKAGING: protect the material from tearing, bursting or contaminating, helps in promoting the product effectively, gives extra support for handling and stacking.

TERTIARY PACKAGING: protect the material from tearing, bursting or contaminating, and aids in distribution and promotion.

Types of Packaging Material consist of *Polyethylene Bags/pouches, 2 layers Laminates, 3 layers Laminates, Mono cartons, Jars, Master cartons.* Every material have different parameters to be check upon to meet the standards.

I have worked on the poly bags, laminates, mono cartons and master cartons. Each material has different physical parameters depending on the type of material.

1. POLY BAGS: In Poly Bags we check their Gram Per Square Meter/GSM, ART WORK, SHADES, and Physical properties like Breakage/damage, Seal & it's margin, size (length and breadth) and transparency.

Margins Standards Lies Between 8-12 mm.

2. MONO-CARTONS: In Mono-cartons we check their Gram Per Square Meter/GSM, ART WORK, SHADES, and Physical properties like Breakage/damage, Side Pasting, size(length and breadth and height).

3. LAMINATES: In Laminates we check their Gram Per Square Meter/GSM, ART WORK, SHADES, Seal strength, Peel Strength and Physical properties like Breakage/damage, and size(length and breadth).

4. MASTER-CARTONS: In Master cartons we check their Gram Per Square Meter/GSM, ART WORK, SHADES, compression Strength, Bursting Strength and Moisture.

5. HIPS: In HIPS (High Impact Polystyrene) Use for Sprinkler range of product usually check for breakage/ damage, size. Etc.

Some of the packaging lab tests are as follows:

- ✓ GSM
- ✓ Peel Bond Strength
- ✓ Sealing Strength
- ✓ Compression Strength
- ✓ Bursting Strength
- ✓ Moisture For Master-cartons
- ✓ Thickness

Microbiological analysis of spices is of the utmost importance since it reveals the sanitary conditions of the place in which they are produced and manufactured. Because they are cultivated, collected, and processed in warm, humid locations utilizing uncomplicated production procedures, herbs and spices may include a diverse array of native microflora. These conditions are optimal for the growth of these organisms. In black pepper, paprika, chili powder, and cumin seeds, high microbial total counts of up to 8 log CFU/g were found in studies on the microbiology of these commodities (Baxter and Holzapfel, 1982; Bhat et al., 1987; McKee, 1995). These studies were conducted by Baxter and Holzapfel; Bhat et al.; and McKee. According to Garcia, Iracheta, Galvan, and

Heredia (2001), herbs and spices may provide a possible route for the introduction of food spoilage organisms into a variety of dishes.

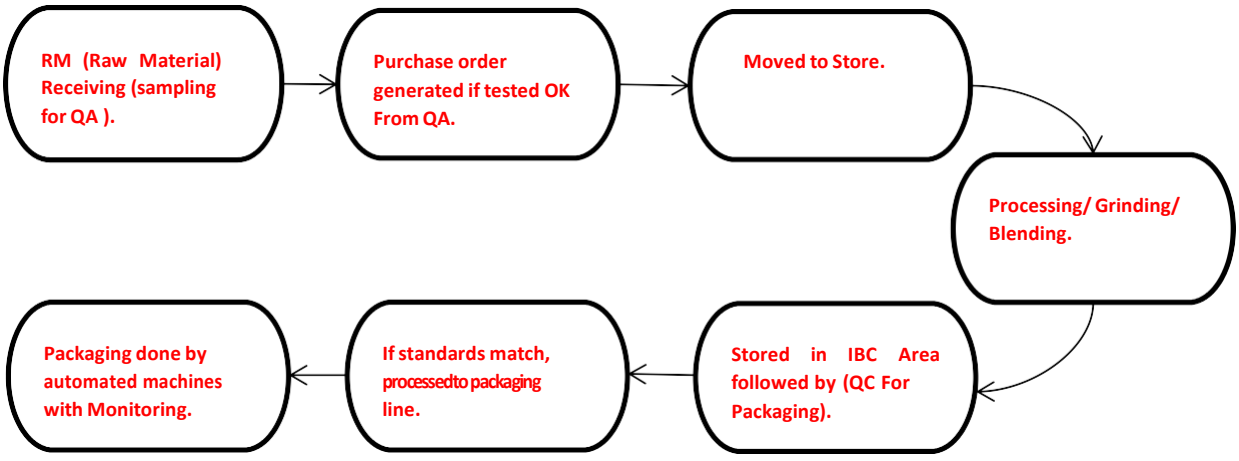
Indicators of Hygiene of premises/ plant for WHOLE, BLENDED & POWDERED SPICES are:

- ✓ AEROBIC COUNT/ g (10^5-10^7Max.)
- ✓ YEAST & MOULDS/ g (10^3-10^5Max.)
- ✓ ENTEROBACTERIACEA/ g (10^3Max.)

