MINISTRY OF FOOD PROCESSING INDUSTRIES
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PM Formalization of

Micro Food Processing Enterprises (PMFME) Scheme

HANDBOOK

OF

CHICORY

AATMANIRBHAR BHARAT

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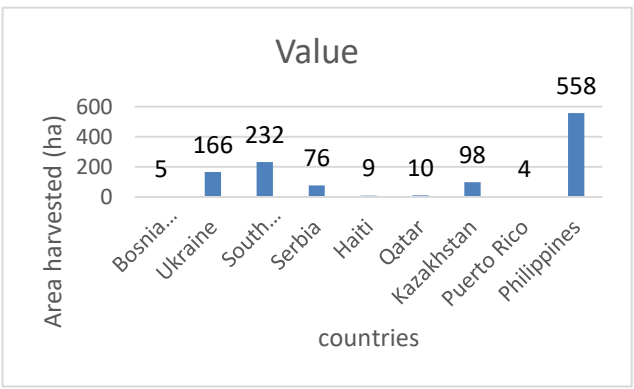
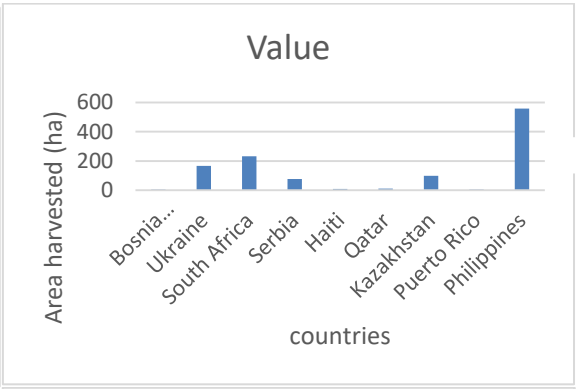
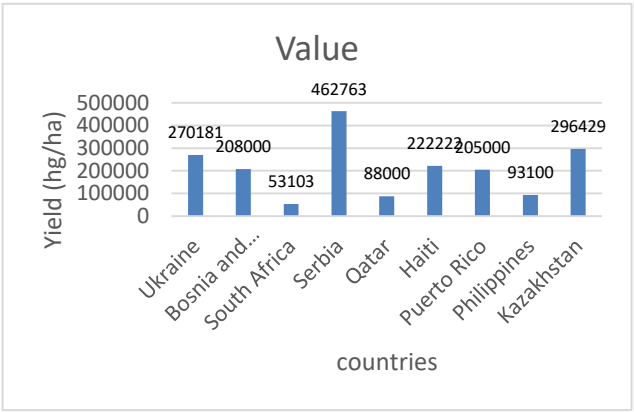
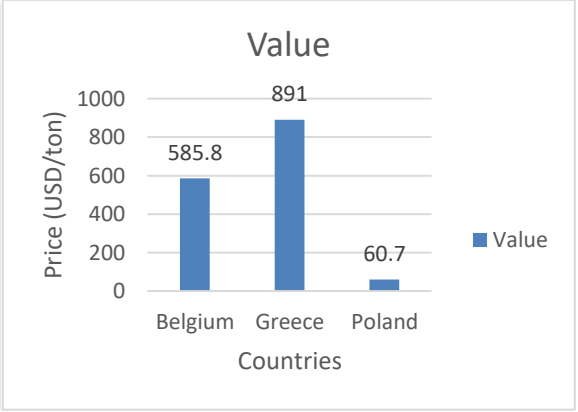
Introduction

Chicory (*Cichorium intybus* L.) is a globally cultivated perennial herb belonging to genus Cichorium of the Asteraceae family. This specie is native to Europe (Mediterranean region), but it can be grown in any other temperate or semi-arid climate (northern Africa, mid-Asia, eastern USA, Australia). Being rich in various bioactive compounds of human health significance such as sesquiterpene lactones like lactucopicrin, sonchuside C, guaianolid glycosides (including sonchuside C, chicoroisides B and C,), Inulin, proteins, fats, flavonoids, hydroxycoumarins, oils, terpenoids, vitamins and most importantly caffeic derivatives such as isochlorogenic acid, chicoric acid, dicaffeoyl tartaric acid and chlorogenic acid, this crop is gaining great importance in market (Petropoulos et al., 2017). As per the report of Markets and Markets, chicory market size globally in 2020, is estimated to be around USD 685 million and is expected increase is projected to be around USD 905 million by 2025 with compound annual growth rate of about 5.7 %. In India chicory is mainly cultivated in the area of Gujarat and Uttar Pradesh accounting for alone for about 97% of the total chicory produced I India. Chicory root has been utilised as substitute for coffee since World War II when coffee was expensive and lower in supply. Chicory has medicinal significance as it is hepatoprotective, antioxidant, immunological, anti-inflammatory, antidiabetic, hypolipidemic, gastro-protective, cardiovascular, antimicrobial, sedative and anti-cancerous (Bahmani et al., 2015). Foods and beverages that are organic in nature and have such diverse health benefits are in great demand among millennials because of rising awareness corresponding to healthcare measures, rising disposal incomes and busy lifestyles. Other demand driving factors include increasing application of chicory in cosmetic industry as a result of its anti-oxidative and anti-inflammatory properties.









Market Dynamics

Drivers: Chicory as cost effective substitute of coffee with numerous health benefits

Coffee is a premium beverage commodity and chicory being cheaper than coffee can be a potential ingredient in the beverage industry. Prices of coffee have increased further as a result of rise in the coffee prices globally. It is therefore making tough for the industries to absorb high raw material cost. Hence, they blend chicory with coffee in order to protect their margin. Many large companies holding best selling brands have increased chicory content in the coffee sachets to 49% from 30%. This has thus again increased demand for cultivating chicory and harvesting chicory roots for producing instant chicory powder across many major countries. Products made from chicory like roasted chicory powder that can be absolutely used as coffee substitute has lower price, numerous health benefits and hence, is gaining popularity among consumers and processing industries.

Restraints: Traditional mindset and greater dependency of consumers on mainstream products like coffee, tea etc.

Chicory does not have same organoleptic properties as coffee such as characteristic dark coffee flavour and aroma of coffee. In contrast chicory has woody, bitter nutty taste with slightly herbal flavour. Coffee is besides having characteristic flavour is also involved in ritual, emotions and memories of people worldwide. Hence, people find it tough to replace it with any other beverages. With time, coffee consumers associated coffee consumption with enhancing energy, brain function, positive mood and improved memory. Similarly, green tea consumption is also associated with improving metabolism of the body and having synergistic effect on weight loss. Black tea is believed to help in mental and physical robustness. As a result of increased demands tea and coffee are cultivated and processed at greater rate in many countries. As per the figures of FAOSTAT, around 112 million tons and 7.05 million tons of coffee and tea respectively were produced globally in 2018. Since, these are grown in large amounts hence, are available at less prices to the processing industries. Hence, these reasons hamper the growth of chicory market in the world.

Opportunities: Growth in applications of chicory across various industries

Chicory root fibre have spread its root not only in food and beverage industry but also many other diversified areas such as in pet food production, dietary supplements, pharmaceuticals and cosmetic industry. Chicory root fibre can help in sugar reduction by assisting with flavour and texture. Moreover, chicory leaves and roots can be used for salads in preparing various recipes. Chicory contains many nutrients such as vitamin A,K,C and B group vitamins. It is a great source of minerals like iron, manganese, copper and vitamins. Inulin fibre present in roots of chicory functions as a type of prebiotic and assists in growth of beneficial gut bacteria. Hence, is used in dietary supplements. Oligosaccharides present in chicory roots boost the collagen of skin and smoothens the wrinkles which favours the potential of chicory in cosmetic and daily care industries. All these factors and benefits of chicory justifies the need of more chicory production and processing, motivating the upcoming entrepreneurs and established industries to think in this direction and earn through chicory processing.

Upcoming projected growth among different segments in chicory business

By type: Instant powder segment ruled the chicory market globally in 2019 due to popularised acceptability, convenient utility and easy availability of instant powder worldwide. Various chicory processing companies offer chicory powder for consumption and as raw material for diverse application in different other industries. Moreover, rising interest of consumers on caffeine-free and ready-to-drink beverages also adds to the demand for chicory processing in powder form. Hence, chicory in powder form is projected to rise at a substantial ratein future.

By form: Chicory powder is estimated to have largest share in total chicory market during upcoming areas. Chicory powder can be used in various diversified field whereas other forms have constraints of limited use. Moreover, powder form is produced more by the chicory processors which makes another reason for chicory in powder form leading the market.

By plant-part: Since chicory roots contain most of the bioactive compounds and other compounds of interest (such as inulin which is highly utilized as fibre source in food and bevereges) than other plant part, root processing will lead the market in term of chicory processing.

By application: Application of chicory in food and beverage sector will lead the market as chicory is highly used as substitute of coffee. Chicory leaves are used as salads worldwide. Roots of chicory contain inulin which is used as fibre source in various food products.Flower and leaves have wide application in producing flavoured vinegar. Besides these application chicory flour extracts also have application as flavour enhancers in cookies, breads and cakes. Thus, with such wide application in food and beverage section chicory application mainly in food and beverage sector will lead the market.

