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# A Study On The Effect Of Different Balancing Techniques On Physical And Functional Properties Of Carrot (*Daucus Carota*) Slices

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**ABSTRACT**

Carrot is one of the important root vegetables rich in bioactive compound like carotenoids and dietary fibers with appreciable levels of several other functional components having significant health – promoting properties. The consumption of carrot and its products id increasing steadily due to its recognition as an important source of natural antioxidants having anticancer activity . Apart from carrot roots being traditionally used in salad and also used in preparation of curries in India, these could commercially be converted into nutritionally rich processed products like juice, concentrate, dried powder, canned, candy, pickle etc. Carrot powder could be utilized for supplement product likes cakes, breads, biscuits and preparation of several type of functional products. The present review highlights the different physio- functional properties of dried carrot powder by using of different blanching techniques .

**Keywords :** carrot slices , Nacl , kms , water, oil , colour. Wetability

# 1 GENERAL OVERVIEW OF CARROT PRODUCTION ANDVALUE ADDITION

## 1.1 INTRODUCTION

Carrot (*Daucus carota*) belongs to the Apiaceae family. It is a commonly grown vegetable which was originated around northwest India in Asia. As carrots are fresh root vegetables they grown as annual vegetables. About 2000 to 3000 years ago carrots were cultivated for medicinal purpose. Carrots are cultivated and produced for various uses both in fresh and processed form. As carrots are fresh root vegetables they grown as annual vegetable (Prasad, 2021). Carrots are the fleshy edible roots which are rich and cheap sources of dietary fibers, betacarotene, vitamin C, vitamin K, potassium and non-nutritive bioactive phytochemicals. Except carrot carotenoid pigments are not usually present amongroot vegetables. Increased consumption of fruits and vegetables decreases the risk of various diseases like cancer (Bansal, 2016). Red carrots are generally a source of lycopene which is an effective anti-cancerous carotenoid (Prasad, 2021). Carrot as a temperate crop usually cultivated in India during winter season. These are rich in phytonutrients, vitamins and minerals and rank seventh among fruits and vegetables in overall contribution to nutrient. New carrot-derived products found to have increased consumption rate in recent years (Bansal, 2016).Carrots are root vegetables known for their vibrant orange color, though they can also be found in other colors like purple and white. They are rich in beta-carotene, which is converted into vitamin A in the body, promoting good vision and overall eye health. Carrots are also a good source of fiber, vitamins, and minerals. They can be enjoyed raw, cooked, juiced, or incorporated into various dishes such as salads, soups, and stir-fries. Additionally, carrot tops (the greens) are edible and can be used in salads or as a garnish (Hossain, 2015). Carrots are rich in carotene, ascorbic acid and contain more moisture, fat, carbohydrate, sugar and fiber. Due to the presence of terpenoids and polyacetylenes, it gives a characteristic flavor. The different colored root gives medicinal properties towards human health due to presence of different pigments. The pigments present in carrot helps to develop macular pigment which is essential for functioning of eye (Anon., 2014). Carrots can be eaten either raw or cooked. Some value-added products also made from carrot are wine, soup, jam etc. Carotenoids and dietary fibers found rich amount in carrot. The carrot shows anti-oxidant and anti-cancer activity. Carrots can be used commercially by converting it into nutritionally rich product like juice, dried powder etc (Dubey and S.K, 2015). The β carotene present in cake helps as a supplement in cake. Different types of carrot have been found that is imperator carrot; having a small shoulder with tapped tip, Nantes carrot have a blunt tip with medium length, largeand medium length carrots are called Danvers, carrots have large shoulder with short height are called chastened ( Kelley, 2012). The carrots are also varies upon taste ,color, size .They may taste lightly sweet or can taste earthy or bitter (John, 2010).When the vegetables are supplied abundantly, then there is a chances of spoilage of the vegetables ,in order to avoid this preservation is the best method to store food for a long time by increasing their shelf life and available them in the off season period (Sharma and Dubey, 2017).Carrot is highly nutritious as it contains vitamins like B1,B2,β-carotene etc. The β- carotene helps to prevent cancer as it is the precursor of vitamin A (Navazio, 2012). Drying is the most traditional method to preserve the food ,but blanching is done before drying in order to inactivate all the enzymes which may lead to deterioration of the food .In the process of dehydration ,the products are dried and no moisture is present inside the food, the moisture is totally removed in order to control the growth of micro-organisms (Singh and S.K, 2013).In some area sun drying is used in a popular method as it is the most budget friendly way. The carrots are spread in a large area where they are exposed to sunlight and the dehydration process occur, it may lead to change in color, texture, taste due to the direct exposure of sunlight (Goyal, 2014). But the disadvantages of this process are sun drying is a climate dependent process, we cannot undergo the process in cloudy weather. It also depends on air velocity, humidity, etc. If the food is not dried in a particular time period, then there is a chance of spoilage in alarge manner. As the demand of the growing population is increasing day by day on conventional food, different air dryers are used to dry the food as the dryer helps in uniform drying method. In the driers the food products are exposed to hot air with desired amount of temperature and velocity, which result in moisture migration from the surface of food. As the uniform amount of hot air is blown, the products are dried uniformly, the drying time may varies depending upon the type(species), size and thickness of the food (Radhika and Satyanarayana, 2011).