Some Pathogens tests are as follow:

- ✓ SALMONELLA/ 25g (Absent/25g)
- ✓ BACILLUS CEREUS/ g (10^3-10^4Max.)
- ✓ SULFITE REDUCING CLOSTRIDIA/ g

Packaging Line (Online) is a process of packaging finished goods through set of different packaging machines followed by implementing SOP's and continuous Monitoring. Packaging is done into various variety, size and pack type.



Flowchart 3.1: Packaging process

CHAPTER- 4

4. MATERIALS & METHODOLOGY:

In this chapter we'll discuss the test methods including all chemical, packaging, and micro laboratories. Here are some major instruments used in an analytical laboratory (Refer Table 4.1)

MATERIALS	DESCRIPTION	FIGURES
WEIGHING SCALE	An instrument for determining an object's mass or weight is a weighing balance. It is an essential tool in pharmacies, commercial kitchens, and laboratories. It comes in a variety of sizes and has multiple weighing capacities.	 Fig.4.1: Weighing Balance
MOISTURE ANALYZER	An instrument used to measure a sample's moisture content is measured using a device, called a moisture analyzer, which is also termed a moisture balance. It includes a heating system and weighing unit in infrared.	 Fig.4.2: Moisture Analyzer

REFRACTOMETER	A device used to measure the Concentration of a food sample in TSS/ BRIX. The main mechanics is of refractive index in just like in prism. (TSS in Pastes) & (BRIX in Sugars).	 Fig.4.3: Refractometer

SPECTROPHOTOMETER	When a sample solution is run through a spectrophotometer, the equipment detects the number of photons that are absorbed, which is equivalent to measuring the intensity of the light. It is possible to determine the quantity of a known chemical substance (the concentrations) by using the spectrophotometer to measure the intensity of the light that is detected by the instrument.	 Fig.4.4: Spectrophotometer

SOXHLET APPARATUS	In the lab, lipids and other types of molecules can be extracted using an apparatus known as a Soxhlet extractor.	 Fig.4.5: Soxhlet Apparatus
FILTRATION UNIT	The filtration unit can be a centrifuge or closed filterthat is either a pressure or vacuum unit.	 Fig.4.6: Vacuum filtration
CLEVENGER APPARATUS	Perform the steps of the distillation process, which are boiling, condensing, and decanting. The extraction of essential oils using this process is also the recognized standard method for quality control purposes.	 Fig.4.7: Clevenger Apparatus
WATER BATH	A water bath is a piece of laboratory equipment that maintains a steady temperature for an extended length of time, allowing it to be used to incubate materials.	 Fig.4.8: Water Bath

MUFFLE FURNACE	A muffle furnace is a jacketed enclosure that is used to heat a material to extremely high temperatures while keeping it confined and totally isolated. This is accomplished by heating the substance inside the muffle furnace.	 Fig.4.9: Muffle Furnace
HOT AIR OVEN	Hot air ovens kill microorganisms as well as the bacterial spores that they produce by heating the food to extremely high temperatures for several hours.	 Fig.4.10: Hot Air Oven
DISTILLATION UNIT	A distillation unit is a method for separating mixtures based on differences in the volatile nature of the components present in a liquid mixture that is being heated to a boiling point.	 Fig.4.11: Distillation Unit

Table 4.1: List of Instruments (Source: www.google.com)

4.1 TYPES OF ANALYSIS:

Three Types of analysis are done to ensure the quality of the products and these include physical testing, chemical analysis and microbiological analysis.

4.1.1 PHYSICAL ANALYSIS-

Physical Tests are those which are done using our senses i.e. eyes, nose, skin and tongue. It includes visual inspection, manual handling and sensory evaluation.