In future, Asian pacific region is expected to grow at higher compound annual growth rate during upcoming years. Although in developing country like India the chicory business is in nascent stage owing to the fact that majority of people are unaware of the health benefits, but with increase in awareness regarding chronic diseases risks people are diverted towards accepting healthy benefits and including herbal ingredients in their diet. This will lead to high demand of healthy substitutes and ingredients such as chicory in the market. Various processors have already started making their way in this direction. Some of them are Delecto Foods Pvt Ltd (India), Pioneer Chicory (India), Farmvilla Food Industries Pvt Ltd (India), PMV Nutrient Products Pvt Ltd (India), Murlikrishna Foods Pvt Ltd (India), Narasu’s Coffee Company (India), Jamnagar Chicory Industries (India), and Herbs & Crops Overseas (India). International players in this field include Cosucra Groupe Warcoing (Belgium), Cargill Incorporated (US), Sensus (Netherlands), Starwest Botanicals (US), NP Nutra (US), Reily Foods Company (US), BENEO GmbH (Germany) and Leroux (France).

Introduction about Chicory

Cichorium intybus L, also known as chicory, witloof and blue sailor's succory belongs to family Asteraceae. This is an erect perennial herb having height of about 80-90cm and a fleshy taproot of about 75 cm length. This genus contains majorly six species. It is grown in countries such as the Belgium, UK, France, Germany, Netherlands,USA, South Africa, andIndia. It is originated in the temperate regions of the world and is found wild in India in the regions of Andhra Pradesh and Punjab. However, it is grown in Tamil Nadu, Gujarat, Bihar, Himachal Pradesh and Uttar Pradesh. Commercially seed is produced in temperate areas of Himachal Pradesh, Jammu and Kashmir, and some hilly regions of Uttar Pradesh. Chicory roots are yellow brownish from out side and white from inside with a very thin bark. It contains a well-developed root with matured central part. Its leaves are oblong, lanceolate and crowded at the base giving a rosette arrangement. It contains blue coloured flowers. Maturing fruits appears to be brownish black in colour whereas fully matured ones arepale in colour. Seeds present inside the fruits are ovoid(Bais et al., 2001).

Selection of cultivars 19

Altogether, at least six cultivar groups, mainly differentiated on the basis of their use, are recognizable (Barcaccia et al., 2016).

Taxonomy	Cultivar Group	Utilization
C. intybus	-	-
subsp. intybus	Wild	-
var. foliosum	Witloof chicory	cooked/salads
var. porphyreum	Pain de Sucre	cooked/salads
var. latifolium	Radicchio	Salads
var. sylvestre	Catalogne	Cooked
Cichorium intybus var. sativum	cooked	coffee substitute (roasted), inulin extracts/cooked
subsp. glabratum	Wild	-

Chicory as a vegetable

Chicory cultivars bred for salad use have more and bigger leaves than any of the other cultivars. To decrease bitterness, salad leaves are frequently blanched in the field. Roots that are young and tender can be boiled and consumed as a vegetable. Chicory extracts can also be found in both alcoholic and non-alcoholic drinks. 17 Lettuce (Cichorium tribe, Lactuca sativa L), the leafy salad vegetables known as endive and escarole (C endivia L), radicchio (C intybus L), and chicory grown to be used as a coffee substitute are all relevant vegetables of economic significance (C intybus L). The term "endive" in the United States generally refers to endive or escarole. Although the common name Belgian endive enables to differentiate it from other C endivia crops, this is not as explanatory as the common name witloof chicory, which implies "white leaf chicory." For the intent of market differentiation, some systems have combined both the common names and use the name witloof endive(Bais et al., 2001).

Production technology for chicory products

Chicory Coffee production

When the chicory plant has reached full maturity and is ready to harvest (depending on sowing, usually between August and November). The leaves and the root must first be separated. Chicory leaves are considered organic waste in this case, but they are used as salads in other countries. The root of the chicory plant, which is required for the production of chicory coffee, is then delivered to the factory. The root is chopped into small pieces (ranging in size from a few mm to a few cm) to make drying easier and quicker. Following the roasting of the cut roots, grounding is required to achieve the desired consistency for roasting. When the coffee is fully prepared for further processing to the market, roasting is one of the last pre-treatment processes. As a result, you'll have granulated chicory coffee. To make a different type of coffee, such as instant coffee, the product is roasted, then percolated, and finally spray dried. Because of India's warm climate, the chicory root can be sun-dried at temperatures of 40–45 °C for 3–4 days to achieve the desired moisture content. Although sun-drying is one of the most common drying methods, it has recently been replaced by mechanical drying to improve overall drying process. Chicory coffee is made without any additives in India and other foreign countries, but different variations of chicory are used, such as powder, dried cubes, roasted cubes, roasted granules, and even frozen chicory granules with a size of up to 5 mm. When it comes to chicory drying, the procedure varies greatly between production plants. In some places, it was even observed that the chicory root is not dried at all, and that the only pre-treatment is roasting. In most cases, the average roasting temperature in India is around 140–180 °C (Indzere et al., 2018).

Chicory powder

Bitter and mucilaginous roots are washed, cut into slices, and dried shortly after harvest. Sun-dried or kiln-dried roots are obtained. Even though sun-dried roots look better, kiln-dried roots are much more efficient and preferred. Before roasting, the dried roots are graded into four sizes to ensure uniform roasting. In hot rotating iron cylinders, the roasting takes 30 minutes. To improve the flavour and colour of chicory, small amounts of oil, butter, or clarified butter (0.9kg per 50kg chicory) are added to the roots during roasting. The sugars caramelise during roasting, resulting in an increase in histidine bases. These changes are accountable for the roasted product's distinct flavour. The roasted root pieces are manually-picked and then powdered to eliminate any foreign matter. The final product for blending and flavouring coffee is this powder (Bais et al., 2001).

Chicory wine preparation:

Alcoholic fermentation is to be done by using *Saccharonomycescerevisia* (Brewer's yeast). Carbon (starch and sugars) and nitrogen sources (mustered cake and soya cake) should be added to ensure the ferment ability of chicory roots.

Carbon source: The TSS to be maintained at 12º Brix (in order to get minimum 5% alcohol)

Nitrogen source: The nitrogen concentration to be be maintained at 0.1% (mustered cake and soya)

Immerse chicory roots in water, add carbon and nitrogen sources then heat above 100ºC, cool, and incubate it with yeast (3 %) for ethanol production (Hemke, 2017).

Chicory vinegar production

In this "submerged acetic fermentation" is used. Bacteria work on a solution, which is the alcohol blend, to perform fermentation. Bacteria are constantly dipped in liquid to ferment, where they accumulate and oxidise the alcohol blend into vinegar. Acetic acid bacteria are dipped in liquid to multiply, ferment, and draw energy from the oxidation of ethanol to acetic acid in the submerged state fermentation method. Acetic acid bacteria require a constant supply of oxygen in all parts of the tank to catalyse the reaction that provides them with energy. A disruption in oxygen delivery, particularly in the final stages of fermentation, will have an impact on performance. Acetic acid fermentation id done for 28.8±6.28 hours at about 30ºC, followed by acetification, maturation and packaging (Hemke, 2017).

Inulin Extracts

Raw chicory roots should be rinsed to remove any remaining soil or other unwanted materials. Soak chicory root parts in a 0.75 percent of citric acid solution for 24 hours at a ratio of 1:10 (roots: water w/v). The samples should then be washed then dried in an electric oven at 40 °C for 10 hours, and then ground in an electric mill passing through 100 mesh sieves. Inulin extraction to be carried out by addition of water to root powder in a 1:10 ratio (root powder: water, w/v) for 1 hour at an average temperature of 80 °C , assisted by constant agitation. After the extraction process, filter the crude extract using muslin cloth to remove the insoluble residues.Because of the presence of colloidal and particular substances, such as protein, pectin, and cell wall, the resulting solution will be turbid. To remove these impurities, mix the crude concentrated extract with a with a 5% slurry of calcium hydroxidefor 30 minutes at 50–60 °C. Consequently, flocculent so formed will be precipitated and clear bright yellow supernatant will be obtained. This will raise the pH of the solution from 5- 6 to 10–12. Vacuum filter the extract with Whatman No. 4 filter paper and add 10 percent phosphoric acid (H3PO4) to the filtrate extract assisted by vigorous continuous stirring. Adjust the pH to 8-9 and remove the excessive coagulated organic material and calcium through precipitation. Refilter the extract and keep it at 60 °C for 2–3 h then, clarify it again. In orderto eliminate colouring substances, add charcoal powder to filtrate with continuous stirring using a glass rod for aperiod of 15–30 min at 60 °C. Filter the clarified extract with filter paper and concentrate the extract using a rotary evaporator operating at 60 °C. Concentrate up to 40°Brix inulin solutionand then mix with ethanol (99%)and store at 20–25 °C for 4 days. After storage, remove the the supernatants by aspirator and wash the precipitates with ethanol. Place the precipitated inulin under vacuum oven at 40 °C for 1 h in order toremove excess solvent. Freeze precipitated inulin at −20 °C for24 hour and dry for 24 hours in a freeze dryer at −30 °C. Dry mill the dried inulin and store in airtight container (El-Kholy et al., 2020) .

