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Technical Challenges and Opportunities in Export of Food from India: Food Regulatory Compliance and Future Prospects to Prevent Food Frauds using Analytical Techniques

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Abstract: Food safety is the most burning issue for current trade scenario, recently global food safety issues like presence of Ethylene oxide in spices and other food items is being considered as major food safety concern for food exports from India. Earlier, there was a food safety issue on presence of formaldehyde in fish and fishery products which was raised by European Union. Similarly food safety issue related to melamine in infant milk had been raised by China government. In this connection, time to time directives and food laws & regulation has been passed by Indian government as well as other importing country authorities, but still number of Rapid Alert System for Food and Feed (RASFF) has been increasing. There is an increasing trend towards exports from India, however many developed countries as well as developing countries have doubts for food frauds and food safety from food which they are importing from India. Indian Government is now more focused for exporting safe and quality food across globe and is in process to implement food law strictly and fulfil the global food safety requirements. Exporter have to be ready to face technical challenges and have to follow serious compliance because importing countries have more concern for providing safe food rather than importing low cost food in view of food security of their nation. Since India has plenty of land for agriculture and is growing different food including sea food and aquaculture, there is ample opportunity to export quality food at best prices as there is high demand of Indian food and food additives globally. India is growing seasonal grains, vegetables and other food items excessively as per demand and sometimes farmers destroy their crops or sell it at unviable prices because of glut in production however if these commodities are planned for export they will give better returns to for farmers and enhance economy of our country. Modern instrumental and analytical techniques play an important role for prevention of food fraud and provide safe and good quality food which has resulted in benefits not only in export and import of food and food additives but also achieving compliance to food security for nation.

Current article highlight major problems face by exporter as well as importer to export and import safe food from India and their solutions. This article also provides comprehensive studies on food frauds and their detection by modern instrumental techniques with their limitations. Aim of this article is to highlight current challenges to provide safe food and their possible solutions.

Keywords: Food safety, Technical Challenges, Food Fraud, RASFF, Food Security

I. INTRODUCTION

India is second largest food producer over the world and it is expected that it will be largest food producer in future by continuous development of food sector in future. India is largest exported of rice, spices and sea food globally. At present India has transformed from highly deficit country in decade of 1960-1970 to marginally surplus food at present. The food system in India will face various challenges if exporters have a vision for 2030 and beyond, such as the increasing pressure on natural resources (soils, water, air, and forests) and frequent climate change. India has to plan with joint policies from subsidy driven to investment driven and from price policy to income policy approach, policies should focus on encouragement to agricultural heterogeneity towards growing more nutritious food (1)

Over the years, India's growth has been steady, with a substantial portion of its exports heading to the United States, Europe, and Southeast Asia. There are good opportunities for export of food items in the near future, but India is facing many technical difficulties or challenges. Importing countries are implementing stricter regulation with more stringent limits for residue contaminants. India's exports grew by 6.03% in 2022-23with a value of USD 447.46 billion, reaching

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a record high. The expansion of exports of high-value goods and a greater emphasis on the export of services fuelled this expansion. India's growing population, skilled workforce, and improved infrastructure will drive exports in the coming years. In order to increase exports, the government is providing incentives to exporters and improving their ease of doing business. (2,3). Agriculture trade i.e. export and import data of last 10 years is depicted in Figure-01, which shows that after covid-19 pandemic, export of agriculture commodity from India is continuously increasing. Top agricultural products exported in the last three years are depicted in figure-02. Major exported product is marine product, second major exported product is rice and these commodities are continuously in high demand.

II. MAJOR TECHNICAL AND OTHER CHALLENGES FOR EXPORT FROM INDIA

1. Lack of Market Information

Many suppliers and exporters enter this industry or business without a thorough understanding of the marketplace. Some of the biggest issues confronting exporters in India are the lack of accurate, up-to-date market data

2. Supply Chain Disruptions

Exporters have faced a lot of challenges in recent years due to supply chain disruption. It's tough for exporters to get their goods to international markets on time because of the vulnerability in global supply chains created by the COVID-19 epidemic

3. Trade Barriers and Tariffs

Another major problem for exporters is trade barriers and tariffs. Countries engage in trade disputes, which cause exporters to face additional costs and uncertainties. It can be difficult for businesses, especially smaller ones with limited resources for legal and compliance matters, to navigate complex trade regulations and tariffs.

The currency swings are a constant obstacle for exporters. Exchange rates can affect the competitiveness of goods on international markets and the viability of export deals. Improving the impact of trade barriers and tariffs requires risk management strategies (4)

4. Currency fluctuations

Exporters are also confronted with challenges such as utilizing forward contracts or diversifying their currency exposure.

5. Document Complexity

Numerous rules are enforced for exporters, including restrictions on imports, customs paperwork, and product specifications. These rules are subject to change and vary greatly from country to country. For businesses entering new markets, compliance requirements can be time-consuming and costly(6,9)

6. Economic Uncertainty

Economic uncertainty can make it tough for exporters to plan and invest. Inflation, interest rates, and economic uncertainty can affect consumer demand and the business climate in export destinations.(5)

7. Intellectual Property Concerns

Exporters need to make sure they protect their intellectual property rights, especially in technology, medicine, and other important industries. Some markets have big concerns about intellectual property theft and infringement.(10,13)

8. Governmental Restraints

Another important issue that Indian exporters may encounter is the constantly evolving regulations and restrictions imposed by the government. For example, the government recently imposed export restrictions on wheat and flour, for example. Exporters may face even greater challenges due to extraordinary bans and restrictions brought on by licenses, customs, quotas and other formalities(8)

9. E-commerce and Digital Transformation

The digital transformation of business procedures and e-commerce growth has presented both opportunities and obstacles to exporters. Online platforms like EximPedia.app offer global reach, but they also offer useful market data, like export statistics, to help exporter to expand your business internationally (7).