Physical Method :

The particle size is analyzed to gain a better understanding of the product's quality, and this is done regardless of the form that the spice product is offered in. In addition to that, it determines how much foreign organic and inorganic materials there is. In addition to this, the density of the spice is measured, which provides additional assistance in making decisions regarding storage and packaging. During the physical analysis, several parameters are measured at the location where the sample was gathered, and anything from one hundred to two hundred grams of the sample are removed and examined. These physical characteristics include things like color order, test sieve size, broken leaves, and any living or dead insects.

Various parameters and methods for Physical Analysis : -

S. No.	PARAMETERS	METHOD
1.	Color	Visual Inspection
2.	Mold Contamination	Visual Inspection
3.	Living or Dead Insects	Visual Inspection
4.	Rodent Contamination	Visual Inspection
5.	Extraneous Matter	Manual Handling
6.	Sieve Size	Manual Handling
7.	Damaged Matter	Manual Handling
8.	Broken	Manual Handling
9.	Odor/Taste	Sensory Evaluation

Table 4.2: Various parameters and methods for Physical Analysis

Methodology

1. Mix the sample thoroughly.
2. Take out 100 – 200 g of sample
3. Separate the extraneous matter by using physical methods & keep it in a petridish, weigh and note the weight.

Calculation

Weight of Sample: A

Separated Extraneous Matter: B

% Of Foreign matter = (B/A) × 100

Chemical Method:

Apparatus Required

Sieve (30 BSS), Mixer Grinder,Weighing Balance, Butter Paper, Brush, Spoon/Spatula.

Methodology

1. 100 – 150 gm of representative sample is taken
2. Sample was grinded and passed through 30 BSS sieve (in both cases with RedChilli and turmeric sieve pore size should be 30 BSS).

4.1.2 CHEMICAL ANALYSIS

The testing of spices also involves chemical residue testing, which analyzes the usage of dangerous pesticides on spices. These chemical residues include things like solvent residues and ethylene oxide residues, amongst other types of residues. In addition to that, it includes testing for toxins, which looks for the presence of potentially dangerous toxins including aflatoxin and ochratoxin. In addition to this, a metal screening is performed, during which the spices are analyzed to determine whether or not they contain any heavy

metals such as lead, cadmium, arsenic, mercury, methyl mercury, copper, or tin. In addition, the moisture content, the quantity of water-insoluble steam volatile oil, the amount of carbon-free ash, and the amount of acid-insoluble ash are all measured during chemical analysis.

When it comes to chemical analysis, there are specialized tests that are both similar and different for red chili and turmeric.

For Red Chilli Powder

- Moisture Determination
- Total Ash Determination
- Acid Insoluble Ash
- NVEE (Non – volatile Ether Extract)
- SHU
- Colour Value

For Turmeric Powder

- Moisture Determination
- Total Ash Determination
- Acid Insoluble Ash
- Curcumin
- Lead Chromate

4.1.2.1 Moisture determination (Dean and Stark method)

Principle: -

Co-distilling the water in a food sample with a high boiling point solvent that is immiscible in water, collecting the combination that distils off, and then measuring the volume of water is what is involved in the distillation process.

Application: -

The distillation method is an AOAC-approved methodology for determining the amount of moisture present in cheese, spices, and animal feeds. In addition to that, it may provide

accurate readings for oils, soaps, waxes, and nuts.

Apparatus: -

Weighing Balance, Butter Paper, Brush, Spoon/ Spatula, Flat Bottom Flask (250ml), Dean and Stark Distillation Apparatus, Moisture Trap, Copper Wire for Washing.

Excessive moisture can lead to flavor change; can result in flavor loss and lumps.

Reagents:-

Toluene

Procedure: -

1. Place a sample that weighs approximately 10 grams in the distillation flask and fill it completely with the solvent.

2. Pour the solvent into the receiving tube, also known as the moisture trap, by working your way up to the top of the condenser.

3. Turn on the fireplace and maintain a temperature of 70 degrees Celsius for a period of three hours.

4. After the distillation process has been going on for approximately one hour, wash the condenser and the upper section of the moisture trap with the wire to dislodge any moisture droplets that have accumulated there.

5. Proceed until you get two separate readings in a row.

6. Before removing the condenser, toluene should be used to clean the brush and the wire.

7. Before measuring the amount of water trapped in the trap, you must first allow the apparatus to return to the temperature of the surrounding air.

