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RESEARCH PAPER

Sanitary and Phytosanitary measures for the export of Gherkins

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Abstract: Gherkins (*Cucumis sativus)*, the small, crunchy cucumbers renowned for their use in pickling and condiments, have emerged as a significant agricultural commodity in India. This study is based on secondary data collected from FAO and analysed using ratio analysis. The results reflect the regulatory standards designed toensuring food safety and consumer protection by specifying permissible levels for each category of food additive. Maximum levels often align with international standards or Codex Alimentarius guidelines to facilitate trade and ensure consistency in food safety regulations worldwide. Tin (Sn) is a metal that can be present in food due to various processing and packaging methods. The MRL of 250 mg/kg, calculated as Sn, indicates a threshold beyond which tin contamination in food is considered unacceptable. Lead is a toxic heavy metal that can contaminate food through environmental pollution, water, soil and food processing. MRL of lead in food is set at one mg/kg to protect consumers, particularly vulnerable populations such as infants and pregnant women, from the harmful effects of lead exposure. The Codex, set at 72, serves as a baseline for comparison across countries. Deviation from Codex values gives insight into how countries compare to the global average (Codex). For instance, the EU significantly surpasses the Codex benchmark with a deviation of 2.81. Conversely, Australia (58) falls below the Codex benchmark, with a deviation of 0.81, implying fewer AI entities relative to the global average. Using India as a reference point (1.00), Canada and the USA have a deviation of 1.04, suggesting a slightly higher number of AI entities compared to India. Malaysia, Brazil and Chile all show deviations close to 0.97, indicating a similar AI presence to that of India. The gherkins growers need to be educated on the pre-harvest interval of sprays, permissible maximum residue levels, judicious use of pesticides, insecticides and herbicides.

Key words: Additives, Active Ingredients (AI), Codex Alimentarius, Gherkins, Residue Limits, SPS Measures

Introduction

Gherkins (*Cucumis anguria)*, the small, crunchy cucumbers renowned for their use in pickling and condiments, have emerged as a significant agricultural commodity in India, particularly in the southern states of Karnataka, Tamil Nadu and Andhra Pradesh. This study delves into the intricate dynamics of gherkins production and export from India, aiming to provide a comprehensive analysis of this burgeoning sector within the country's agribusiness landscape.

India is one of the leading producers of gherkins globally, with the southern states contributing significantly to the country's total production. Gherkins production in India is supported by small to medium-sized farms, contract farming systems and processing units catering to international markets. Key export destinations include the European Union, the United States, Russia and Japan, where Indian gherkins are prized for their quality and competitive pricing. The export of gherkins plays a crucial role in India's agricultural economy, generating substantial revenue and employment opportunities, particularly in rural areas where gherkins cultivation is prevalent. The industry contributes significantly to foreign exchange earnings and supports the livelihoods of thousands of farmers and workers engaged in cultivation, harvesting, processing and export activities.

The cultivation of gherkins in India has grown substantially over the past three decades, driven by increasing global demand for pickled products and processed foods. Gherkins are valued for their distinctive taste, firm texture and suitability for pickling, making them a favored ingredient in a variety of culinary applications worldwide. The rise in popularity of international cuisines and the growing consumer preference for convenience foods have further fueled the demand for gherkins, positioning India as a key player in the global gherkins market. Gherkins aretypically grown as a cash crop by smallholder farmers in regions with favorable agro-climatic conditions. The cultivation process involves careful selection of seeds, proper soil preparation and precise irrigation techniques to ensure optimal growth and quality. Farmers often adopt integrated pest management (IPM) practices to mitigate pest and disease risks, minimizing chemical inputs and adhering to global food safety standards.

India is the largest producer and exporter of gherkins in the world; it accounts for 15 per cent of the total world production, 25 to 27 per cent of the global export share and earns about $ 223 million in the year 2020-21(Director General of Commercial Intelligence and Statistics, 2022). In India, about 90,000 marginal and small farmers are engaged in gherkins cultivation, hold 65,000 acres of land under gherkins production and more than 50 companies are involved in the processing and export of the produce. The country produced 2,17,521.42 metric tonnes of gherkins worth of ₹ 14,873 million in the year 2020-21(DGCIS). India emerged as the largest exporter of gherkins, with 1,23,846 metric tonnes valued at USD 114 million from April-October,

2021, while in 2021-22 exports exceeded USD 200 million (Agricultural and Processed Food Products Export Development Authority, 2022).