## 1.2 ORIGIN, DISTRIBUTION AND PRODUCTION OF CARROT

The wild carrot is considered as the ancestor of domestic carrot *(DAUCUS CARROTA*). Both the wild carrot and the domestic carrot co-exist in this present world. Generally the wild carrots are domestic to the area of Asia andsome parts of Europe (Dahham, 2015). Approximately about 10000 years ago the carrots seeds were found for medicinal purpose. The carrots were generally originated in Himalayas and Hindu Kush center of the continent and it moved both in the direction of Silk Road. The Silk Road was established during the period of Hans Dynasty of China and it was generally a network of trade route established for the commercial purpose (Shebaby, 2014). Generally, it is considered that the purple rooted carrot (a variety of carrot) was found at the meeting area of Himalayas and Hindu Kush mountains in the region of Afghanistan. It was domesticated in Afghanistan and the nearby regions of India, Pakistan, Russia, Iran and Anatolia (Shebaby, 2015). The carrot is assumed to be originated from the purple rooted carrots with anthocyanins as well as the yellow rooted mutant which lacks anthocyanins. These forms of carrots were spread to the East and West regions of Asia around 10th or 11th century. Later it spread to Arab occupied Spain around 12th century, China in 13th century, Northwest Europe by the 14th century and England by the early 15th century. The purple rooted carrot along with the yellow mutant form spread to the Mediterranean region and the western part of Europe in 11 to 14th centuries and to China, India and Japan in between 14 to 17th centuries. The white color carrotwas first found in the 14th century (Shebaby, 2017). The orange root carrots were found in the area of Spain and Germany by 15th or 16th century and soon became the famous color. It is found that these carrots were more sweeter as compare to the purple and yellow one and they did not stain the utensils and fooditems (Zgheib, 2014). All these characteristics made it famous than other varieties of carrots. Before 16th century the carrots are generally purple rooted and yellow rooted. The purple rooted carrots are rich in anthocyanin and because of this reason the yellow carrots were preferred because they did not release any anthocyanin during cooking process. In the late 15th century the Dutch people developed a deep orange variety of carrot which became popular in the 16th century and also considered as the ancestor of the carrot we know (modern cultivated carrots) (Daaboul, 2018). Different varieties of carrots were developed in different region of the globe. In 10 to 11th centuries the purple rooted and the yellow carrots were appeared in the area of Syria, North Africa and Spain. By 12 to 14th centuries there is a wide variety of carrots like purple, yellow red, white was found in the region of Italy, China, France, Germany, the Netherlands and England. Later in between 15 to 17th century red, yellow, purple, orange and white carrots were appeared in some parts of England,Northern Europe and Japan, North America. Daucus consist of about 20 species which are found in the area of Mediterranean region. The wild *DAUCUS CAROTA* mainly found in the high altitude region of Europe, west Asia, northern Africa and local regions of tropical Africa (Sela, 2015).

### 1.3 VARITIES OF CARROT

There is a wide variety of carrots are cultivated all over the world. Each carrot has their own specific characteristics and morphology. Some of the different variety of carrots are given below:
Imperator: These are the long root carrots approximately about 10 inches in length. The imperator carrot contains high sugar in it and these are very good in look and taste. These are very good for freshly eating and often preferred in salad items (Arunkumar, 2014).
Danvers: These are the deep orange color carrots with medium length, rounded body and pointed end. These are approximately about 6 to 7 inches long. This type of carrots are well known for their vibrant color , excellent taste and storage quality (Terrazas, 2017).

Nantes: These carrots are cylindrical in shape with a blunted tip. These carrotsare almost colorless and often used in salad making and fresh eating (Thakre, 2018).

Chantenay: Chantenay carrots are the bulky, short conical rooted carrots. It canbe used in both raw and cooked form (Arunkumar, 2014).

Rainbow carrots: Generally, carrots are orange in color but the carrots which are cultivated earliest in Afghanistan were purple, red or yellow in color later the Dutch people created the orange variety of carrot in about 17th century (Dias, 2019).

Purple carrots: These are the variety of carrots which contains antioxidant i.e. anthocyanin. It provides a spicy flavor and often used in making soup, salad, snacks and juices (Thakre, 2018).

Yellow carrots: It is the variety of carrot which is the hybrid of both orange and yellow varieties of carrots. It does not contain anthocyanin and basically prefer for cooking, juice making etc. (Dias, 2019).

White carrot: These are the variety of carrots which are colorless still very sweet in taste. These are about 6 to 8 inches in length. These carrots have a mild and natural taste and are typically sweeter than the orange carrots (Arunkumar, 2014).

## 1.4 NUTRITIONAL INFORMATION AND HEALTH BENEFITS

Nutritional value:

The nutritional value for 100 grams of two small to medium raw carrots (*DAUCUS CAROTA*) are:

Table No: 1 Nutritional value

| | |
|---|---|
| Water | 88% |
| Calories | 41 |
| Protein | 0.9grams |
| Carbs | 9.6 grams |
| Sugar | 4.7grams |
| Fiber | 2.8 grams |
| Fat | 0.2 grams |

Carrots are good source of several vitamins, minerals, beta carotene,potassium, phylloquinone and especially biotin and vitamin B6. Carrots are rich in multiple variety of vitamin, minerals and other beneficial things which provides multiple health benefits like: Source of antioxidants: Carrots are colorful vegetables rich in high amount of antioxidants. Antioxidants are found in the form of vitamins, carotenoid and polyphenol. Orange carrots are rich in carotenoids which a powerful antioxidant and it have the ability to counteract the effect of free radicals (Sing D, 2020).Immune-booster and Anti carcinogen: Carrot contains the antioxidant carotenoid which have a strong ability to reduce free radicals and ultimately helps in reducing the chance of cancer in the body. It was proven to reduce cancers like breast cancer, lung cancer etc. It is rich in vitamins like vitamin C,B,K which helps in boosting the immune system(B. Cotes, 2018).Provides protection against sun damage: Carrot contains many derma-friendly ingredients, one of the most important ingredients is beta-carotenewhich is converted into vitamin A inside the body and provides protection againstthe harmful damage from sun rays and helps in tissue rejuvenation (S. Varanasi, 2018).Management of dental health: Carrot contains a variety of nutrients that provides protection against various damage causing bacteria and prevents tooth decay (Y. Zou and A. Jiang, 2016).

## 1.5 PROCESSING AND VALUE ADDITION

Value addition of carrots involves transforming raw carrots into processedor value-added products that offer higher market value, convenience, and versatility. Some examples of value-added products made from carrots are carrot soup, carrot salad, carrot puree, carrot juice, carrot chips, carrot powder, carrot jam or chutney, carrot cake or muffins etc. (Praanjal, 2023). By adding value to carrots through processing and creating these value-added products, producerscan cater to diverse consumer preferences, extend the shelf life of carrots, and increase their profitability in the market (Tushir, 2017).

# 2 POST HARVESTING MANAGEMENT OF CARROTS BYDRYING METHOD

Post-harvest management of carrots by drying involves several steps to ensure the quality, safety, and shelf stability of the dried product. There are several methods for drying carrots, including air drying, sun drying, oven drying, and using food dehydrators. Each method requires proper ventilation, consistent temperature control, and adequate airflow to ensure even drying and prevent spoilage (Shafiq 2018).