Calculation: -

$$Moisture\ \% = \frac{Volume\ of\ water\ (ml)}{Wt\ of\ the\ Sample\ (gm)} \times 100$$

Volume of water(mL)= 0.05×Reading

- ***Calculation for Red Chilli Powder: -***

  Sample Wt. = 10.2374

  Volume of Water = 0.5ml

  Moisture % = 0.5 x 100/10.2374

  Moisture = 4.88% .....(Eq. 1)

- ***Calculation for Turmeric Powder: -***

  Sample Wt. = 10.0603

  Volume of Water = 0.7ml

  Moisture % = 0.7 x 100/10.0603

  Moisture = 6.15% .....(Eq.2)

Precautions: -

1. To control emulsion breakages, allow the apparatus to cool whendistillation is completed.
2. Use clean glass wares
3. To avoid moisture interference from outside, put cotton plugcontaining CaCl2 at the top of the condenser.

4.1.2.2 Total Ash Analysis

Principle: -

The remains of a substance after it has been entirely burned are known as ash. Ash is also referred to as the dust or powdery substance that a substance is reduced to after it has been completely burned. Ash cannot be burned again. During this step, water and other volatile molecules are turned into vapor, while organic substances are burned to produce carbon dioxide and nitrogen oxides in the presence of oxygen in the air. The vast majority of minerals can be altered to become oxides, sulfates, phosphates, chlorides, or silicates.

Apparatus: -

Weighing Balance, Brush, Spatula, Crucible and Muffle Furnace– regulated at 550±25˚C.

Reagent: - Absolute Alcohol.

Procedure: -

1. Weigh accurately 2g of well mixed sample in the tarredcrucible.
2. Pour about 2ml of ethanol on the material in the tarred dishand char it.
3. Ignite the muffle furnace for 2 hours at 550±25˚C.
4. If ignition is incomplete wet the sample with 1-2 drops ofwater and put it again in the muffle furnace for 1 hour.
5. Continue till two consecutive readings.

Calculation: -

$$TOTAl\ ASH\ (Dry\ Basis)\% = \frac{(W1 - W2) \times 100}{Wt\ of\ the\ sample\ (g)} \times \frac{100}{(100 - M)}$$

W1 = Wt. of crucible with Ash Content

W2 = Wt. of empty crucible

M = Moisture Content of Sample

Calculation for Red Chilli Powder: -

Wt. of sample = 2.0416g

W2 = 21.8386g

W3 = 21.9164g

M = 3.71%.....(from Eq. 1)

Total Ash = {(21.9164 – 21.8386) x 100 x 100}/{2.0146(100-3.71)}

Total Ash = 4.01%

Calculation for Turmeric Powder: -

Wt. of sample = 2.0300g

W2 = 21.3833g

W3 = 21.5063g

M = 6.15%.....(from Eq. 2)

Total Ash = {(21.5063 – 21.3833) x 100 x 100}/{2.0300(100-6.15)}

Total Ash = 6.47%

Precautions: -

1. Use clean and tarred crucible.

4.1.2.3 Acid Insoluble Ash

Principle:-

The phrase "acid-insoluble ash" refers to the method that is used to calculate the amount of acid-insoluble ash that is present in cellulose samples. The sample consists of dry ash, and hydrochloric acid was applied to the residue after it was processed. After being filtered, washed, and burned, the insoluble residue is then weighed. This approach determines the amount of acid-insoluble substance present.

Apparatus: -

Weighing Balance, Brush, Spatula, Filter Paper (Whatman No 42),Beaker (25ml)

Reagents: -

Hydrochloric Acid diluted in Water 1:2.5(v/v)

Test Portion: - Total Ash obtained.

Procedure: -

1. Add to the test portion 25ml of HCl and boil for 10 min.
2. Allow to cool and filter the content through ash less filterpaper.
3. Give the filter paper a thorough washing in hot water until the pH strip reveals that the washings are clear of any traces of hydrochloric acid.
4. Insert the filter paper into the crucible previously used.
5. Preheat the muffle furnace to 550 degrees Celsius for one hour.
6. Place the dish in the desiccator to cool it down, and then weigh it.
7. Continue till two consecutive readings.