Karnataka has a reputation as a "horticultural state" in the entire country as it has made tremendous and versatile achievements in horticulture. Karnataka is the largest producer and exporter of gherkins from India. It produced 11,973 metric tonnes, which is about 60 per cent of the country's production in the area of 457 hectares of land during 2019-20. Karnataka contributes 90 per cent of the country's gherkins export (Department of Horticulture, GoK, 2021).

Objective of the study

To document the SPS measures for the export of gherkins to different destinations

Material and methods

The research is based on secondary data obtained from Food and Agricultural Organisation (FAO) database. The data pertaining to the SPS measures required for gherkin export from India to different destinations. The Maximum Residual Limits (MRL) for different residual contents like solubilizing and dispersing agents, firming agents, preservatives, colouring matters, thickening agents, acidifiers, flavourings and contaminants were collected from the FAO. Maximum Residual Limits (MRLs) for AI (Active Ingredients) in gherkins among various countries and regions, relative to the Codex Alimentarius standards were collected from FAO.

The analysis of deviation of number of active ingredients from codex and deviation from Indian standards ratio analysis was used (Kallummal and Gurung, 2020)

$$\text{Deviation of Codex} = \frac{\text{Number of Active ingredients}}{\text{Codex value}}$$

Results and discussion

Product definition

a. Prepared from clean, sound gherkins of cultivars conforming to the characteristics of *Cucumis sativus L.*

b. That may or may not be peeled and may or may not have seeds removed;

c. Packed with or without a suitable liquid packing medium and seasoning ingredients appropriate to the product; and

d. Is preserved in an appropriate manner before or after the container is closed–such preservation to include acidulation to a pH of 4.6 or less either by natural or controlled fermentation or addition of a vinegar or an edible acid and may also include heat pasteurization,refrigeration or a chemical preservative.

Types and kinds of pack

Fresh pack type: Prepared from fresh, uncured and unfermented cucumbers.

Cured type: Prepared from cucumbers which have been cured in salt brine or in other suitable curing solution with or without natural or controlled fermentation. Such salt stock may be sufficiently desalted, if necessary, during preparation for processing.

Styles

a. Whole - cucumbers with a maximum diameter of 54 mm. In containers larger than 4 litres, the cucumbers may have a maximum diameter of 65 mm. Whole cucumbers of this style may be designated as "gherkins" when they are not larger than 27 mm in diameter.

b. Whole curved - whole gherkins with a maximum diameter of 27 mm and curved at least 35°.

c. Halves - gherkins divided lengthwise into halves.

d. Finger cut, sliced lengthwise or spears - gherkins cut lengthwise into sections of approximately equal size.

e. Ring cut or chunks - gherkins cut at right angles to the longitudinal axis having a thickness from 2 to 4 mm and a maximum diameter of 27 mm.

f. Slices or cross cuts or chips - gherkins cut at right angles to the longitudinal axis.

g. Strips ("Asier") - large gherkins, peeled, divided lengthwise. The prepared halves are cut at right angle to the longitudinal direction into strips of approximately 10 mm width.

Permitted ingredients

Gherkins

Water

Vinegar

Salt (Sodium Chloride)

Vegetable Oils

Nutritive Carbohydrate Sweeteners

Paprika

Herbs

Spices

CondimentsVegetables(shall not exceed five per cent of the total weight of the product)

Quality criteria

Colour: The gherkins shall have normal colour characteristics typical of the variety, type of pack and style.

Texture: The gherkins shall be reasonably firm, crisp and practically free from shrivelled, soft and flabby units and reasonably free from very large seeds.

Flavour: The gherkins shall have a good flavour typical of the type of pack and in consideration of any characterizing flavouring or special ingredients used.

Size uniformity

a.Whole style: spears or sliced lengthwise: 80 per cent or more, by count, of the cucumbers shall meet the following requirements:

Length - the length of the longest unit shall not exceed that of the shortest unit by more than 50 percent.