## 2.1 PRE-TREATMENT(BLANCHING) BEFORE DRYING

Blanching involves briefly immersing the prepared carrots in boiling water, followed by rapid cooling in ice water. Blanching helps to stop enzymatic activity, remove any surface contaminants and preserve color. The blanching time may vary depending on the size and thickness of the carrot pieces (Iqbal, 2018). It is a widely used method used in fruits and vegetable processing companies prior to freezing, canning , drying and other suitable processing techniques (Felipe Richter Reis, 2023). It is a pre- heat treatment before drying, freezing or canning usually conducted to modify texture and to inactivate the deleterious enzymes (Eun-Ho Lee, 2021). In order to avoid deterioration in texture, flavor, color and nutrient. Blanching is of various types i.e. water blanching, steam blanching (Rana Muhammad Adil, 2019) in-can and vacuum steam blanching. The most common blancher type is water blancher, with screw/belt conveyor, where the water is heated up to 100°C and depending on product the goods are either immersed with it. It results in increased leaching of minerals and nutrients such as vitamins and produces effluents with large biological oxygen demand (Felipe Richter Reis, 2023). In steam blancher food grade steam is diffused in to closed chambers and forced with fans to increase heat transfer. It reduces high temperature, gradient between the surface and centerof goods that are blanched. It is more energy efficient and produces lower biological oxygen demand and hydraulic loads than water blanching (Fellows, 2019). Can-blanching done for canned foods which helps to remove inter-cellular gases from plant tissue, it also assists the formation of partial vacuum in the head space. Vacuum steam blanching is an innovative steam blanching method where the air and water vapor are expelled by the vacuum pump to facilitate steam deep penetration in the materials to improve blanching efficiency and uniformity (M.A .Karim, 2021).Previously it was studied that vacuum steam blanching could soften texture and reduce the drying time of carrot but mechanism was not clear (Lei Gao, 2021) but currently it is clear that the vacuum steam blanching soften texture and enhances drying rate of carrot via micro-ultra-structure modification, here it comes for understanding and controlling the blanching trigger texture formation and drying enhancement(Jafarl and Hosseini, 2017). In the pre-treatment of carrot, white particles are formed in the secondary phloem (Lee Kim and Han, 2018). Blanching treatment also done chemically by using potassium metabisulphite (0.1%), $NaHCO_3$(0.1%), NaCl(1%), $CaCl_2$(0.5%), in water at 100°C for 180 seconds and steam blanching for 300 seconds, it have better retention of ascorbic acid (Navneet Kaur, 2018). The blanching treatment reduces the total Phenolic compound, so that it prevent enzymatic browning reaction and also improve the supply of protein and soluble fibers (Wallaf Costa Vimercati, 2021). Microwave blanching is a heat treatment given to bio-materials, which has the advantage of volumetric heating, lower nutrient loss and high quality end product (Xiao, 2017). The influence of blanching on frozen products of carrot determine the quality and shelf life of product during storage.

## 2.2 DRYING RATE

Drying is a most preferable and ancient method of food preservation. Various drying techniques are there, but we have to choose the proper method in order to increase the shelf life of the product, by decreasing the moisture content (N.Naemeka and R.Nwakuba, 2023). It is the most expensive and time consume process in post-harvest operation. It is the process of removing moisture in a product up to certain threshold value in order to decrease water activity to reduce physical damage by reducing microbiological activity. Drying rate refers to the speed at which moisture is removed from a substance during drying, it can be influenced by several factors like temperature, humidity, air flow and the properties of that particular food product (Charles Nwajinka, 2016).

Carrot is a nutritious root vegetable grown worldwide. It contains valuable Phyto nutrients like phenol, polyethylene, and carotenoid. Carrot are cultivated in different part of Nigeria. It is essential to convert them into powder to minimize post-harvest losses and incorporate them as blends in food. Dried carrot powder is produced through a dehydration process that removes the moisture content from fresh carrot while retaining their essential nutrients, color, flavor and functional attributes. This introduction aims to give a summary on functional properties of dried carrot powder.

## 3.OBJECTIVE:

The aim and objective of physico-functional properties is to preserved the nutritional content and functional characteristics of fresh carrots. While retaining their health benefit and flavor it is important to make food product easier. These properties is also taken into consideration antioxidants activity, fiber content ,vitamin and mineral retention and overall functioning in food processing and formation. The aim of physico-functional properties of carrot powder encompasses a comprehensive understanding as how the powder form of carrot maintains changes or increases its nutritional sensory and functional attributes compared to fresh carrots (Dar , 2014).

1. NUTRITIONAL PRESERVATION-The initial aim is to assess in which way carrots convert into powder form how that affect the retention of essential nutrients such as vitamins e.g. vitamin A, C and minerals Potassium, magnesium and Phyto-chemicals e.g. beta –carotene, luteal. For healthy benefits as fresh carrots carrot powder should plays a significant in nutrition.

2. FUNCTIONAL PROPERTIES -Functional properties is maintain or enhance by Carrot powder, such as water holding capacity, oil absorption capacity and emulsifying ability. These properties are also crucial in food applications including baking, meat production and beverages. food manufacturing optimizes formulations for texture shelf life and overall quality all are possible by the powder behavior.

# 4. PHYSICO- FUNCTIONAL PROPERTIES:-

## 4.1 Bulk density-

Material Science identifies bulk density as apparent density, as the ratio of the mass of various particle of a materials and the total volume they occupy, that consists the particle, own volume, inter particle, void space and internal pore volume. Bulk Destiny and particle Destiny are two different things. Particle Destiny consists of an intrinsic characteristics of a solid material in which there is no void volume (Ondrej, 2013) .Whereas Bulk density depending on how the materials is manipulated .One of the best examples of Bulk density is that powder is pour in to cylinder, it also leading to a higher bulk Destiny i.e. when the cylinder is agitated the particle will likely settle closer together. So, powder is taken both freely settled and tapped Destiny. In Accordance with Compacting procedure tapped Destiny refers to bulk Destiny with vibration of containers. Bulk Destiny consists of valuable measurements i.e. powder granular, fragmented solid mainly applied to mineral, chemical, pharmaceutical, food items and small particle. Bulk density is measure of the mass of substance per unit volume when it is a bulk or loose or loose state without any compaction (masek, 2013).It is also applicable in the field is geology ,engineering and agriculture. Bulk Destiny is a unit such as kg per cubic meters (kg/m3) or pound per cubic foot(lb/ft3) .