Calculation: -

$$Acid\ Insoluble\ Ash(Dry\ Basis)\% = \frac{(W1 - W2) \times 100}{Wt.\ of\ sample\ (g)} \times \frac{100}{(100\text{-}M)}$$

W1= wt. of crucible with ash content

W2= wt. of empty crucible

M= moisture content of sample

Calculation for red chilli powder: -

W1=21.2902gW2=21.3822g

Wt. of sample = 2.0249gM= 3.71%

AIA%= {(21.3902-21.2822) x100x100}/2.0249 x (100-3.71)

AIA (Dry Basis) % = 0.35%

Calculation for turmeric powder: -

W1=21.1638gW2=21.1694g

Wt. of sample = 2.0084gM=6.15%

AIA% = {(21.1694-21.1638) x 100 x 100}/2.0084 x (100-6.15)

AIA (Dry Basis) % = 0.29%

Precautions: -

1. Use clean and tarred Crucible.
2. Filter paper should be Ashless.
3. Take care of filter paper during filtration to avoid its tearing.
4. Wash the filter paper properly.

4.1.2.4 Lead Chromate

Principle:-

The "turmeric fingers" that appear in advertisements on television are actually colored. Pure turmeric powder that is available for purchase should be used very carefully in food and drink preparation. The turmeric that is sold today (which is a starch powder similar to tapioca) has been tainted with very carcinogenic yellow dyes such as lead chromate, methyl yellow, and other yellow dyes.

Apparatus: -

Test Tube, Glass Funnel, and Whatman Filter Paper No.1.

Reagents: -

Diphenyl Carbazide and 1:7 Sulphuric Acid

Test Portion: -Total Ash Obtained

Procedure: -

1. Take total ash obtained and pour 4 – 5 ml 1:7 SulphuricAcid into it.
2. Shake it properly and filter through ordinary filter paperinto a test tube.
3. Pour slowly 2 – 3 ml of diphenyl carbazide dye.
4. If violet colour appears, test is positive.

Calculation: -

Wt. of sample = 2.0208g

Wt. of empty crucible(W1) = 20.4329g

Wt. of crucible with ash (W2) = 20.5835g

Result: -

Orange colour appeared, there is absence of chromate.

Precautions: -

1. Use clean and tarred crucible.
2. Take care of filter paper during filtration to avoid its tearing.
3. Wash the filter paper properly.
4. Filter paper used should be ashless.

4.1.2.5 Non – Volatile Ether Extract

Principle :-

Extraction of the material using diethyl ether, removal of the volatile fractions, removal of the insoluble substances, drying and weighing of the non-volatile residue, and weighing of the remaining residue.

Apparatus: -

Flat Bottom Flask (250ml), Soxhlet Extraction Unit, Water Bath,Whatman Thimble Tube, Tissue Paper, Cotton and Balance.

Reagent: -

Diethyl Ether

Procedure: -

1. Weigh accurately 2.5g of sample on tissue/filter paper.Extract the sample in continuous extraction apparatus withDi-ethyl Ether for 18 hours.
2. Keep the temperature at 60 - 70˚C.After complete extraction remaining ether is transferred in the round bottom flask and ether is removed by evaporating on water bath.
3. Then flask is transferred in hot air oven at 110˚C±2˚C for 1hr to complete removal of diethyl ether.
4. Cool the flask in the desiccator and take the weight till the loss in wt. between successive weighing is less than 2mg.
5. Take the lowest reading.
6. Calculate the % NVEE with the help of formula.

Calculation: -

$$\%NVEE\ (Dry\ Basis) = \frac{(W1 - W2) \times 100}{W} \times \frac{100}{(100 - M)}$$

W1=wt. in gm. Of flask with non-volatile extract

W2=wt. in gm. Of empty flask,

W=wt. of sample in gm.

Calculation for Red Chilli: -

W2 = 102.6810g

W1 = 103.0196g

Wt. of sample = 2.4062g

M = 3.71%

NVEE = {(103.0196-102.6810) x 100 x 100}/2.4062 x (100 – 3.71)

% NVEE (Dry Basis) = 14.6%

Precautions: -

1. Sample should be passed through 60 BSS mesh.
2. Sample weight should not be less than 2.5g.

4.1.2.6 SHU (Scoville Heat Unit)

Principle:-

The pungency (spiciness or "heat") of chili peppers and other spicy foods is measured using a scale called the Scoville scale. This scale assigns a value in Scoville hot Units (SHU), which is determined by the concentration of capsaicinoids, of which capsaicin is the most prevalent component.