Diameter - the diameter of the largest unit shall not exceed that of the smallest unit by more than 50 per cent.

These requirements do not apply to cucumbers packed in containers of over 4 litres.

b. Ring cut; slices; cross cuts: 80 per cent or more by weight of units having the most uniform size meet the following requirement for individual containers or sample units.

b. Diameter - the diameter of the largest unit shall not exceed that of the smallest unit by more than 50 per cent.

a) Curved gherkins - means whole gherkins that are curved at an angle of 35°.

b) Misshaped gherkins - means whole gherkins, nubbins and other deformed gherkins

c) Blemished - means affected to a degree that materially detracts from appearance and edibility by discolouration, scars, scratches, skin breaks or other similar imperfections.

d) Mechanical damage - means crushed or broken units.

e) Stem - means any stalk longer than 15 mm.

f) Poor texture - excessively shrivelled, very soft or flabby or units with very large seeds.

g) Off colour - units that vary markedly from the colour typical of the variety and type of pack.

h) Hollow centres - whole gherkins in which the internal cavity is large or ring cuts and slices in which a substantial portion of the centre is missing.

i) Grit, sand or silt - means any mineral impurities, whether in the liquid packing medium or imbedded in the skin or flesh of the gherkins that affect the edibility.

Mineral impurities

All styles and types, except for gherkins that are peeled not more than 0.08 per cent m/m.

Fill of container

Minimum fill (pickles plus packing medium)

The containers shall be well filled with gherkins and the product (including packing medium) shall occupy not less than 90 per cent of the water capacity of the container. The water capacity of the container is the volume of distilled water at 20°C which the sealed container will hold when the completely filled.

Minimum volume fill for whole and whole curved styles

The gherkins ingredient shall occupy not less than 55 per cent for cured type and 53 per cent for fresh pack type of the total capacity (volume) of the container.

Minimum volume fill for all styles except whole

The vegetable and fruit ingredient in styles other than whole shall occupy:

a. Not less than 55 per cent in the case of fresh pack;

b. Not less than 57 per cent in the case of cured, of the total capacity (volume) of the container

Maximum Residual Level (MRL) of food additives to export of gherkins

Maximum Residual Level (MRL) of food additives to export of gherkins were presented in Table 01.The table categorizes various food additives along with their maximum permissible levels in food products. Solubilizing and Dispersing Agents: Polysorbate 80, allowed up to 500 mg/kg either alone or in combination with other solubilizing agents like Xanthan Gum, Gum Arabic, Alginate (Calcium, Ammonium, Sodium, Potassium), Propylene Glycol Alginate and Carrageenan, Each of these substances is permitted under specific conditions and concentrations, likely reflecting their roles in enhancing texture, stability, or emulsification in food products. Firming Agents like Calcium Chloride, Lactate and Gluconate were allowed up to 250 mg/kg in various combinations. These agents are used to maintain or improve the firmness of food products, particularly in canned or preserved foods.

Table 1. Maximum Residual Level (MRL) of food additives to export of gherkins

Food additives	Maximum level
Solubilizing and dispersing agents	
Polysorbate 80 (polyoxyethylene 20 sorbitan monooleate)	500 mg/kg singly
or in combination	
Xanthan gum	
Gum Arabic	
Alginate (Ca, NH4, Na, K)	
Propylene glycol alginate	
Carrageenan	
Firming Agents	
Calcium chloride, lactate and gluconate	250 mg/kg singly or in combination
Preservatives	
Sulphur dioxide (as a carryover from raw product)	50 mg/kg
Benzoic acid and its sodium and potassium salts	1000 mg/kg singly or in combination
Potassium sorbate	
Coloring matters	
Riboflavin	300 mg/kg singly
or in combination	
Fast green FCF	
Chlorophyll copper complex	
Tartrazine	
Annatto extract	
Turmeric	
Sunset yellow FCF	
Beta-carotene	
Oleoresin of paprika	
Brilliant blue FCF	
Caramel, plain	
Caramel (ammonium sulphite treated)	
Thickening agents	
Guar gum	Limited by Good
Manufacturing Practices (GMP)	
Gum arabic	
Carob bean (Locust bean) gum	
Tamarind seed polysaccharide	
Acidifiers	
Acetic acid	Limited by GMP
Lactic acid	
Malic acid	
Citric acid	
Flavourings	
Natural and synthetic flavourings	Limited by GMP