## 4 .2 Water absorption capacity –

The ability of a materials to absorb water is called Water absorption. How much a material can absorb water under specific conditions mentioned as percentage of materials weight and volume. It is a comparison between water absorption of a materials and its dried weights. (Holloway, 2020) .Necessarily it is also applicable in agriculture of sol water retention, construction for concrete and masonry materials, moisture content of food product in food industry as water absorption capacity is very crucial for e.g. in construction. How much a water concrete and mortar can absorb water to avoid degradation, this information is very necessary. Simultaneously determining irrigation requirements and nutrients of plant testing of soil absorption capacity is needed. Water absorption capacity is also testing in different ways taken as simple of materials in water for a specific period then measuring increase in volume and weight of materials (Michael, 2020). The proportion in weight and volume before and after immersion leads to water absorption capacity of water. The water absorption capacity can greatly affect the mechanical, thermal, electrical properties of a materials. Swelling, warping, degradation or loss of wood, paper, polymers can cause due of excessive water absorption. It is beneficial to control the water absorption capacity of water such as filtration, moisture and management. It also effects durability, strength and physical properties.

**4.3 Oil absorption capacity –**

The oil absorption capacity means a substance which can absorb oil in a specific condition also we can say that an ability of a material, typically a powder or porous substance to high absorbed oil . used in various field like cosmetic like talc, environmental remediation. An its capacity is also determined by mixing a measured oil with the material until the oil absorbed. Moreover, measured typically y weight of material, surface area, chemical composition and structure. And the high surface area of porous material leads tohave high oil absorption capacity (Lawal, 2005) . And the condition which can affect the capacity of oil absorption is surface area, chemical composition, porous material with maximum surface area leads to have the higher oil absorption capacity, The most important and noticeable thing is that the priority and hydrophobic nature of the material surface can affect its affinity for oil .

**4.4 Wettability –**

Adversely if the liquid material doesn't wet the surface it forms droplets or beads up minimizing contact with solid. Various processes and phenomena in both natural systems are influenced by Wettability. Coating, adhesion, printing process are affected by wettability in manufacturing and material processing. It determines the behavior of contaminants in soils and ground water. For the functioning of biological surface, such as leaves and fur wettability plays a very vital role. Wettability is commonly assert using contact angle management. The contact angle is formed between the tangent to liquid surface in three phase that are solid, liquid, air interface (Paranusor 2016). High wettability is indicated bya low contact angle whereas liquid absorb on surface. Surface roughness, surface chemistry, surface energy and the nature of liquid all are included in effective factors of wettability. Surface roughness have a great effect on contact areas effect pinning or spreading of the liquid droplet. Simultaneous the interactions between the molecules of the liquid and the solid surface are determined by surface chemistry, influencing whether liquid wets and beads up on the surface (Fernandez, 2016). The energy required to create a unit area of surface is also known as surface energy which is also effects spreading behavior of liquid. It determines the balance between Adhesive and cohesive forces between the liquid and solid. . Hydrophilic-the surface attracted the most and quickly spread the water molecules. The surface where the water tends to wet it forming athin film. .Hydrophobic- the surface which repel and restrict water molecules and preventing them to spread easily .water Beads up on these surface and restricted to wet them . Amphiphilic-it is the combination of both hydrophilic and hydrophobic. It can easily handle both water and non-polar liquid.

**4.5 Dispersibility –**

Dispersibility indicates the capability of a substance to disperse or spread in a systematic way in a liquid or solid medium. This concept is vital in various field, including chemistry, pharmacy, materials science and environmental science. It describes how well a material can be evenly distributed throughout a medium, forming a homogeneous mixture (kapoor, 2022) . In the context of particles or powders, dispersibility indicates how readily they can be dispersing in a liquid solvent or a solid matrix. High dispersibility implies that the particles or powder an equally incorporated in to the medium, while low dispersibilitysuggests that they may clump together or settle out unevenly. Dispersibility play a crucial role in many applications such as pharmaceuticals formulation, paints and coating, food products, and environmental remediation. In pharmaceuticals, dispersibility impacts the bioavailability and efficacy of drug. In paints and coating, it affects the appearance, stability and performance of the final product. In environmental science, dispersibility affects the transport and fate of pollutants in air, water and soil(Ragya & feng, 2022) . Dispersibility can be levied using various techniques according to the characteristics of the particles and the dispersing medium. Common method includes visual inspection, Microscopy turbidity measurements, particle size analysis and rheological measurement. These techniques provide info about the degree of the dispersion, particle size distribution, stability and rheological properties the dispersion. Numerous factor affect dispersibility, including particle size, particle shape, surface chemistry, surface charge and the properties of the dispersing medium. smaller particles tend to disperse more readily than large particles due to their higher surface area and Brownian motion . Particle shape an affect the packaging and flow behavior of particles influencing their dispersibility . Surface chemistry and charge determine the interaction between particle and the dispersing medium , affecting stability and aggregation behavior (Haas, 2020) . Dispersibility significantly influence the performance and property of materials and products. In pharmaceuticals, its affect the dissolution rate, bioavailability and stability of drug formulations. In paints and coating, dispersibility influence color intensity , gloss , formation and adhesion property in food product , dispersibility affects texture , appearance , mouth feel and shelf life . in environmental application, dispersibility determines the mobility, reactivity and persistence of contaminants and nanoparticles.

**4.6 Color –**

In the context of physico-functional properties, color indicates the optical existences of a material or substance and it affects its physical and functional characteristics. Color plays a vital role in the functional properties of phytochemicals, which are natural compounds found in plants. These compounds contribute to the coloration of fruits, vegetables, and other plant-based foods. Phytochemicals, such as flavors, carotenoids, and anthocyanins, are responsible for varieties of colors in plant-based foods. For example, carotenoids impart yellow, orange, and red hues, while anthocyanins contribute to red, purple, and blue colors. The rigid amount of combination and concentration of Phyto chemicals in a food determine its color (Gong, 2015). The color of plant-based foods often correlates with their Phyto functional properties. For example, foods with vibrant colors, such as dark green leafy vegetables or blood-colored berries, tend to be rich in Phyto chemicals with potent antioxidant and anti-inflammatory effects. These compounds protect cells from oxidative stress and inflammation, which are implicated in various chronic diseases. Food processing and cooking methods can impact the color and Phyto functional properties of plant-based foods. Heat, light, pH, and enzymatic reactions can degrade or alter Phyto chemicals, affecting both color and functionality(Tiwari, 2018) . Therefore, selecting gentle cooking methods and minimizing processing steps can help preserve the nutritional and functional qualities of colorful foods. By maintaining a variety of colorful foods into their diets, mankind can be benefited from the synergistic effects of Phyto chemicals with different functional properties. The color of a substance can influences various properties, including: Aesthetics: The visual appeal of a product depends on its color, has the ability to influence consumer preferences and perceptions. A pleasant color can compel someone to go with them where as a less attractive color has the repulsive force despite of the qualities of the product. Identification: Color can be used for differentiation. For example, in the food industry, color is often used to differentiate between various products or to indicate ripeness or freshness. Quality: Changes in color can signal changes in the quality or condition of a material. For instance, in the pharmaceutical industry, color changes in drugs or tablets may indicate degradation or contamination. (Trilokia, 2022). Functionality: Color sometimes indicates functional properties of materials. For example, in the case of pigments or dyes, the color may provide specific functionalities such as UV protection, heat resistance, or chemical stability. Overall, color is a significant aspect of physico-functional properties as it can influence how a material is perceived, identified, and utilized in various applications.