Chicory can be used as substitute in various products:

1. Application of inulin extracted from chicory (Cichorium intybus L.) roots in order to improve the properties of low-fat symbiotic yoghurt

Inulin extract obtained from chicory roots can be added in the low-fat symbiotic yoghurt. Chicory inulin is observed to have high content of reducing sugars (4.9%). When inulin is added at 1%, it enhanced the textural, microstructural and sensory properties of yoghurt. This yoghurt can be said as functional synbiotic product as it has both probiotics (N6logcfug−1)andprebiotics. Inulin addition to this probiotic yoghurt enhanced the viability of *L.bulgaricus, S.thermophilus,L.acidophilusandB.bifidum.* Hence, chicory inulin can be used in low fat symbiotic yoghurt (El-Kholy et al., 2020).

2. Baked and groundroots of chicory can be used as substitute of coffee and also leaves can be utilized as vegetables. Chicory can be used as forage plant for feeding animals (Saeed et al., 2017).
3. Chicory contains dietary fiberslike inulin and fructose oligosaccharides and numerous other functional food ingredients which can aid ingood health maintenance and in prevention of diseases. Inulin is mostly applied into food as low-calorie sweetener, fat substitute and texture modifier, in order to increase dietary fiber content, improve technological and sensory value of the products (Drabińska et al.,2016).
4. Chicory powdered roots finds another application in successfully replacing wheat flour (10%) and fat (25%) in cracker production after debittering by soaking the roots in water or citric acid solution (Massoud et al., 2009).
5. Chicory fiberscan also be incorporated in restructured sausages in order to replace fat, given the fact that addition of chicory fibercan significantlyreducethe moisture, fat, hardness and pH values of sausages (Choi et al., 2016).
6. Flour from dehydrated chicory root can be used to prepare food dough for baking (Bossard et al., 2006).
7. Dried chicory root extract (2–6%) can be implemented into yogurt-ice cream formulation with intention to decrease production costs by replacing dairy ingredients with other low-cost alternatives, such as inulin and buttermilk. By increasing the amount of dried chicory root extract in yoghurtice cream formulation the textural and flavor properties can be increased(Kumar et al.,2018).
8. Chicory root extracts (1, 2 and 3%) can be added in yogurt due to health promoting effect of chicory inulin as well as its ability to form creamy emulsions with aqueous liquid(Jeong et al., 2017).

Abbrevations

PPEs – Personal Protective Equipments

RLAF – Reverse Laminar Airflow

Technology choices

- Chicory roots can be dried by
  - Solar dryer
  - vacuum oven
  - forced convection laboratory dryer (Tecno Dalvo, Model CHC/F/I, Argentina),
  - electric oven
  - mechanical drier
  - microwave
- Electric mill can be used for milling of chicory roots.
- Spray dryer can be used for the manufacturing of instant spray dried chicory powder

Plant and Machines

1. Mesco Equipment Private Limited, Kolkata (West Bengal) – http://www.mesco.co.in/mesco-tea/index.php

2. Gimpex Overseas Private Limited, Kolkata (West Bengal) - http://www.gimpexindia.com/ (Contact in this mail id – opgimpex@gmail.com)

3. Vikram Forgings & Allied Industries Private Limited, Kolkata - http://www.vikramindia.in/

4. Gem Allied Industries Pvt. Ltd., Kolkata - https://www.gemdryers.com/

5. Zenith Forgings Private Limited, Kolkata - http://www.zenithforgings.com/

6. Fengxiang Food Machinery Co. Ltd., China –

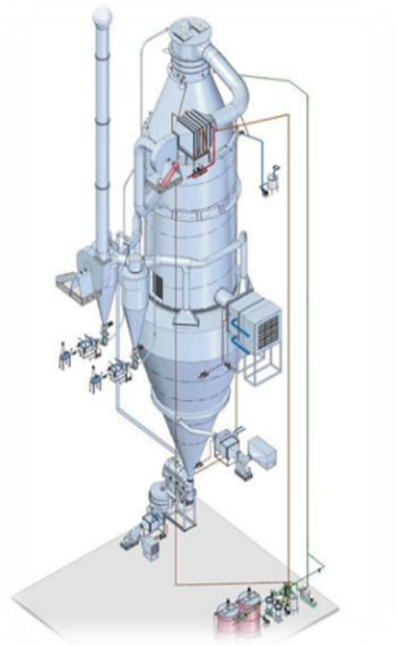
https://fx-foodmachine.en.alibaba.com/?spm=a2700.details.cordpanyb.4.4b313e8ax1G6Zj

FC-305 chicory slicing machine, chicory cutting machine, chicory slicer cutter

7. SSP Private Limited, Faridabad (Haryana) - https://www.sspindia.com/

This powder plant includes 3 processes -

i. Roasting of Chicory cubes
ii. Continuous extraction
iii. Spray Drying



Chicory Powder Plant

9. Pioneer machinery and spares, Coimbatore - https://teamachinery.com/

Quality characteristics of Chicory

Chicory root contains high amount of inulin (storage carbohydrate), that composed of fructose units whose linkages cannot be broken down by enzymes reside in human intestine and therefore, classified as dietary fiber (Chandra et al. 2016). It also contain chicoric acid, saccharides, organic acids, polyphenols such as chlorogenic and caffeic acid (Denev et al., 2014). Inulin extracted from chicory is also defined as prebiotic as it is non-digestible in human body that further helps in growth and functioning of gut microorganism such as bifidobacteria, lactic acid microflora and enhances the formation of short-chain fatty acids (SCFAs) (Roberfroid and Delzenne, 1998).

SCFAs formation decreases the pH of gut and thus, hamper in the growth of harmful bacteria. SCFAs is known for its anti cancerous properties such as promotion of cancer cell cycle arrest, apoptosis, inhibit migration of cancer cell in colon and lowering of chronic inflammation (Zeng et al. 2014). Chicory also act as antioxidant, anti-inflammatory, anti-parasitic and anti-hepatotoxic (prevent liver problem) that imparts positive health benefit. Chicory inulin can be used for the manufacturing of fructose syrup as it is a polymer of fructose molecules with an end glucose molecule. Fructose provides 1.3 times more sweetening effect than beet sugar, therefore, fewer calories is used for the equivalent sweet sensation (Chandra et al. 2016). As it contains low calories and rich in dietary fiber, it becomes a good choice for diabetic and obesity people (Nwafor et al. 2017). Chicory act as fat as well as sugar substitute as it is known for its stabilizing, texturing and gelling characteristics (Arkel et al. 2012; Keenan et al. 2014 and Gonzalez-Tomas et al. 2009). Chemical and mineral content of chicory leaves and roots are given in table 1 and table 2.

Table: 1 Chemical composition of leaves and roots of chicory (Massoud et al. 2009)

Chemical composition	Leaves	Roots
Moisture content (%)	83.06 ± 1.55	75.63 ± 0.39
Crude protein (%)	14.70 ± 1.03	4.65 ± 0.25
Crude ether extract (%)	3.68 ± 0.19	1.69 ± 0.71
Ash (%)	10.91 ± 1.86	4.25 ± 0.11
Total carbohydrates (%)	70.71 ± 3.08	89.41 ± 1.07
Total soluble sugars (%)	7.80 ± 1.45	11.06 ± 1.00
Inulin (%)	10.95 ± 2.56	44.69 ± 0.88
Crude fiber (%)	16.78 ± 2.20	5.12 ± 1.55
Total phenolic content (mg GAE/ g dry extract)	26.4 ± 1.05	20.0 ± 0.9

Table 2: Mineral content of chicory leaves and roots (Massoud et al. 2009)

Mineral content (mg/100g)	Leaves	Roots
Calcium	292.61± 13.35	181.26 ± 4.40
Potassium	166.57 ± 3.43	103.7 ± 4.62
Magnesium	6.944 ± 5.86	20.14 ± 1.69
Sodium	88.84 ± 2.58	67.42± 2.45
Iron	9.178 ± 0.85	1.77± 0.21
Copper	0.596 ± 0.06	0.362 ± 0.015
Manganese	0.904 ± 0.01	0.312 ± 0.10
Zinc	0.91 ± 0.03	0.390 ± 0.03
Lead	0.025± 0.01	0.038± 0.003

Packaging

- Instant chicory of 15Kg should be packed in corrugated cartons with single heavy polyliner inside.
- Chicory extract and liquid malt extract of around 300 kg should be packed in High Density Polyethylene (HDPE) drums.
- Roasted chicory cubes and dried chicory cubes of around 35 kg and 40kg should be packed in HDPE bags, respectively.
- Roasted chicory powder of 25kg and malt extract powder of 25Kg should be packed in carton or HDPE Bags

Product specific GHP/GMP/HACCP

GHP/GMP for chicory (FSSAI, 2018)

I. Establishment – design and facilities

1) Location and Surroundings

- Industry shall be situated away from environmentally polluted areas like open sewage, drain, public lavatory or any factory which produces disagreeable or obnoxious odour, fumes, excessive soot, dust, smoke, chemical or biological emissions to avoid risk of contamination from external environment.
- In case it is already existing, appropriate control measures shall be taken.
- The site boundaries shall be clearly identified with appropriate access control to prevent the chances of theft and sabotage.
- Dogs, cats or other pet animals should not be allowed to enter the premises.
- The manufacturing premise shall not have direct access to any residential area.
- The manufacturing premises shall be located away from flood prone area. Where the premises are located in areas prone to flooding, it is recommended that height of the manufacturing area should be suitably elevated to prevent the risks due to flooding.
- The surrounding areas of the establishment shall be kept in good order. Roads, yards, parking lots outside the factory building should be free of debris and refuse, and from any source of pollution.
- There should not be any stagnant water surrounding the facility. Where buildings are surrounded by grassed or planted areas, a clear space should be provided between the grassed planted areas and the building. Such grassed/planted areas should be regularly tended and maintained.