Apparatus: -

Sample, 95% Ethanol, 250ml flat bottom flask, Condenser Suit, Whatman No.1 Filter paper, Heating Mantle, 1ml Pipette, 100ml Volumetric Flask.

Procedure: -

1. Take 1gm of sample (powdered form).
2. Add 100ml 95% ethanol.
3. Add condenser suit and keep it for 3 hours on 20˚C.
4. Let it cool down at room temperature, then filter it involumetric flask with filter

paper.

5. Let the flask fill up to its maximum value, i.e., 100ml.Use the pipette(1ml) to draw out the quantity of the sampleas told.
6. Pour it in a washed volumetric flask, then make up the flaskwith 3% sucrose.
7. Serve it to the judges for tasting.

Calculation: -

Y = 10000/X

SHU = Y/Sample Weight

Where, X is the solution drawn by the pipette.

Calculation for Red chilli powder: -

Sample wt. = 1.0044g

X = 0.27ml

Y = 10000/.27 = 37037.03

SHU = 37037.03/1.0044

SHU = 36874.79

Precautions: -

1. Sample weight should not be less than 1g.
2. Set the apparatus on heating mantle with utmost care.

4.1.2.7 Colour Value

Principle:-

Spices are any pungent and aromatic plant substances that are used to flavor food or beverages. Spices can be ground or whole. The purpose of this research was to determine whether or not spices contain colors that are not allowed in meals.

Apparatus: -

Spectrophotometer, Beakers, Cotton, Volumetric Flask, Funnel, Whatman No.1.

Reagent: -

Acetone

Procedure: -

1. Weigh accurately 0.1g of ground sample in a volumetricflask (100 ml).
2. Dilute to volume with acetone. Cover the volumetric flasktightly with stopper.
3. Shake the flask and let it stand for 16 hours at roomtemperature in dark.
4. After 16 hours filter the sample with Whatman filter no.1and makeup the volume with acetone up to 100ml.
5. Use acetone as blank. (Which represent zero point).
6. Take two cuvette and fill it with sample and acetone respectively.
7. Take the sample reading at 460nm.

Calculation: -

$$Colour\ Value = \frac{sample\ absorabnce\ at\ 460nm \times 16.4}{sample\ wt.}$$

Calculation for Red Chilli Powder

Sample Wt. = 0.1363g

Reading on Spectrophotometer = 0.525

Colour Value = (16.4 x 0.525)/0.1363

Colour Value = 63.17

This value represents according to FSSAI.

4.1.2.8 Curcumin Content

Curcumin is an ingredient contained in foods made with turmeric or ginger. Curcumin is the principal bioactive constituent of Turmeric; a spice commonly used to flavour and preserve food; itis one of the main ingredients in curry powder.

Apparatus: -

Flat Bottom Flask (250ml), pipette (10ml), Volumetric Flask (250ml), reflux condenser, heating mantle, filter paper, balance, volumetric flask(100ml), spectrophotometer.

Reagents: -

Acetone

Procedure: -

1. Take 1 gm sample in a flat bottom flask.
2. Add about 75 – 80ml of acetone in it.
3. Gently reflux for 1 hr. with the help of reflux condenser.
4. Cool to room temperature and filter quantitively into 250mlvolumetric flask.
5. Wash the residue on the filter paper thoroughly withacetone.
6. Dilute the filtrate with acetone up to mark.
7. Pipette out 1ml of the solution in to 100ml of volumetricflask.
8. Make up the volume up to 100ml with acetone.
9. Measure the absorbance of the solution at 420nm, against the acetone blank.

Calculation: -

% Of Curcumin = 25 x 0.25 x Sample Absorbance / 2 x Sample weight x Standard absorbance.

Calculation for turmeric powder: -

Weight of the sample = 1.0005g
Absorbance of the sample = 0.214

Curcumin % = 0.214x25x0.25/1.0005x2x0.200

Curcumin % = 3.34%

4.1.2.9 Starch %

Apparatus:

Weighing Balance, 250ml Conical Flask, 500ml Erlenmeyer flasks,100ml, 250 ml Beaker, Soxhlet heating assembly, Whattman no.1, 2 filter paper,funnel, Tissue paper, pH Paper, G4 crucible, Vacuum Filtration, HAO, Tripod Stand, 100ml, 25ml Measuring cylinders.