## 5.MATERIALS AND METHODS: -

### 5.1 Bulk density (BD) –

To calculated the bulk density of 1gm of carrot powder in a 100 ml cylinder. First, we need a 100ml graduated cylinder with a spatula or scoop for transferring the powder. Then measure 1gm of carrot powder. Then carefully transfer the weighed carrot powder into the 100ml graduated cylinder. For record initial volume, note the initial volume reading on the graduated cylinder, make sure to record the volume accurately, reading from the bottom of the meniscus. (Sahni, 2017) . Then fill the graduated cylinder with water up to the 100ml mark. After adding water, note the final volume reading on the graduated cylinder. Then calculate the volume of the carrot powder by subtracting the initial volume from the final volume (volume of powder = Final volume –Initial volume) ( SuleT , 2019) Then, calculate the bulk density using the equation (1) . For more accurate results, repeat the procedure several times and take the average of the density values obtained .

$$Bulk\ Density\left(BD, \frac{g}{cm^3}\right) = \frac{M}{V} \quad (1)$$

Water absorption capacity (WAC)-

Water absorption capacity for dried carrot powder is conducted to understand how much water the powder can absorb under specific condition. First, we need a balanced to measure the weight of the powder, a container for mixing the powder with distilled water. Fist we take 1gm of carrot powder. ( Kumar, 2022) . Then place the 1gm of carrot powder in a container and add a known amount of oil. The amount of oil you add will depend on the specific procedure. For example, you might add oil until the powder is fully saturated or until a certain consistency is achieved. : Let the carrot powder absorb the oil for a specific period of time . After the absorption period filter or drain off any excess oil from the mixture. Then measure the weight of the carrot powder after it has absorbed as much oil as possible. After filtering or draining weight the container with the oily carrot powder. The increase in weight from the initial weight of the dried powder represent the amount of the oil absorbed. After filtering or draining weight the container with the oily carrot powder. The increase in weight from the initial weight of the dried powder represent the amount of the oil absorbed. . Subtract the initial weight of the dry carrot powder from the final weight of the oily powder to find the amount of oil absorbed. Then, calculate the oil absorption capacity by using the equation (2) .

$$water\ absorption\ capacity = \frac{weight\ of\ the\ water\ absorbed}{initial\ weight\ of\ the\ dry\ powder} \times 100 \quad (2)$$

### 5.2 Oil absorption capacity (OAC) –

Oil absorption capacity is an important parameter used to assess the quality of dried carrot powder. First, we need a balance weight of powder sample, that powder sample mixed with oil, and you will choose any kind of oil that used for the absorption test. Take 1gm of carrot powder and Place the

1gmof carrot powder in a container and then mix required amount of oil to the sampleand add oil until the sample is fully saturated. : Let the carrot powder absorb the oil for a specific period of time . After the oil absorption, remove or drained the excess oil from the sample. Subtract the initial weight of the dry carrot powder from the final weight of the oily powder to get exact amount of oil absorbed. (Shere, 2017) . Then calculate the oil absorption capacity by using the equation.

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$$oil\ absorption\ capacity = \frac{weight\ of\ the\ oil\ absorbed}{initial\ weight\ of\ dry\ powder} \times 100 \qquad (3)$$

**5.3Wettability –**

To calculate wettability of 1gm of carrot powder. We need a balanced weightof carrot powder sample, need a Petridis and micro pipette for liquid dispense and a camera for capture images. Measure 1gm of carrot powder. Then Place a small amount of carrot powder on the flat surface and spread it evenly to create a thin layer. Then Using micro pipette for dispense a small droplet of liquid onto the surface of the carrot sample. Ensure the liquid should be cover the surface of the powder. : Use the camera or smart phone to capture a clear image of the liquid droplet on the surface of the powder. Make sure the camera is positioned directly above the droplet. : Use image analysis software or a protractor tomeasure the contact angle formed between the liquid droplet and the surface ofthe carrot powder. The contact angle is the angle formed between the tangent to the droplet at the point of contact with the powder surface and the surface itself. (Haq & Dar, 2022) . Repeat the process multiple times with different droplets of liquid to ensure accuracy. Take the average of the contact angle measurements obtained. : A smaller contact angle indicates better wettability, meaning the liquid spreads more easily across the surface of the powder. Conversely, a larger contact angle indicates poor wettability, meaning the liquid forms a more spherical shape on the surface. ( Kumar, 2022).

**5.4 Dispersibility-**

We need a graduated cylinder or a beaker, a balance to measure the weight of the powder, distilled water or another suitable liquid for dispersion, and a stopwatch or timer. Measure 1 gram of carrot powder. Add the measured carrot powder to the graduated cylinder or beaker containing a known volume of liquid (e.g., 100 ml of distilled water). Then Stir or shake the mixture vigorously to ensure the powder is evenly dispersed in the liquid. Start the stopwatch or timer as soon as you finish mixing the powder with the liquid. Watch the mixture over time and note how long it takes for the powder to settle at the bottom of the container. This settling time is an indication of the dispersibility of the powder. (Steffen, 2002) . Stop the timer when the powder has fully settled at the bottom of the container. Record the sedimentation time in seconds or minutes. : The dispersibility can be calculated by using the formula: Dispersibility = 1 / Sedimentation Time ( Zwernemann, 2002). This formula gives you the reciprocal of the sedimentation time, where a higher dispersibility value indicates better dispersibility (i.e., faster settling time). For more accurate results, repeat this procedure several times with fresh samples of carrot powder and liquid, and take the average of the dispersibility values obtained.