2) Building design, construction and layout

2.1 Building design and layout

- Plant layout should be designed, constructed and maintained in order to facilitate good manufacturing and hygienic practices.
- The building shall provide adequate working space with a logical flow of materials, products, personnel and to the extent that is practicable physical separation of raw from processed area to prevent any cross-contamination.
- Sufficient space and proper placement of equipment's as is necessary for the maintenance of sanitary operations.
- The plant should have a proper space for inward and outward vehicle movement.
- Openings intending for transfer of materials shall be designed to minimize any cross contamination from foreign matter, pests, etc.
- The manufacturer should demonstrate adequate controls (in terms of segregation of area) where there is manufacturing of products like Pre & Probiotics.
- Designed, constructed and maintained to prevent entry of insects and rodents.

2.2 Internal Structures

2.2.1 Walls and Partitions

- They shall be soundly constructed of materials that are durable, cleanable, and impervious to food, grease and water with no toxic effect in intended use. For example: emulsion oil paint (which is easily cleanable by wiping); tiles (which are less porous and causes less crevices).
- Premises shall be free of flaking paint and plaster to prevent the accumulation of dust, minimise condensation, and shredding of particles.
- Wall floor joints should be curved in processing and packaging areas to facilitate cleaning.
- Wall and pillar guards (SS) should be used to avoid daily wear and tear of the surfaces.

2.2.2 Ceilings and overhead fixtures

Ceilings -

- Shall be maintained in sound condition and constructed of materials that are durable
- cleanable, and impervious to food, grease and water with no toxic effect in intended use.
- Shall be sealed to prevent the entry of dirt, dust and pests.
- Shall be free from flaking paint or plaster.

Overhead fixtures-

- Shall be suitably protected so that they do not act as contaminants in case of breakage

2.2.3 Floors

- Shall be non-slippery, sloped appropriately, to allow adequate drainage.
- The drainage shall flow opposite to the flow of manufacturing process flow.
- Shall be maintained in good repair with no cracks and crevices.
- Shall be made of materials that are durable and easy to clean such as Epoxy coated floors or PU flooring or any other suitable flooring.
- Wet cleaning should be avoided. This causes slippery. Sweeping and mopping is more appropriate and cost effective.
- The floor and the walls should not be damp or moist.

2.2.4 Doors& Window's

- Shall have smooth, non-absorbent surfaces.
- Wooden doors are not recommended as it promotes mould growth, termites with ageing.
- shall be easy to clean.
- Shall be close-fitting and with suitable precautions to prevent entry of pests.
- Gaps if any between the door and the floor should be closed with suitable material like rubber strips, polyurethane etc. to avoid pest entry.
- To ensure dust, insects, birds and animals to be kept out of the premises entry/exit points should be suitably protected with such as strip PVC/air curtains/ doors with automatic self-closing devices etc.
- External opening windows, roof vents or exhaust fan, where present, shall be adequately screened to avoid any external pest ingress.
- Stairs, lift cages and auxiliary structures such as platforms, ladders, chutes should be so situated and constructed as not to cause contamination.

3. Equipment Design and Installation

i. Equipment and containers that come in direct contact with food (including food contact surfaces) and used for food handling, storage, processing, packing shall be –

- located, designed and fabricated so that it permits necessary maintenance and periodic cleaning.
- kept in good order, repair and condition as to minimize any risk of contamination. These include free from cracks, crevices, open seams etc.
- made of impervious, corrosion free material which do not impart any toxicity to the food material and shall be easy to clean.
- shall be placed to achieve easy and effective cleaning of adjacent areas like floors, walls, ceilings and other surfaces.

ii. Equipment, containers and piping should be clearly labelled and identifiable.

iii. All openings such as manholes, inlets, outlets, draining out of points, etc. should be made such that they can be locked and/or effectively sealed.
iv. Manufacturing vessels, pipework, and material handling equipment are well bonded and smooth to prevent material build up and promote sanitary conditions.
v. Hygienic design features may include:

- Pipes shall be sloped, with no dead-legs or right-angled bends
- Domed tops, curved sides, conical bases for vessels/tanks.
- Flexible hoses shall have a smooth (not ribbed) internal surface and have fittings which are sanitary and easy to connect/disconnect hoppers

vi. All utensils/ container containing food products shall be covered with a properly fitted cover/lid or with clean gauze net/ any other material. This helps to completely protect food from dust, dirt, flies and other insects

vii. In case, the equipment & utensils are also used for purpose other than preparation of chicory related products, adequate control measures shall be implemented such as cleaning, sanitization etc. to ensure avoidance of cross-contamination.
viii. There shall be appropriate facilities for cleaning and disinfecting the food contact equipment and instruments, and wherever possible Clean-In-Place (CIP) should be adopted.
ix. Defective equipment shall, if possible, be removed from production and quality control areas. If the equipment is such that they cannot be removed, they should be clearly indicated with their status.

4. Facilities/ Utilities

4.1 General

- The facilities are essential services that play a vital role to industry. Quality facilities and utilities provided like water, light, hygiene facilities etc. are a prerequisite for an effective food safety.
- Back-up systems and other parallel infrastructure systems can be planned for continuous & uninterrupted supply.
- As Industry Best Practice Qualification of the Utilities (Water Systems, HVAC, Compressed Air/ Gas others) should be done to give a confidence of reliable, continuous & uninterrupted supply of desired quality.
- Pipe-work, electrical fittings, ventilation openings and similar services lines shall be designed, fixed and constructed to avoid creation of recesses.
- Services lines shall be identified by colours and the nature of the supply and direction of flow shall be marked/indicated.

4.2 Water System

- Adequate supply of potable water shall be available to meet operational needs.

- Water including steam/Ice used as a product ingredient or in contact with food of food contact surfaces or used for equipment and plant cleaning shall be potable.
- Potable water quality shall be as specified in the latest edition of BIS standard on drinking water (IS 10500). Potable water shall be analysed at least semi-annually to confirm that it meets the requirements of this standard.
- Where it is necessary to store water, storage facilities including the storage tanks and water pipes shall be adequately designed, made of material that is non-toxic, corrosion resistant material and periodic cleaned and maintained to prevent contamination and records of the same should be maintained.
- The tanks shall be covered to prevent access by animals, birds, pests and other extraneous matter.
- Where water filters are used, they shall be regularly monitored or effectively maintained.
- Recycled water used in processing or as an ingredient shall not present risk of contamination. It shall be of the same standard as potable water.
- Non potable water (for use in, for example, steam production, firefighting & refrigeration equipment and other similar purposes where it will not contaminate food) shall have a separate system.
- Non-potable water systems shall be identified and shall not connect with, or allow reflux into, potable water systems.
- The material of construction of pumps, valves, storage and distribution skids shall be non-reactive, non-corrosive, non-leaching and sanitary in design.
- Water lines (used in internal Cleaning & as ingredients) shall be clearly separated and identified from others.
- Color coding of separate pipelines for potable water and non potable water is recommended.

4.3 Air Quality and Environment conditions

- Ventilation systems natural and /or mechanical including air filters, exhaust fans, wherever required, shall be designed and constructed so that air does not flow from contaminated areas to clean areas.
- Proper ventilation (naturally and mechanically) that provides sufficient air exchange to prevent unacceptable accumulation of dust as well as to remove contaminated air, is of utmost importance.
- Ventilation systems should be kept clean and maintained in good condition.
- The design of all ventilation and extraction systems should be of the sort that allows proper cleaning.
- Air intake points shall be fitted with fly screens which should be fitted with dust filters.
- These air-intake points shall be located so as to avoid the intake of air contaminated by microorganisms, dust aerosols, chemicals and smoke.
- The air- intake levels should be at least 1 m above the internal floor levels and outside surfaces. Within a dusty environment such as a mill, it is advised that dust extractors should be installed where necessary; the units should be inspected and maintained to ensure their functionality.