Reagents:

100% Alcohol Solution, 10% Alcohol Solution, Diethyl Ether, HCl, 2.5N NaOH Solution, Distilled Water, Fehling's Solution A & B.

Procedure:

1. Weigh about 4g of sample in a Whattman no.2 filter paper and wash the samplewith 50ml diethyl ether in a 250ml conical flask.
2. Now make 10% Alcohol solution in 150ml and wash the sample again with itfollowed by 15-20ml 100% alcohol solution.
3. Transfer the residue of filter paper in a 500ml Erlenmeyer flask with the help ofdistilled water and add 20ml HCl and 200ml distilled water.
4. Reflux it for 2.5 hrs.
5. After cooled down adjust the pH to 7 with the help of 2.5N NaOH solution andnow make up the volume with distilled water.
6. Filter the hydrosylate with dry filter paper in 250ml conical flasks by discardingfirst 10ml.
7. Measure 25ml of both Fehling's solutions in a 500ml beaker and add 50ml aliquot(Filtered hydrosylate) to it.

8. Boil the solution for 4minutes and weight the empty G4 crucible.

9. Now Vacuum filter the Solution in G4 crucible and wash the beaker with distilledwater thoroughly.

10. Keep the G4 Crucible in the HAO For 2.5 hrs and finally weigh the crucible.

11. Calculate the dextrose% followed by starch%.

Calculations:

$$\text{Dextrose\%} = \frac{\text{wt. Of Dextrose } (W_2 - W_1) * 500 *}{0.1 \text{ Wt. Of Sample (gm)} * \text{Vol. Of Aliquot (ml)}}$$

W_2 = wt. of G4 Crucible after drying, W_1 = wt. of empty G4.

Starch% = Dextrose % * 0.90

Chapter- 5

5. RESULT & DISCUSSION

Table: 5.1 Kashmiri Red Chilli Powder

S.No.	*PARAMETERS*	*FSSAI STANDARDS*	*RESULTS*
1.	Description	Mold, living and dead insects, insect pieces, and rodent contamination are not permitted on it. The powder must be dry and free of any dangerous contaminants, including dirt, coloring matter, flavoring matter, mineral oil, and any other potentially toxic ingredients.	**Complies**
2.	Color & Appearance	Red & Powdered	**Complies**
3.	Taste	Characteristic	**Complies**
4.	Moisture % By wt. (Max.)	11.00% Max.	**4.44%**
5.	Total Ash % by wt. on DB (Max.)	8.00% Max.	**7.09%**
6.	Acid Insoluble ash % by wt. on DB (Max.)	1.30% Max.	**0.52%**
7.	NVEE % by wt. on DB (Min.)	12.00% Min.	**17.50%**
8.	Crude Fibre % by wt. on DB (Min.)	30.00% Min.	**19.37%**
9.	Mesh Size	30 BSS	**Complies**
10.	Salmonella	Absent In 25g	**Absent**

Table: 5.2 Red Chilli Powder

S.No.	*PARAMETERS*	*FSSAI STANDARDS*	*RESULTS*
1.	Description	Mold, living and dead insects, insect pieces, and rodent contamination are not permitted on it. The powder must be dry and free of any dangerous contaminants, including dirt, coloring matter, flavoring matter, mineral oil, and any other potentially toxic ingredients.	**Complies**
2.	Color & Appearance	Characteristic & Powdered	**Complies**
3.	Taste	Characteristic	**Complies**
4.	Moisture % By wt. (Max.)	11.00% Max.	**3.74%**
5.	Total Ash % by wt. on DB (Max.)	8.00% Max.	**6.22%**
6.	Acid Insoluble ash % by wt. on DB (Max.)	1.30% Max.	**0.26%**
7.	NVEE % by wt. on DB (Min.)	12.00% Min.	**16.62%**
8.	Crude Fibre % by wt. on DB (Min.)	30.00% Min.	**20.37%**
9.	Mesh Size	30 BSS	**Complies**
10.	Salmonella	Absent In 25g	**Absent**