**5.6 color-**

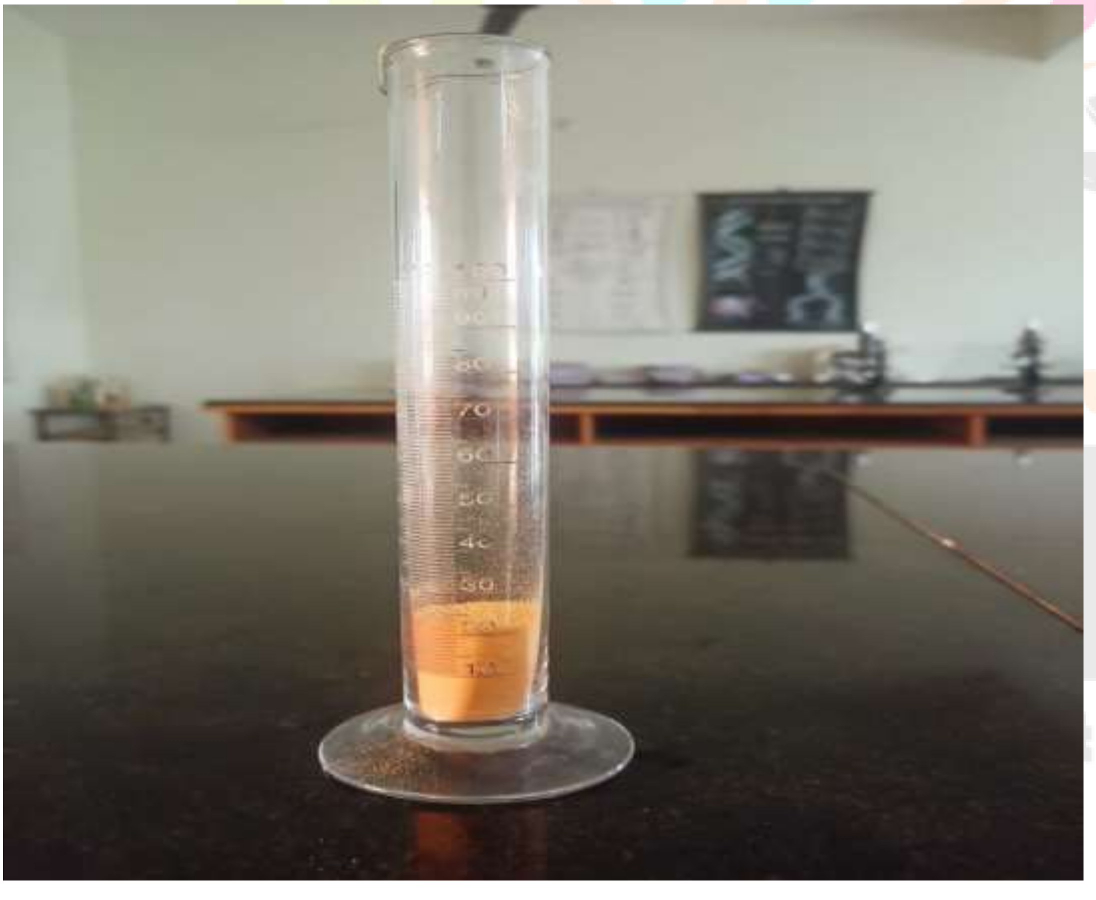
First, we took the carrot sample and put in to the sample in the image analysis process. The sample were put into the color picker app. A color picker also known as color chooser or color tools .it is used for adjust and select the colors values. In graphical design field and image editing field the color picker tools are allow for user to select and modify Color values visually instead of entering them as text. The goal of this Color picker is help to understand the relationship between colors as color appearance can be influenced by neighboring colors. In the color picker app, we selected the sample from different angle because it reflects or transmit the light w the color parameter. The lab value that indicate the L for lightness and a for redness and b for yellowish. To determine the ΔE value we were compare them against standard value to any change in thesample color (Olcay, 2021).

## 6. RESULT & DISCUSSION: -

Functional properties of BD, WAC, OAC, Wettability, Dispersibility, Color were analyzed for carrot powder.

### 6.1 Bulk density:

The mass of the control sample of carrot powder was 10gm with 18ml volume, so the bulk density of was 0.55g/ml and for Nacl solution sample the mass value was 10g with 19ml volume, the BD was 0.52g/ml, similar with KMS solution sample the mass value was 10g with 14ml of volume, so the BD was 0.71g/ml. Here we can observe that the KMS sample was showed higher bulk density whereas the Nacl sample was showed lower bulk density. The increase in KMS valued in sample that could indicate oxidation or spoilage. Also due toin proper storage condition that a leads to increase the value of KMS in bulk density of carrot powder (Kumar, 2012). The decrease of Nacl value in bulk density of carrot powder could be attributed to several factors that are carrot powder exposed to moisture, especially in high humidity environment, Nacl can dissolved into the moisture so that the dissolution can leads to decrease the value of Nacl in bulk density. Inhomogeneous distribution of Nacl with the sample can result in variability in bulk density measurement.



(Fig 1: Bulk density of carrot powder)6.2Water absorption capacity:

We take 8gm of carrot powder sample that mixed with 6ml of distilled water and then weight that sample with tube So, that the result of control was 14.32g and the Nacl solution sample was 14.02g and the KMS solution sample was 14g. Further the sample was centrifuged for several period of time then the water of sample was drained off and again weight of that sample. The value of control sample was 7.42g and the Nacl sample was 7.22g and the KMS sample was 7.2g. then put the formula i.e. (Ww-dw/ dw) x100 and calculate the value of KMS, Nacl and control sample. The valued of control was 6.42g and 6.22g wasvalue of Nacl and 6.20g was the value of KMS. Here we can clearly observe that the control value of WAC was increases with KMS value decreases of the sample. If the control value for water absorption capacity of carrot powder is increasing, it could be due to several reasons are; Variations in Particle Size that Changes in the particle size distribution of the carrot powder can affect its water absorption capacity ( Chantaro, 2008). Finer particles tend to have a higher surface area, leading to increased water absorption capacity. Moisture Content that Differences in the moisture content of the carrot powder samples can influence their water absorption capacity. Higher moisture content can result in greater water uptake by the powder particles. A decrease in KMS value in the water absorption capacity of carrot powder could be due to Higher moisture content in the carrot powder can dilute the concentration of KMS, affecting its measured value in water absorption capacity tests (Kapoor , 2022). If the moisture content increases, it could lead to a decrease in the perceived KMS concentration.