4.4 Lightning

- Adequate natural or artificial lighting shall be provided in the industry, to enable the employees/workers to operate in a hygienic manner.
- Lighting fixtures should be appropriately protected to ensure that food is not contaminated by breakages of electrical fittings.
- Bulbs, tubes shall be enclosed in protective casings to ensure no spread of broken pieces in case of breakage.
- The artificial lighting should not alter colours and white light should be used where the colour of the food is a critical quality parameter and it has to be monitored.
- Selection of lighting systems and mounting location is important consideration to prevent flying insects invading the structure.
- Selecting sodium vapour lighting systems, which are less attractive to insects and installing lights mounted on poles or ground at least 20ft away from building can greatly help in minimizing insect settling on building and gaining access inside.
- Insects are attracted to ultra-violet light emitted by mercury vapour lights and are also attracted to the warmth around light systems.
- Fluorescent strip lights should be protected by shatterproof diffusers or sleeve covers in production areas.
- White lights should be away from buildings to prevent pest ingress.
- High pressure sodium lights can be provided near buildings & No lights should be there near doors and windows

4.5 Personal hygiene facilities and Employee facilities

- shall be available to ensure that an appropriate degree of personal hygiene can be maintained to avoid any cross contamination. Such facilities shall be suitably located & designated.
- Facility shall have following facilities- hand washing, lavatories, changing facility, rest and refreshment room. Such facility shall be suitable located and designated.

4.5.1 Hand washing facilities

- Facility with shot and cold or suitable temperature controlled potable water with suitable hygienic means of drying hands can be provided in such a position that the employee must pass them when entering the processing areas. This will help employees to automatically get an alert for hand washing without a miss.
- Where hot and cold water are available, mixing taps should be provided.
- Hand washing notices shall be posted on walls near hand wash stations.
- Non- Perfumed liquid soap should be used in dispensers to wash hands as soap bars are a potential source of cross contamination.
- The design of taps should be such that there is no hand contact after washing while closing the taps. Preferably, elbow or foot operated taps are used in food manufacturing units.

4.5.2 *Hand drying and sanitizing facility*

- Hand drier where installed should be in working condition at all the times during working hours.
- Where paper towels are used, a sufficient number of dispensers and receptacles should be provided near to each washing facility. Paper towel rolls should be covered from top at all time to avoid dust and dirt on them.
- Generally, and preferably, hand driers are considered better than paper towels based on cost efficiency and effectiveness.
- The dustbins used to throw the used-paper towels, should be foot-operated. This avoids any direct hand contact (washed hands) to open the dustbin.
- Self-drying hand sanitizer should be provided and should be used after drying of hands. This is the next step of disinfecting hands after cleaning.

4.5.3 Lavatories

- Lavatories shall be separate from other areas and shall not be directly connected to the storage and manufacturing areas.
- Sufficient number and separate toilets/urinals for male and female should be provided. Industry best practice of 1:25 is followed for facility: employee ratio.
- Adequate supply of water should be provided in toilets and urinals. Potable water should be used at the toilet wash basin stations, as the employees may need to touch food items while in production areas.
- All toilet facilities should be clean and sanitized at all times of the working hours.
- Toilets should be so designed so as to ensure hygienic removal of waste matter.
- Toilets should be well lit and ventilated and should not open directly into food handling areas.

4.5.4 Changing facilities

- Suitable and sufficient facilities for persons working in the processing areas should be provided for changing their clothes, keeping their personal belongings and Street footwear.
- Separate areas should be provided for home personal clothes and company uniforms (in case there is a designated full uniform used by employees during processing).
- Factory Footwear should be cleaned periodically and not to be used for external purposes

4.5.5 Rest and refreshment room

- Rest & Refreshment Rooms shall be separate from other areas. These areas shall not lead directly to the manufacturing and storage areas
- Staff canteens shall be managed to ensure hygienic storage of ingredients and preparation, storage and serving of prepared foods.
- Employees' own food shall be stored and consumed in designated areas only away from Process & storage area. Tiffin's and personal belongings also shall not keep in Lockers. Note:

A display board mentioning' Dos' and 'Don'ts' for workers should be posted in a prominent place inside the premises, in English orlocal language, for all to understand. This will help all the employees to maintain their alertness on good hygiene practices.

4.6 Drains and Waste Disposal

- Adequate drainage and waste disposal systems and facilities shall be designed and constructed so that the risk of contaminating food or potable water supply is avoided. ii.
- Drains shall be designed to meet expected flow loads, constructed so as to prevent accumulation or back flow of waste water.
- Drains should be located so that they can be easily and effectively cleaned and inspected.
- All waste and other waste materials shall be removed from time to time from the places where food is handled, or processed or packed.
- A waste bin should be placed in all appropriate places with a proper cover and shall be emptied regularly. The design of the waste bin shall be such that no hand touch is required. This avoids cross contamination chances.
- They shall be washed daily with a disinfectant and dried before next use.
- Drains shall be equipped with appropriate traps to effectively capture contaminants.
- Wherever existing, scrap stores/yards are to be designed and managed in such a way as to enable them to be kept clean and free form animals and pests.
- Segregation of non-biodegradable waste like plastics /metals / glass materials, bags, containers should be done, before disposal.
- Waste disposal shall be done in accordance with specific requirements of the Factory Act / State Pollution Control Board requirements.

4.6.1 Area Classification for Cleanliness Introduction

- movement of material and methods, low to high
- High care area: The area where product/material is gets exposed, having controlled temperature, humidity and differential pressure .eg processing, primary processing area, filling, sampling, dispensing etc.
- Low care area: The area where product/ material is not exposed like, Washing area, secondary packing area, Warehouse. High care zone should be monitored for environmental conditions in respect to microbial loads.

II. ESTABLISHMENT - CONTROL OF OPERATIONS

1. Supplier Approval and Food receipt

- Supplier Quality Development Programme laying down the criteria for selection, approval, review and ongoing approval should be implemented.

- All raw material, process aids, ingredients consignments shall be procured from internally approved suppliers who are FSSAI/FDA/ Ayush licensed/ registered or licensed from other regulatory authorities.
- An approved supplier should be evaluated as per the quality supplied and other relevant factors.
- Raw materials received shall be according to the storage and processing capacity of the processing plant.
- All raw materials and ingredients, wherever applicable, shall conform to all Standards laid down under the relevant regulations.
- All raw materials, ingredients and packing material and process aids, wherever applicable, shall be inspected and sorted before processing.
- The manufacturer shall have procedures in place to confirm that the incoming materials meet the documented specifications through certificate of analysis, visual inspection, laboratory testing, review of label for allergens etc.
- Records of raw materials or ingredients or any other material used in processing as well their source of procurements shall be maintained for traceability.
- It is recommended to have food grade certificates for applicable food processing aids from suppliers.
- All bulk tankers/ containers receipt if any shall be checked for seal integrity / previous cargo / inspection checklist at the time of receipt.
- All packaged raw materials shall be checked for 'expiry date'/'best before'/'use by date', packaging integrity and storage conditions.
- The incoming vehicles that bring the raw materials, shall be checked for cleanliness and hygiene i.e. the trucks are clean, with no pests or dirt, with no strongodour other than that of the raw material.

2. Storage and Material Control

2.1 General

- The buildings, grounds fixtures and equipment of product storage areas and vehicles loading & unloading bays shall be designed, constructed, adapted and maintained to facilitate the operations carried out in them and to prevent damage.
- Raw materials, ingredients, packing material and finished goods shall be stored in clean, dry, well ventilated spaces protected from dust, condensation, fumes, odours or other sources of contamination.
- Materials and product shall be suitably stacked with due regard given to safety.
- Aisles should be kept clear and not used for temporary storage of materials.
- Receiving and dispatch bays shall be provided for receiving of material and dispatching of finished product from the storage areas. These shall be designed to protect materials and products from the weather. Receiving areas shall be equipped to allow containers of incoming materials to be cleaned where necessary.
- Adequate spacing should be maintained between pallets to ensure sufficient ventilation.

- Periodic visual checks should be made of all pallets, racks and other storage infrastructure, w.r.t structural integrity and infestations.
- There should be a separate sampling & dispensing area in the warehouse.
- Raw material and ingredients shall be stored as per the storage conditions mentioned on the label or as specified by the vendor. Printed packaging materials shall be stored in safe, separate and secured manner.
- All materials and product should be clearly marked with their relevant Identification/Lot Number, to maintain the traceability.
- The identification marking should be easily accessible/visible even when the material or product is stacked.
- Storage area temperatures shall be monitored.
- In case Fresh material of botanical origin is used as a raw material, it shall be stored in a separate dedicated area with appropriate controls.

2.2 Access to storage area

- Access to material and product storage areas should be restricted to those working in those areas and to other authorised persons.
- A suitable air curtain should be provided at all entrances and exits opening to the external environment, in order to maintain the internal conditions of the storage area at an appropriate level for the product therein. I
- When the storage area is connected directly to the manufacturing area, a buffer area/pass box/ air lock should be provided between the storage area and the manufacturing area.
- Insectocutors shall be installed in storage areasappropriately.

2.3Damaged, Rejected & Recalled Goods

- Damaged goods should be placed in a designated place physically segregated from Good stocks and properly labelled.
- Only products which have been properly inspected to ensure that the product and packaging are fully acceptable may be re-packed into outer packaging in a suitable area.
- If it is necessary to re-pack goods of different production codes into the same outerpackaging, the package should be marked with a date of minimum durability (Best Before date) that relates to the oldest packet in the case.
- Products which have been recalled or returned, and lots which have been rejected for re-working or recovery of materials or disposal should be so marked and physically segregated and identified.
- Records for such returned or recalled materials shall be properly maintained as per the FSSR recall regulation 2017.