Source: Food and Agriculture Organization

Preservative, Sulphur Dioxide was permitted up to 50 mg/kg, typically used to prevent microbial growth and oxidation in gherkins fruits. Benzoic Acid and its Salts, Potassium Sorbate were allowed up to 1000 mg/kg in combinations, serving as effective antimicrobial agents in acidic food products. Coloring matters like Riboflavin, Fast Green FCF, Chlorophyll Copper Complex, Tartrazine, Annatto Extract, Turmeric, Sunset Yellow FCF, Beta-Carotene, Oleoresin of Paprika, Brilliant Blue FCF and Caramel, each of these coloring agents has specific maximum limits depending on their usage and concentration needed to achieve desired coloration in food products.

Thickening Agents: Guar Gum, Gum Arabic, Carob Bean (Locust Bean) Gum and Tamarind Seed Polysaccharide were limited by Good Manufacturing Practices (GMP), ensuring their safe usage without specific maximum limits but under controlled conditions to maintain food texture and viscosity. Acidifiers like Acetic Acid, Lactic Acid, Malic Acid and Citric Acid were limited by GMP, allowing flexibility in usage to adjust acidity levels in food products while adhering to safety standards. Flavorings agents like Natural and Synthetic Flavorings were limited by GMP, ensuring that flavoring substances are used within safe limits to enhance taste profiles without overpowering or compromising food safety.

The result reflects regulatory standards aimed at ensuring food safety and consumer protection by specifying permissible levels for each category of food additive. Additives serve critical roles such as improving texture, enhancing flavor, extending shelf life or maintaining food quality during processing and storage. Maximum levels often align with international standards or Codex Alimentarius guidelines to facilitate trade and ensure consistency in food safety regulations worldwide. Transparent labeling of additives and adherence to maximum levels help consumers make informed choices about their food purchases based on health considerations and dietary preferences. The structured regulation of food additives, as detailed in the table, underscores the balance between innovation in food processing and ensuring consumer safety and confidence in food products globally. This regulatory framework supports both industry innovation and public health goals through transparent standards and limits on additive usage (Smitha and Murali, 2013).

Maximum Residual Level (MRL) of contaminants to export of gherkins

Maximum Residual Level (MRL) of contaminants to export of gherkins were presented in Table 02. The maximum levels of contaminants specified for Tin (Sn) and Lead (Pb) in food products are crucial regulatory measures aimed at ensuring food safety and protecting public health. Tin is a metal that can be present in food due to various processing and packaging methods. The maximum level of 250 mg/kg, calculated as Sn, indicates a threshold beyond which tin contamination in food is considered unacceptable (Murali *et al*.). Tin can leach into food from tin-plated cans or containers, especially acidic foods and its accumulation in the body over time can lead to adverse health effects. Regulatory bodies set this limit to prevent potential health risks associated with tin exposure, such as gastrointestinal disturbances and long-term toxicity. Food manufacturers and processors must adhere to stringent quality control measures to ensure compliance with these limits. This involves monitoring and testing food products throughout the production and packaging process to mitigate any risks of tin contamination. Additionally, proper selection and maintenance of packaging materials that minimize tin leaching into food are essential to meet these regulatory standards.

Table 2. Maximum Residual Level (MRL) of contaminantsto export of gherkins

Contaminants	Maximum level
Tin (Sn)	250 mg/kg, calculated as Sn
Lead (Pb)	1 mg/kg

Source: Food and Agriculture Organization

Lead is a toxic heavy metal that can contaminate food through environmental pollution, water, soil and food processing. The maximum allowable level of lead in food is set at 1 mg/kg to protect consumers, particularly vulnerable populations such as infants and pregnant women, from the harmful effects of lead exposure. Lead ingestion, even in small amounts over time, can cause neurological and developmental damage, especially in children. Food safety regulations globally aim to strictly enforce this limit to prevent lead poisoning and its associated health risks. Food processors and manufacturers must implement robust quality assurance and control measures to ensure that food products meet these stringent standards. This includes sourcing raw materials from uncontaminated sources, implementing effective cleaning and sanitation practices and regularly testing finished products for lead content.