(Fig 2 – water absorption of carrot powder)

### 6.3 Oil absorption capacity –

We take sample with tube value of control was 9.1g, similar with forNacl was 8.6 g and for KMS was 8.6 g. then add 10ml of Rice bran oil for each sample and then that sample was centrifuged for several period of time. Afterthat excess water was removed from the sample then that sample was weight so the value was 6.9g for control, 6.8g for Nacl and 6.8 for KMS. Then put the formula (Ww-dw/dw) x100, the result would be for OAC were 2.2g for control, 1.8g for Nacl and 1.7g for KMS. The increases the value of control sample because if there were initial control sample value due to different factor such as storage condition or processing method. The decrease of Nacl value because of high concentration of Nacl could potentially interfere with the oil absorption process that lead to inaccuracy in measurement. ( Dar & Sharma, 2014) .


(F i g 3: Oil absorption of carrot powder)

**6.4 Wettability –**

We take 1gm of carrot powder sample and spread it on Petri dish and then add water through micropipette to the sample until the sample was completely wetted. The control of the sample was set in 3 number time and the Nacl sample was set in 2 number of time and the KMS sample was set in 2 number of times. The result would be increases in control sample of carrot powder because of the increase in wettability in the control sample of carrot powder could be due to several factors (Qin & Zhen, 2021) . One possibility is that the control sample might have undergone a different drying process or had different particle sizes compared to the experimental samples. Additionally, variations in the composition of the control sample, such as moisture content or surface properties,could also affect its wettability.


(Fig 4: Wettability of carrot powder)

**6.5 Dispersibility**

Dispersibility refers to the ability of substance to disperse or spread evenlyin a solvent or dispersing medium. It is a measure of how readily a substance can be dispersed or mixed into a liquid to form a homogeneous solution or suspension. Substances with high dispersibility will readily disperse dissolved, while those with low dispersibility may clump together or settle out of the solution

. Take 1gm of carrot powder and then add the weighed carrot powder to a known volume of the standardized solution in a container (Jniszewska , 2021). Agitate the mixture using a stirring rode, blender or shaking apparatus to disperse the powder in the liquid medium. After a specific time period, allow the mixture to settle or observed if the powder remain suspended in the liquid. Measure the amount of settle material at the bottom of the container or observed the degree of suspension Calculate. The dispersibility can e calculated as the ratio of the amount of disperse materials to the total amount of materials added, multiplied by 100 to expressed it as a percentage. Dispersibility (%) = (Amount of dispersed materials / Total amount of material adds) x100. Then the result would be in Nacl sample was low same as the KMS and control samples. Measure the amount the amount of settled materials at the bottom of the container or observed the degree of suspension. Carrot powder with large particles sizes may have lower dispersibility because large particles tends to algometer and settle more easily , reducing their ability to dispersibility( Dorota, 2021) . Moisture can cause particles to sticks together, making it harder for them to disperse in solvent. The surface properties of carrot powder particles, such as roughness or irregularities can affect their ability to interact with the dispersing medium, If the surface is not conducted to wetting orinteraction with the solvent, dispersibility may be low.

### 6.6 Color

Color parameter help to studied the parameter of the carrot powder. The lab value that indicate the(L) for lightness and (a) for redness and (b) for yellowness that help to determine the ΔE value of the carrot powder sample. The color measurements result for carrot that show below in the table. The ΔE value indicated how much percentage of the powder color changed after drying. ( Naraeni & Rizali, 2021) .

**Table 2** _color parameter of carrot powder

| SAMPLES | L | A | B | ΔE |
|---|---|---|---|---|
| 2mm control sample | 60.5 | -3 | 57 | 6.26 |
| 4mm control sample | 57.3 | 2 | 59 | 12.35 |
| 2mm Kms sample | 52 | 2.6 | 50 | 16.75 |
| 4mm kms sample | 49.6 | 6.3 | 48.3 | 22.4 |
| 2mm Nacl sample | 44.3 | 6.3 | 44.6 | 23.11 |
| 4mm Nacl sample | 43.6 | 8.3 | 46 | 35.6 |

## 7. Conclusion

In conclusion, physico functional properties assess highlight the potential of carrot powder being an essential element in various food applications, including goods dressings, good baked, beverages, and soups. Carrot powder has a particular bulk density value that shows its appropriate for convenient handling and incorporation into various food formulation. The high-water absorption capacity of carrot powder proposed that it has ability to improve the retention of moisture (Karki&Datt, 2012) The oil absorption capacity of carrot powder indicates its ability to bind fats and oils making it suitable for use in product like dressing or emulsions . The excellent dispersibility and wettability of carrot powder suggest its ease of incorporation into liquid- based formulation. Carrot powder shows a distinct color retention value that is unique and specific, its ability to maintain the characteristic orange color of fresh carrot which is desirable for visually appealing food product.

## 8.REFERENCE


(1) Nationalreferralfoodlaboratoryforvegetables.http://www.icar.org.in/en/ node/7847.2.

(2) Cotes, B. Rämert, & U. Nilsson, “A first approach to pest management strategies using trap crops in organic carrot fields,” Crop Prot., 2018, doi: 10.1016/j.cropro.2018.05.025.

(3) Chantaro, P., Devahastin, S., & Chiewchan, N. (2008). Production of antioxidant high dietary fiber powder from carrot peels. LWT-Food Scienceand Technology, 41(10), 1987-1994.

(4) Dahham, S.S.; Tabana, Y.M.; Iqbal, M.A.; Ahamed, M.B.; Ezzat, M.O.; Majid, A.S.; Majid, A.M. The anticancer, antioxidant and antimicrobial properties of the sesquiterpene β-caryophyllene from the essential oil of Aquilaria crassna. Molecules 2015, 20, 11808–11829

(5) Dubey, S.K., Singh, S.K., Nigam, S.N., Sah, Uma, Ali, M. and Yadav, A.S. 2015. Experimenting with farmer’ capacity and social institution building for ensuring village level seed sufficiency: A case of