2.4 Cleaning of Storage area

- Effective cleaning of storage premises and equipment must be carried out at the defined frequency and using the methods and materials specified in well-designed cleaning schedules and procedures.
- Cleaning standard operating procedures (SOPs) shall be defined and records demonstrating compliance shall be maintained.
- Storage areas should be regularly inspected for cleanliness and good housekeeping.
- Cleaning materials should be stored in a separate location in order to avoid contamination.

3. Food Packaging

- Packing area must be designed to ensure no external contamination and care must be taken to avoid product being directly exposed to the environment.
- Air-curtains, strip curtains, wire-mesh, partitions etc. must be in place to avoid any contamination.
- All personnel involved in packing must be vaccinated annually and records of the same must be maintained.
- All personnel involved in packing and handling of product must have protective covering.
- Recycling of packaging or product rejects must be done with prior approval from quality control department and with extreme care so as to avoid contamination.
- All "Industrial" packaged products must have details such as Lot No, FSSAI logo, Lic No., Veg logo, Ingredient name, for immediate identification in supply chain.
- Packages are usually tailored to fit the product and designed to last throughout its shelf life.
- Innovative packaging material can also help minimize insect invasion.
- Specifications for packing materials should be followed.
- It should protect the food, also be free from contamination, should not taint the food or impart off- flavours or off-odours to the product.
- Packing materials should be stored in a separate area which is dust free and pest proof

4. Finished Product Storage

- Finished product must be stored in clean area and not directly on the ground.
- It should be palletized, stored on pallets with a cardboard or plastic layer (slip sheet) to avoid splintering. Tarpaulins and/or pallets must be used as appropriate.
- Sampling and quality testing of the product must be carried-out in parallel to production.
- Approved, Rejected and under test product must be clearly segregated and stored.
- Quality testing and approval of the product is mandatory before despatch of the product. Records of the same must be maintained.
- The finished product should be stored in containers constructed of suitable materials, fitted with suitable close- fitting covers and kept in place at all times.
- Containers shall be designed to ensure proper cleaning and maintenance.
- Storage areas should be maintained in a dry, clean conditioned and in a well ventilated state.

- All materials should be stored off the floor on clean pallets and at least 20 cm from the wall in order to allow proper cleaning, pest control and ventilation.
- Prior to the release of the finished product, the finished product should be checked and approved by the quality assurance department. Records should be kept.
- Batches of finished product that has been approved by the quality assurance team should be stored in separate areas and under appropriate conditions Batches of finished product that doesn't meet the required specifications, should be quarantined, labelled clearly and held in a separate area to prevent accidental use.

5. Food transportation

- Ensure that transportation vehicles are dedicated for food products and there is no cross contamination from other non-food commodities.
- Each vehicle must be inspected before loading for infestation, spills, rodents, insects/pests as well as any vehicle damages or spillages.

6. Food traceability and food recall

- FOs shall have a traceability system for assigning codes or lot numbers to incoming materials, packaging materials and finished products, etc. This will help to identify products backward & forward complete traceability.
- FBO shall have a documented and effective product recall plan in place in accordance with the Food Safety & Standards Recall Regulations.
- Such a plan shall allow the FBO to effectively locate all affected food products that may cause a potential threat to public health and enable the complete, rapid recall of the implicated lot of the product from the market. Where a product has been recalled because of an immediate health hazard, other products which are produced under similar conditions which may also present a hazard to public health shall be evaluated for safety and may need to be recalled.
- Recalled products shall be held under supervision until they are destroyed, used for purposes other than human consumption, determined to be safe for human consumption, or reprocessed/reworked in a manner to ensure their safety.

7. Food testing

- Representative samples from material lots as well as finished product lots shall be tested for all quality parameters, residues, contaminants, toxins etc., at least once in six months.
- This can be either at an in-house lab or any external NABL accredited lab.
- Laboratory facilities on site should implement good laboratory practices, should have adequate space and should also have the appropriate equipment required for tests to be done. Access to laboratory areas should be restricted to authorized personnel only.

III. ESTABLISHMENT - MAINTENANCE AND SANITATION

1. Cleaning and Sanitation

1.1 Cleaning and sanitation

- Cleaning and sanitizing programmes shall be established at facility to ensure that the food-processing equipment and environment are maintained in a hygienic condition to prevent contamination of food, such as from metal shards, flaking plaster, food debris and chemicals and records of the same shall be maintained.
- The programme should ensure that all parts of the establishment are appropriately clean, and shall include the cleaning of cleaning equipment.
- Master sanitation schedule shall be maintained for overall facility through checklists which includes: - Areas, items of equipment and utensils to be cleaned; Responsibility for particular tasks; Cleaning method and frequency of cleaning; Monitoring arrangements for checking effectiveness of cleaning; Person responsible for cleaning; Persons responsible for monitoring & verification of effectiveness of cleaning; in case of any deviation what correction & corrective actions being taken; where ever chances of microbial risk with product air count & swab test being recommended.
- Cleaning and disinfection chemicals shall be food grade wherever chances of it may come in direct or indirect contact through equipment's or plant surfaces, handled and used carefully and in accordance with manufacturers' instructions.
- Cleaning shall remove food residues and dirt and it can be carried out by the separate or the combined use of physical methods, such as heat, scrubbing, turbulent flow and vacuum cleaning or other methods that avoid the use of water, and chemical methods using appropriate cleaning agents.
- These facilities should be constructed of corrosion resistant materials, be easy to clean and shall have adequate supply of hot and cold potable water, where appropriate.
- Cleaning procedure should generally involve –
    - ✓ Removing gross visible debris from surfaces.
    - ✓ Applying a detergent solution to loosen soil and bacterial film (cleaning)
    - ✓ Rinsing with water (hot water where possible) to remove loosened soil and residues of detergent.
    - ✓ Dry cleaning or other appropriate methods for removing and collecting residues and debris and
    - ✓ Where necessary, cleaning should be followed by disinfection with subsequent rinsing.

1.2 House keeping

- A housekeeping schedule covering manufacturing and storage areas shall be maintained.
- The surrounding areas including roads, parking lots and drains should be well maintained.

- Walls and floors should be maintained neat and clean. Ceilings and light fixtures should be easy to clean.
- Drains should be sufficiently sized and well sloped.
- Drains should have removable grates installed for ease of cleaning.
- Waste storage areas should be clearly marked and waste shall be disposed of in a timely manner.

2. Maintenance

- Maintenance workshops shall be separate and away from production areas. Whenever spares, changed parts and tools are stored in the production area, these shall be kept in dedicated rooms or lockers.
- Tools and spare parts, for the manufacture of products which are susceptible to microbial contamination, shall be disinfected before these are carried inside the production areas.
- Preventive maintenance of equipment and machinery shall be carried out regularly as per the instructions of the manufacturer.
- Temporary fixes that put product safety at risk shall be removed / permanently fixed in a timely manner.
- Lubricants, heat transfer fluids or any other similar material shall be food grade where there is no risk of direct or indirect contact with the product.
- Plant equipment's breakdown records shall be maintained.

3. Pest control System

3.1 General Requirements

- The organization shall have a nominated pest control technician to manage pest control activities and/or deal with external pest management agency.
- Pest control program shall identify target pests and address plans, methods, schedules and control procedures.
- Program shall include a list of chemicals which are approved for use in specified areas.
- Effective sanitation and Hygiene, inspection of incoming materials and monitoring can minimize pest infestation and thereby limit the need for pesticides.

3.2 Preventing access

- Buildings shall be kept in good condition to minimize pest activity and to eliminate potential breeding sites.
- Holes, drains and other places where pests are likely to gain access shall be sealed. ii. Windows, doors and ventilation openings shall be designed to minimize pest entry.

3.3 Monitoring and Detection

- The complete manufacturing plant and surrounding areas must be regularly examined for pest activity.
- Pest-monitoring program shall include the placing of detectors and/ or traps in key locations to identify pest activity.
- A map of detectors and traps shall be maintained. Detectors and traps shall be designed and located so as to prevent potential contamination of materials, products or facilities.

3.4 Eradication

- The pest control will be carried out with permissible chemical, physical or biological agents, within the appropriate limits.
- Records of pesticides/insecticides used shall be maintained to show the type, quantity and concentrations used; where, when and how applied, and the target pest.
- Incase of insect infestation area, appropriate fumigation should be done as per Plant quarantine Rules.

IV. ESTABLISHMENT- PERSONAL HYGIENE

1. Health of food handlers

- Food handlers suffering from, or to be a carrier of a disease or illness likely to be transmitted through food, shall not be allowed to enter into any food handling area.
- A system shall develop by Food Business Operators, whereby any person affected by illness or symptoms of illness shall report to the management and medical examination of a food handler shall be carried out apart from the periodic checkups, if clinically or epidemiologically indicated.
- A record of these examinations signed by a registered medical practitioner shall be maintained for inspection purpose.
- In food-handling areas, personnel with open cuts, wounds or burns shall be required to cover them with suitable water-proof dressings before starting operations.
- Any lost dressing must be reported to supervision immediately. The dressings should preferably be brightly coloured and metal detectable

2. Hygiene of food handlers

- Food handlers shall maintain a high degree of personal cleanliness.
- Food business shall provide to all food handlers adequate and suitable clean protective clothing, head covering, face musk, gloves and footwear and the food business shall ensure that the food handlers at work wear only clean protective clothes, head covering and footwear every day.