Maximum Residual Limits (MRL) on Active Ingredients (AIs) to export of gherkins

The Table 03 presents a comparison of the Maximum Residue Limits (MRLs) for Active Ingredients (AI) set by various countries and regions compared to the Codex Alimentarius Commission (Codex) standards, with deviations noted from the Indian standards. The Codex Alimentarius Commission establishes international food standards to protect consumer health and ensure fair practices in the food trade. Its standards are considered a benchmark for safety and quality across different countries and regions.

The Codex, set at 72, serves as a baseline for comparison across countries. Canada and the USA both align precisely with this benchmark, indicating that they have exactly 72 AI entities each (Kallummal *et al*, 2018). Other countries like Japan (94), Chile (84) and the EU (202) exceed the Codex benchmark, suggesting a higher number of AI entities in these regions compared to the baseline. Deviation from Codex values gives insight into how countries compare to the global average (Codex). For instance, the EU significantly surpasses the Codex benchmark with a deviation of 2.81, indicating a strong presence of AI entities within its member states (Chandan and Nalin, 2018). Conversely, Australia (58) falls below the Codex benchmark, with a deviation of 0.81, implying fewer AI entities relative to the global average. Using India as a reference point

Table 3. Maximum Residual Level (MRL) on Active Ingredients to export of gherkins

Country	Number of Active Ingredients	Deviation from codex	Deviation from India
Codex	72	1.00	1.04
Brazil	67	0.93	0.97
Canada	72	1.00	1.04
EU	202	2.81	2.93
USA	110	1.53	1.59
Chile	84	1.17	1.22
India	69	0.96	1.00
Malaysia	67	0.93	0.97
Mexico	110	1.53	1.59
Japan	94	1.31	1.36
Australia	58	0.81	0.84

Note: Codex- International standard
Source: Food and Agriculture Organization

(1.00), the table also illustrates how other countries differ in terms of AI entity numbers compared to India. Canada and the USA have a deviation of 1.04, suggesting a slightly higher number of AI entities compared to India. Malaysia, Brazil and Chile all show deviations close to 0.97, indicating a similar AI presence to that of India (Boza and Munoz, 2017).

The result reveals significant disparities in the registration of active ingredients across different regions. The EU leads in absolute numbers, reflecting a robust regulatory framework and possibly a larger market for such substances. The USA and Mexico show a strong presence in active ingredient registration, aligning closely with each other and surpassing the global average (Codex). Countries like Malaysia, Brazil and Chile demonstrate moderate levels of active ingredient registration, suggesting ongoing development and regulatory alignment with global standards. Variations in active ingredient counts may reflect differences in national regulatory policies, agricultural practices, and pharmaceutical industries' priorities. The result underscores the diversity in regulatory environments and industrial capacities across countries concerning active ingredient registration. Understanding these variations is crucial for stakeholders in agriculture, pharmaceuticals and regulatory bodies to navigate international standards and market dynamics effectively.

Conclusion

Gherkins (*Cucumis anguria)*, the small, crunchy cucumbers renowned for their use in pickling and condiments, have emerged as a significant agricultural commodity in India, particularly in the southern states of Karnataka, Tamil Nadu and Andhra Pradesh. This study delves into the intricate dynamics of gherkins production and export from India, aiming to provide a comprehensive analysis of this burgeoning sector within the country's agribusiness landscape.

Gherkins is a high-value, export-oriented crop. Compliance with stringent sanitary and phytosanitary measures is essential to meet the requirements of importing countries. Developed countries often use stricter Maximum Residual Limit (MRL) as non-tariff barrier with setting the more number of active ingredient limits above the codex standard and developing countries were set there limit less than the codex standard. To fulfill the requirement of SPS measures and Maximum Residual Limits (MRL), the gherkins growers need to be educated on the pre-harvest interval of sprays, permissible maximum residue levels, judicious use of pesticides, insecticides and herbicides. Chemical testing laboratories need to be established at processing unit level.

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