chickpea (Cicer arietinum L.). Indian J. Extn. Edu. 51: 15-21.
(6) Dar, A. H., Sharma, H. K., & Kumar, N. (2014). Effect of frying time and temperature on the functional properties of carrot pomace, pulse powder and rice flour–basedextrudates. International journal of food engineering, 10(1), 139-147.
(7) Gong, Y., Deng, G., Han, C., & Ning, X. (2015). Process optimization based on carrot powder color characteristics. Engineering in agriculture, environment and food, 8(3), 137-142.
(8) Holloway, M. D., & Holloway, E. (2020). Dictionary of Industrial Terminology. John Wiley & Sons.
(9) Haas, K., Dohnal, T., Andreu, P., Zehetner, E., Kiesslich, A., Volkert, M., ... & Jaeger, H. (2020). Particle engineering for improved stability and handling properties of carrot concentrate powders using fluidized bed granulation and agglomeration. Powder technology, 370, 104-115.
(10) Haq, R., Dar, M. S., Kumar, P., Prasad, K., & Nayik, G. A. (2022). Effectof size reduction operation on particle size distribution, carotenoid content, hydration and functional characteristics of dehydrated carrot shreds. Journalof Postharvest Technology, 10(2), 81-91.
(11) John, N., Colley, M. and Reiten, J. 2010. Principles and practices of organic carrot seed production in the Paci c Northwest. Organic Seed Alliance· www.seedalliance.org.
(12) Janiszewska-Turak, E., & Witrowa-Rajchert, D. (2021). The influence of carrot pretreatment, type of carrier and disc speed on the physical and chemical properties of spray-dried carrot juice microcapsules. Drying Technology, 39(4), 439-449.
(13) Kelley, W.T., Granberry, D.M., Boyhan, George E. and Phatak S.C. 2012. Commercial Production and Management of Carrots. In: University of Georgia Cooperative Extension (Eds by Kelley, W.T., MacDonald, G. and Phatak, S.C.), P 325.
(14) Kapoor, R., & Feng, H. (2022). Characterization of physicochemical, packing and microstructural properties of beet, blueberry, carrot and cranberry powders: The effect of drying methods. Powder Technology, 395,290-300.
(15) Kumar, K., & Kumar, N. (2012). Development of vitamin and dietary fibre enriched carrot pomace and wheat flour based buns. Journal of Pure and Applied Science & Technology, 2(1), 107-115.
(16) Lawal, O. S. (2005). Functionality of native and succinylated Lablab bean (Lablab purpureus) protein concentrate. Food Hydrocolloids, 19(1), 63-72.
(17) Mašek, O. (2013). Biochar and carbon sequestration. Fire phenomena and the earth system: an interdisciplinary guide to fire science, 309-322.
(18) Nuraeni, F., Warnasih, S., & Rizali, V. H. (2021). Characterization ofPhysico-Chemical Levels of Î²-Carotene and Antioxidant Activity in Dried Carrot Dregs Powder. Helium: Journal of Science and Applied Chemistry, 1(1), 19-24.
(19) Navazio, J. 2012 The Organic Seed Grower: A Farmer’s Guide to Vegetable Seed Production. Chelsca Green Publishing, P 392.
(20) Olcay, N., Aslan, M., Demir, M. K., & Ertaş, N. (2021). Development of a functional cake formulation with purple carrot powder dried by different methods. Food and Health, 7(4), 242-250.
(21) Qin, Z., Sun, H., Tang, Y., Yin, S., Yang, L., Xu, M., & Liu, Z. (2021). Bioinspired hydrophilic–hydrophobic Janus composites for highly efficient solar steam generation. ACS Applied Materials & Interfaces, 13(16), 19467-19475.
(22) Radhika, G. B., Satyanarayana, S. V. and Rao, D. G. (2011). Mathematical Model on Thin Layer Drying of Finger Millet (Eleusinian coracana). Advanced Journal of Food Science Technology.3(2): 127-131.
(23) Sahni, P., & Shere, D. M. (2017). Comparative evaluation of physico- chemical and functional properties of apple, carrot and beetroot pomace powders. International Journal of Food and Fermentation Technology, 7(2), 317-323.
(24) Sule, S., Oneh, A. J., & Agba, I. M. (2019). Effect of carrot powder incorporation on the quality of pasta. MOJ Food Process Technol, 7(3), 99- 103.
(25) Sahni, P., & Shere, D. M. (2017). Comparative evaluation of physico- chemical and functional properties of apple, carrot and beetroot pomace powders. International Journal of Food and

Fermentation Technology, 7(2), 317-323.
(26) Sharma, K. D., Karki, S., Thakur, N. S., & Attri, S. (2012). Chemical composition, functional properties and processing of carrot—a review. Journal of food science and technology, 49(1), 22-32.
(27) S. Varanasi, L. Henzel, S. Sharman, W. Batchelor, & G. Garnier, "Producing nanofibres from carrots with a chemical-free process," Carbohydr. Polym., 2018, doi: 10.1016/j.carbpol.2017.12.056.
(28) Singh D, Dhillon TS, Singh R. Characterization for different traits in Asiatic and European Type carrot (Daucus carota var. sativa L.) Germplasm Lines. International Research Journal of Pure and Applied Chemistry 2020;21(8):26-32.
(29) Sharma, N., Sharma, A., Sharma, J.P., Dubey, S.K. Dabas, J.P.S., Singh B.K., Kumar, A., Ahmad, N., Chakraborty, S., Joshi, P., Nand K., Maurya, P.P., Singh, K. and Dubey, A.V. 2017. Farmers' preferences to varietal attributes as an indicator for acceptance and adoption of aromatic rice(Oryza sativa) varieties. Indian J. Agri. Sci. 87: 51-5.
(30) Singh, S.K., Dubey, S.K., Ali, M. Nigam, S.N., Srivastava, R.K., Saxena, K.B., Yadav, A.S. and Kumar, A. 2013. Development and promotion of an informal and formal feed system through farmer participatory seed production of pigeon pea (Cajanus cajan L.) in Uttar Pradesh, India. Agro. Sustain. Food Sys. 37: 531-49.11
(31) Shebaby, W.N.; Mroueh, M.; Bodman-Smith, K.; Mansour, A.; Taleb, R.I.; Daher, C.F.; El-Sibai, M. Daucus carota pentane-based fractions arrest the cell cycle and increase apoptosis in MDA-MB-231 breast cancer cells.BMC Complement. Altern. Med. 2014, 14, 387.
(32) Tiwari, S., & Sarkar, N. (2018). Development and evaluation of carotene rich carrot powder. Int. J. Res. Biosci. Agricul. Techn, 6(1), 123-131.
(33) Trilokia, M., Bandral, J. D., Gupta, N., Sood, M., & Sharma, S. (2022). Quality evaluation and storage stability of carrot pomace powder. The Pharma Innovation, 11(3), 1134-1139.
(34) Thürmann, P. A., Steffen, J., Zwernemann, C., Aebischer, C. P., Cohn, W., Wendt, G., & Schalch, W. (2002). Plasma concentration response to drinks containing β-carotene as carrot juice or formulated as a water dispersible powder. European Journal of Nutrition, 41(5), 228-235.
(35) taş, N. (2021). Development of a functional cake formulation with purple carrot powder dried by different methods. Food and Health, 7(4), 242-250.