- Head-covers or caps, masks, gloves, shoe-covers (where product is directly touched) and such other hygiene measures must be in place as appropriate to ensure product contamination risk is avoided.
- Food handlers shall always wash their hands with soap and clean potable water, disinfect their hands and then dry with hand drier or clean cloth towel or disposable paper at the beginning of food handling activities immediately after handling raw food or any contaminated material, tools, equipment or work surface, where this could result in contamination of other food items or after using the toilet.
- Hand sanitizers must be placed at the entrance of production area.
- Toilets and canteen for employees must be away from production area. All toilets must be equipped with soaps or liquid detergents and provision for uninterrupted water supply.
- Food handlers engaged in food handling activities shall refrain from smoking, spitting, chewing, sneezing or coughing over any food whether protected or unprotected and eating in food preparation and food service areas.
- Food handlers should trim their nails and hair periodically, does not encourage or practice unhygienic habits while handling food.
- They shall not smoke, spit, eat or drink in areas or rooms where raw materials and food products are handled or stored; wash their hands at least each time work is resumed and whenever contamination of their hands has occurred; e.g. after coughing / sneezing, visiting toilet, using telephone, smoking etc.

3. Visitors

- Food Business Operator should implement and display visitor control policy.
- The Food Business shall ensure that visitors to its food manufacturing, cooking, preparation, storage or handling areas must wherever appropriate, wear protective clothing, footwear and adhere to the other personal hygiene provisions envisaged in this section.
- Visitors do & don'ts rules shall be displayed at prominent areas

V PRODUCT INFORMATION AND CONSUMER AWARENESS

1. Product information & labeling

- All packaged food products shall carry a label and requisite information as per provisions of Food Safety and Standards Act, 2006, Legal Metrology (Packaged Commodity Rules 2011) and Regulations made there under so as to ensure that adequate and accessible information is available to the each person in the food chain to enable them to handle, store, process, prepare and display the food products safely and correctly and that the lot or batch can be easily traced and recalled if necessary.
- The label shall provide information to enable the food handler to store, process, prepare and display the food products safely.
- The label shall enable easy traceability and recall if necessary.

2. Consumer awareness and complaint handling

- Information shall be presented to consumers in such a way so as to enable them to understand its importance and make informed choices.
- Information may be provided by labelling or other means, such as company websites, education programmes and advertisements, and may include storage, preparation and serving instructions applicable to the product.
- The Food Business shall have a system to handle product complaints with identified person or people responsible for receiving, evaluating, categorizing, investigating and addressing complaints.

VI. TRAINING

- All personnel shall be aware of their role and responsibility in protecting food from contamination or deterioration.
- Food handlers shall have the necessary knowledge and skills to enable them to handle food hygienically.
- Suitable trainings shall be given to all personnel handling food to enable them to have the required knowledge and skills in GHP and GMP for specific tasks along with personal hygiene requirements commensurate with their work activities, the nature of food, its handling, processing, preparation, packaging, storage, service and distribution.
- Cleaning operatives should be adequately trained so that they fully understand: the cleaning schedules; chemicals listed and safety precautions required; the need for protective clothing; the appropriate dilutions of cleaning agents; the personal hygiene standards expected of them as well as the use and care of cleaning equipment.
- Personnel employed to only fulfill a cleaning role, should be identified by either the use of different coloured protective clothing, design or colour of hat or by overall symbols.
- Proper hair restraints should be in place; only shirts without pockets should be allowed or in cases where shirts do have pockets, nothing in the shirt pocket should be allowed and no jewellery should be allowed.
- Periodic assessments of the effectiveness of training, instructions programmes as well as routine supervision and checks should be made to ensure that food hygiene and food safety procedures are being implemented correctly and effectively by all personnel.
- Managers and supervisors of food processes shall have the necessary knowledge and skills in food hygiene (GHP and GMP) principles and practices to be able to judge potential risks and take necessary action to remedy deficiencies.
- FBO management shall ensure providing necessary trainings & resources to their employees to develop food safety culture at plant site.
- FBO shall appoint trained & competent managers and supervisors for management and supervision of food safety systems.

VII. AUDIT, DOCUMENTATION AND RECORD

1. Self-evaluation and review

- The FBO shall conduct a self-evaluation process to review the effectiveness of the implemented food safety system at periodic intervals though internal and external audits or other mechanisms, but atleast once in a year.
- Necessary corrective actions based on self evaluation results shall be taken.
- FBO should also undertake a complete review of the systems including self-evaluation results, customer feedback, complaints, new technologies and regulatory updates at periodic intervals, but atleast once in a year for continual improvement.

2. Documentation and records

- Appropriate documentation & records of processing, production and distributions shall be maintained in a legible manner, retained in good condition for a period of one year or the shelf-life of the product, whichever is more.
- Suppliers should have effective pre-requisite programs in place and should be verified annually. Audits should be carried out on suppliers of raw materials.

HACCP

Implementing Hazard Analysis and Critical Control Point (HACCP) is crucial for any food manufacturing process. A HACCP plan covers the total supply chain, from inbound logistics, through storage, processing, sanitation and maintenance to the final use by the consumer. It is essential to carry out to identify the weakness of the production line and to suggest critical limits in compliance with legislation and therefore the preventive and corrective measures. Though HACCP system was designed to aim zero defect products, yet it is not feasible to achieve 100% defect free products. However, it sets a goal to minimize the associated risks during production and subsequently reduce unacceptable unsafe products. Table shows hazard analysis of chicory powder.

Table :- Hazard analysis for chicory powder (FSSAI, 2018)

Sr. No.	(1) Ingredient/ processing step	(2) Identify potential food safety hazards introduced, controlled, or enhanced at this step		(3) Do any potential food safety hazard require preventive control?		(4) Justify your decision for column 3	(5) What preventive control measure(s) can be applied to significantly minimize or prevent the food safety hazard?	(6) Is the preventive control applied at this step?	
				Yes	No			Yes	No
1.	Receipt of raw material	Biological	None	-	-	-	-	-	-
		Physical	Damaged container	-	No	a) physical verification is carried out for all incoming material during receipt. b) Material receipt checklist available	-	-	-
		Chemical	None	-	-	-	-	-	-
2.	Material storage	Biological	None	-	-	-	-	-	-
		Physical	None	-	-	-	-	-	-
		Chemical	None	-	-	-	-	-	-
3.	Weighing and dispensing of raw materials	Biological	Microbial contamination like *Staphylococ-us aureus, Salmonella*	-	No	a) environmental conditions are maintained to prevent growth of pathogens. b)dispensing is carried out under controlled environment (RLAF) c) material is being handled by using PPEs. d) Cleaning and sanitation procedure for area and dispensing tools is in place. e) line clearance procedure followed.	-	-	-
		Physical	Presence of foreign particles	-	No	a) material handling by using PPEs b) Use of RLAF c) cleaning and sanitation procedure for area and dispensing tools is in place. d) dispensing done by	-	-	-

						trained personnel. e) line clearance procedure followed.			
		Chemical	None	-	-	-	-	-	-
4.	Transfer of dispensed material to production	Biological	None	-	-	-	-	-	-
		Physical	None	-	-	-	-	-	-
		Chemical	None	-	-	-	-	-	-
5.	Charging of material	Biological	Microbialc ontaminati on like *Staphyloc oc-us aureus, Salmonell a*	-	No	a) working in controlled area. b) personnel hygiene practices followed. c) material is being handled by using PPEs. d) cleaning and sanitation procedure for area and equipment in place.	-	-	-
		Physical	Presence of foreign particles	-	No	a) material handling by using PPEs b) personal hygiene practice followed c) cleaning and sanitation procedure for area and equipment is in place.	-	-	-
		Chemical	Residue of cleaning agent and previous product	-	No	a) Visual check and line clearance procedure in place. b) procedure for cleaning and sanitation of equipment is in place.	-	-	-
6.	Blending	Biological	None	-	-	-	-	-	-
		Physical	Pieces of ceramic balls	Yes	-	Ceramic balls may break due to impact of balls on inner surface of ball mill.	Process control: subsequent sieving step	-	No
		Chemical	None	-	-	-	-	-	-
7.	Sieving	Biological	Microbial contamina tion like *Staphyloc*	-	No	a) working in controlled area. b) personnel hygiene practices followed.	-	-	-

			oc-us aureus, Salmonell a			c) material is being handled by using PPEs. d) cleaning and sanitation procedure for area and equipment is in place. e) cleaning of sieve and magnetic grill done.			
		Physical	Presence of foreign particles	Yes	-	a) sieving done through #80 mesh	Verification of sieve integrity before and after sieving	Yes CCP -1	-
						b) magnetic grill attached to sifter	Verification of magnetic grill before and after sieving	Yes CCP -2	-
		Chemical	Residue of cleaning agent	-	No	a) visual check and line clearance procedure in place. b) procedure for cleaning and sanitation of equipment is in place.	-	-	-
8.	Packaging	Biological	Microbial contamination like *Staphyloc oc-us aureus, Salmonell a*	-	No	a) working in controlled area. b) personnel hygiene practices followed. c) material is being handled by using PPEs. d) cleaning and sanitation procedure for area and equipment is in place.	-	-	-
		Physical	None	-	-	-	-	-	-
		Chemical	None	-	-	-	-	-	-
9.	Material storage	Biological	None	-	-	-	-	-	-
		Physical	None	-	-	-	-	-	-
		Chemical	None	-	-	-	-	-	-