Table: 5.3 Turmeric Powder

S.No.	*PARAMETERS*	*FSSAI STANDARDS*	*RESULTS*
1.	**Description**	Mold, living and dead insects, insect pieces, and rodent contamination are not permitted on it. The powder must be dry and free of any dangerous contaminants, including dirt, coloring matter, flavoring matter, mineral oil, and any other potentially toxic ingredients.	**Complies**
2.	**Color** & **Appearance**	Characteristic & Powdered	**Complies**
3.	**Taste**	Characteristic	**Complies**
4.	**Moisture** % By wt. (Max.)	10.00% Max.	**6.74%**
5.	**Total Ash** % by wt. on DB (Max.)	9.00% Max.	**7.22%**
6.	**Acid Insoluble ash** % by wt. on DB (Max.)	1.50% Max.	**0.36%**
7.	**Lead Chromate**	Absent/ Negative	**Complies**
8.	**Starch** % by mass (Max.)	60.00% Max.	**50.37%**
9.	**Curcumin Content** % by mass	2.00% Min.	**3.76%**
10.	**Mesh Size**	60 BSS	**Complies**
11.	**Salmonella**	Absent In 25g	**Absent**

Chapter-6

6. CONCLUSION

Spices are an important part of many different kinds of international cuisine. They not only enhance the flavor of food but also provide numerous health benefits. Red stew, turmeric, and pepper are among the different flavors that are often utilized in various dishes. Different physical, compound, and organic properties recognize these flavors from each other. To fully comprehend the flavors of red stew, turmeric, and pepper, this proposal sought to investigate their physical, compound, and natural properties.

The first step in the research was to examine the spices' physical condition. The spices' color, texture, and particle size were measured. The results showed that the two spices had different physical properties. Turmeric had a brilliant yellow tone and a fine surface, though red stew had a dazzling red tone and a coarse surface. The flavors also had different molecule sizes, with turmeric having the smallest and red stew having the largest. After that, chemical analysis was used to figure out the spices' chemical makeup. Red chilli was found to have a lot of capsaicin, the compound that gives it its spiciness. Turmeric contained a lot of Curcumin, which is well-known for its anti-inflammatory properties. According to the study, the spices also contained other chemical compounds like carbohydrates, proteins, fats, and minerals.

Quality analysis of spices are extremely important as turmeric and other spices are commonly sold by weight, the potential exists for powders of toxic, cheaper agents witha similar colour to be added, such as lead (IV) Oxide, giving turmeric an orange-red colour instead of its native gold-yellow. Another common adulterant in turmeric, metanil yellow (also known as acid yellow 36), is considered an illegal dye for lease infoods by the British Food Standards Agency. Also, high levels of moisture in ground orwhole spices indicate mould and microbial growth.

During storage, insects breed on spices in varying degrees, depending upon storage conditions, where they are harvested, transportation contamination and the extent of cleaning. Filth levels include foreign materials such as insect fragments (moths, mites, beetles), small stones, metal fragments and glass pieces. Insects and mould growth can change the colour. Microbiological requirements for clean' spices include counts for total bacteria, yeast, mould, coliforms and food pathogens such as Escherichia coli andSalmonella.

Many spices rely on colour control as a symbol of product quality. The ASTA(American Spice

Trade Association) has even compiled a list of standardizations for spice analysis using colour control methods. For example, the colour control of the highly popular spice, paprika, uses ASTA "Colour Units" as an international standard for measuring extractable colour and is determined by spectrophotometric method. The "Colour Unit" score is then used to indicate product quality and set the price.

The food industry will be significantly affected by this study's findings. The varying physical, chemical, and biological properties of the spices may have an impact on their quality, safety, and shelf life. For instance, red chilli has a high bacterial count, indicating that proper handling and storage are required to prevent contamination. Similar precautions must be taken when handling red chilli due to its high capsaicin content to avoid irritation of the skin and eyes.

In conclusion, the physical, chemical, and biological analyses of these spices have provided a comprehensive understanding red chilli, and turmeric. The research has revealed their distinctive properties, including color, texture, particle size, chemical composition, and microbial load. Food researchers, technologists, and gourmet experts can use the findings of this study to develop viable handling, protection, and quality control procedures for these flavors. The concentrate moreover includes the meaning of mindful dealing with and accumulating of flavors to ensure their security and quality. This investigation as a whole sheds light on the physical, chemical, and biological characteristics of these spices and can be a useful resource for future research in this field.

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