Table – Food additives specified in FSSR (2011a) regulations

Product	Food additive	INS No.	Recommended maximum level	Note
Coffee, coffee /coffee substitutes, tea, herbal infusions, & other hot cereal & grain beverages, excluding cocoa	Acesulfame potassium	950	600 mg/kg	188, 160
	Acetic acid, glacial	260	GMP	160
	Acetic acid and fatty acid esters of glycerol	472a	GMP	160
	Acetylated distarch adipate	1422	GMP	160
	Acetylated distarch phosphate	1414	GMP	160
	Acid-treated starch	1401	GMP	160
	Alginic acid	400	GMP	160
	Agar	406	GMP	160
	Alkaline treated starch	1402	GMP	160
	Ascorbic acid	300	GMP	160
	Aspartame	951	600 mg/kg	160
	Benzoates Benzoic acid Sodium benzoate Potassium benzoate Calcium benzoate	 210 211 212 213	1,000 mg/kg	13
	Beeswax	901	GMP	108
	Bleached starch	1403	GMP	160
	Calcium carbonate	170(i)	GMP	160
	Calcium chloride	509	GMP	160
	Calcium lactate	327	GMP	160
	Candelilla wax	902	GMP	108
	Carbon dioxide	290	GMP	59, 160
	Caramel III – ammonia caramel	150c	10,000 mg/kg	7, 160
	Caramel IV-sulfite ammonia caramel	150d	10,000 mg/kg	7,127
	Carnauba wax	903	200 mg/kg	108
	Carob bean gum	410	GMP	160
	Carrageenan	407	GMP	160
	Citric acid	330	GMP	160
	Citric and fatty acid esters of glycerol	472c	GMP	160
	Dextrins, roasted starch	1400	GMP	90,160
	Diacetyltartaric and fatty acids esters of glycerol	472e	500mg/kg	142
	Dimethyl dicarbonate	242	250 mg/kg	18

	Distarch phosphate	1412	GMP	160
	Disodium 5'-guanylate	627	GMP	201
	Disodium 5'-inosinate	631	GMP	201
	Disodium 5'-Ribonucleotides	635	GMP	201
	Ethylene diamine tetraacetates	386	35 mg/kg	21
	Fumaric acid	297	GMP	160
	Gellan gum	418	GMP	160
	Glycerol	422	GMP	160
	Guar gum	412	GMP	160
	Gum Arabic (Acacia gum)	414	GMP	160
	Hydroxybenzoates, Para-		450 mg/kg	27,160
	Hydroxypropyl cellulose	463	GMP	160
	Hydroxypropyl distarch phosphate	1442	GMP	160
	Hydroxypropyl methyl cellulose	464	GMP	160
	Hydroxypropyl starch	1440	GMP	160
	Karaya gum	416	GMP	160
	Konjac flour	425	GMP	160
	Lactic and fatty acid esters of glycerol	472b	GMP	160
	Lecithins	322 (i), (ii)	GMP	160
	Magnesium carbonate	504 (i)	GMP	160
	Magnesium chloride	511	GMP	160
	Magnesium hydroxide	528	GMP	160
	Magnesium hydroxide carbonate	504(ii)	GMP	160
	Malic acid	296	GMP	160
	Methyl cellulose	461	GMP	160
	Methyl ethyl cellulose	465	GMP	160
	Microcrystalline cellulose (cellulose gel)	460 (i)	GMP	160
	Mono- and di- glycerides of fatty acids	471	GMP	160
	Monosodium L-glutamate	621	GMP	160
	Monostarch phosphate	1410	GMP	160
	Neotame	961	50 mg/kg	160
	Nitrogen	941	GMP	160, 59
	Oxidized starch	1404	GMP	160
	Phosphates Sodium aluminium phosphate, acidic Sodium aluminium phosphate, basic	 541 (i) 541 (ii)	 300 mg/kg	 33, 160
	Pectins	440	GMP	160

	Phosphated distarch phosphate	1413	GMP	160
	Potassium carbonate	501 (i)	GMP	160
	Potassium chloride	508	GMP	160
	Potassium dihydrogen citrate	332 (i)	GMP	160
	Powdered cellulose	460 (ii)	GMP	160
	Processed eucheuma seaweed	407a	GMP	160
	Pullulan	1204	GMP	160
	Saccharins Saccharin Calcium saccharin Potassium saccharin Sodium sachharin	 954 (i) 954 (ii) 954 (iii) 954 (iv)	200 mg/kg	160
	Sorbates Sorbic acid Sodium sorbate Potassium sorbate Calcium sorbate	 200 201 202 203	500 mg/kg	42,160
	Salts of myristic, palmitic and stearic acids with ammonia, calcium, potassium and sodium	470 (i)	GMP	160
	Salts of oleic acid with calcium, potassium and sodium	470 (ii)	GMP	160
	Shellac, bleached	904	GMP	108
	Sodium DL-malate	350 (ii)	GMP	160
	Silicon dioxide, amorphous	551	GMP	321
	Sodium acetate	262(i)	GMP	160
	Sodium alginate	401	GMP	160
	Sodium ascorbate	301	GMP	160
	Sodium carbonate	500 (i)	GMP	160
	Carboxylmethylcellulose	466	GMP	160
	Sodium dihydrogen citrate	331(i)	GMP	160
	Sodium fumarates	365	GMP	160
	Sodium gluconate	576	GMP	160
	Sodium hydrogen carbonate	500 (ii)	GMP	160
	Sodium lactate	325	GMP	160
	Starches, enzyme treated	1405	GMP	160
	Starch sodium octenyl succinate	1450	GMP	160
	Steviol glycosides	960	200 mg/kg	160.26
	Sucralose (Trichlorogalactosucrose)	955	300 mg/kg	160
	Sucroglycerides	474	1000 mg/kg	176
	Tara gum	417	GMP	160

	Tragacanth gum	413	GMP	160
	Tripotassium citrate	332(ii)	GMP	160
	Trisodium citrate	331 (iii)	GMP	160
	Xanthan gum	415	GMP	160

FSSAI Standards (FSSR, 2011a; FSSR, 2011b)

1. Chicory

- Roasted chicory powder
- With or without addition of edible oils & fats or sugar (such as glucose, sucrose) in proportion not exceeding 2.0 % by weight in aggregate.
- It shall be free from dirt, extraneous matter, artificial colours as well as flavours
- 500 gm of chicory sample should be sent to the food analyst for analysis.

STANDARDS

Total ash (on dry basis) m/m	not less than 3.5 % and not more than 8.0 %
Acid insoluble ash (on dry basis) m/m in diluted HCl	not more than 2.5 %
Aqueous extracts (on dry basis) m/m	not less than 55 %

2. Coffee-Chicory mixture

- Prepared by mixing roasted and ground coffee and roasted and ground chicory.
- It shall be in a sound, dry and dust free condition with no rancid flavour.
- It shall be in the form of a free flowing powder having the colour, taste and flavour characteristic of coffee - chicory powder.
- It shall be free from any impurities and shall not contain any other added substance.
- The coffee content in the mixture shall not be less than 51 per cent by mass.
- The percentage of coffee and chicory used shall be marked on the label as under

Coffee blended with Chicory
This mixture contains
Coffee…… Per cent
Chicory…….. Per cent

STANDARDS

Moisture	Not more than 5.0 per cent
Total ash on dry basis	Not more than 7.50 per cent.
Acid insoluble ash on dry basis	Not more than 0.6 per cent.
Caffeine content on dry basis	Not less than 0.6 per cent.
Aqueous extracts	Not more than 50 per cent.

3. Instant-coffee chicory mixture

- Product manufactured from roasted and ground coffee and roasted and ground chicory.
- It shall be in sound dry and dust free condition with no rancid or obnoxious flavour.
- It shall be in the form of a free flowing powder or shall be in the agglomerated (granules) form having the colour, taste and flavour characteristics of coffee chicory powder.
- It shall be free from any impurities and shall not contain any other added substance.
- The coffee content in the mixture shall not be less than 51 per cent by mass on dry basis.
- Quantity of instant-coffee chicory mixture sample should be sent to the food analyst for analysis should be 100 gms
- Percentage of coffee and chicory used shall be marked on the label as under

Instant Coffee-Chicory mixture made from
blends of coffee and chicory
Coffee…… Per cent
Chicory…….. Per cent

STANDARDS

Moisture	Not more than 4.0 per cent
Total ash on dry basis	Not more than 10.0 per cent.
Acid insoluble ash on dry basis	Not more than 0.6 per cent.
Caffeine (anhydrous) content on dry basis	Not less than 1.4 per cent.
Solubility in boiling	Dissolve readily in water (30 second) with moderate stirring
Solubility in cold at 16 ± 2ºC	Soluble in water (3 minutes) with moderate stirring

Note :- Chicory dried or roasted should not contain metal contaminants more than 30.0 and 4.0 parts per million by weight for copper and arsenic, respectively (FSSR, 2011c)