10. Nationalism on Products

The flu epidemic prompted countries to prioritize self-care, which can result in restrictions on exporting certain products. If there is a shortage at home, countries might keep vaccines for their citizens or limit exports of essential items like rice.

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11. Uncertain Demand
When conflicts or piracy cause disruptions, the demand for goods can vary greatly. For instance, during times of stressed situation between nations, it is possible for oil prices to rise, leading to an increase in the cost of exports.

12. Climate Concerns
Climate change and trade are closely linked. Changes in trade patterns may be triggered by changes in climate, which may alter the comparative advantages across countries. Changes in land-use may be explained by trade itself, moving excesses of agri-food supply to regions with shortages (11).

13. Regulations and compliance
Exporters in India are required to adhere to numerous regulations and guidelines. This includes the compliance with various laws and regulations, such as customs, foreign trade policy, and export-import management (12).

14. Other Problems –
Apart from the major issues mentioned here, there are several other miscellaneous problems also faced by exporters in India:
a. Packaging and Product Standards
b. Lack of Global Trade Data
c. Weather and Climate while Shipping
d. Less Technological Development
e. Low labour Productivity

III. OPPORTUNITIES IN EXPORT OF FOOD FROM INDIA

Despite the existence of diverse challenges, there are ample opportunities for exporters. Businesses can overcome obstacles by being flexible, exploring new markets, and keeping up with technology. This will help them overcome obstacles and find success in the year to the Atamnirbhar Bharat initiative in India and the Belt and Road initiative in China are two examples (13, 14)

Diversification for Revenue Growth:
Novel revenue streams can be created by leveraging the demand for Smart TVs to provide OTT platforms and data consumption services (51)

Facilitating Business Operations:
Countries are streamlining logistics and regulations to attract businesses, creating an environment where only the most adaptable thrive. The Atamnirbhar Bharat initiative in India and the Belt and Road initiative in China are two examples (13, 14).

Expanding Business Horizons:
Businesses can expand their operations beyond borders thanks to incentives offered by countries, like India's $10 billion PIL scheme for semiconductor manufacturing.

Renewable Energy Focus:
The global shift towards sustainable power opens up a lucrative avenue for suppliers. Supplying equipment and technology to this expanding sector presents numerous opportunities (54)

Capitalizing on Consumer Trends:
The increasing demand for eco-friendly products can open up new avenues for export business.

Digital Transformation:
Leveraging digital platforms and technologies to facilitate international trade can streamline processes and enhance market reach (49)

Strategic Partnerships:
Access to distribution networks can be facilitated by collaboration with local businesses and stakeholders.

Quality Assurance
It is possible to build trust and reputation by ensuring high-quality standards in products and services which are being offered (50)

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Market Research: Strategic decision-making requires thorough market research to identify emerging trends, consumer preferences and competitive landscapes

Government Support

Promoting exports and international trade can be bolstered by government initiatives and assistance programs.

There are both opportunities and challenges in the world of export business. Exporters must stay adaptable and strategic in order to thrive, from navigating volatile market demand to capitalizing on emerging trends like renewable energy. There's plenty of room for growth by embracing digital transformation, building strategic alliances, and keeping an eye on market changes, even though uncertain geopolitical tensions and changing consumer preferences are looming (15, 16).

Exporters can solve these problems by using resources, researching the market, and asking for help from the government. Businesses can make the most of the opportunities in 2024 by being determined, flexible, and creative. They can become stronger and more resilient than ever before (17). Agriculture export zones in India shown in figure-03.

IV. EXPORT OPPORTUNITIES FOR INDIAN FOOD PROCESSING INDUSTRIES

Processed Food products (Proprietary Food)

Changes in food preferences and busy lifestyles are driving the global market for ready-to-eat foods. A range of ready to eat foods such as frozen foods, snacks, and convenience meals can be produced by the Indian food processing industries. These products can be exported to various countries depending on the tastes and preferences of global consumers (18)

Spices and Condiments

India is known as land of spices and high-quality spices and condiments are produced hee. Global demand for agricultural and processed food items is increasing, especially in the Middle East, the United States, and Europe. Spice blends, curry powders, and masala can be produced by the Indian food processing industry to expand its agricultural exports(18).

Dairy Products

It's possible for India to expand its exports of dairy products, like milk powder, cheese, and butter, since it's the world's largest milk producer. This sector can take advantage of the growing demand for premium dairy products worldwide, particularly in Asia, the Middle East, and Africa (19).

Fruits and vegetables

India has ample opportunity for export of fruit and vegetables and their products like frozen fruits, dried and dehydrated vegetables and seasonal fruits which are cultivated in India like banana, mangoes, papaya etc. Since India is dominating in production of fruit and vegetable, these products can be exported and promoted as healthy alternative of processed foods (19).

Confectionery and bakery products

There is a growing demand all over the world for confectionery and bakery products. High-quality ingredients can be used to create these goods, which can be tailored to meet the preferences and tastes of global consumers. Opportunities in specialized areas like organic and gluten-free goods can be explored by this sector (17, 20).

Details of commodity for export purpose and opportunity with requirements is depicted in Table-4

Table:4 Export opportunities for Indian Industries

S. No	Commodity for Export	Product / items	Opportunity	Regulatory Requirements	Potential Profitability
1	Spices and Condiments	Food	Global	Adherence to food safety standards	High
2	Tea and Coffee	Beverages	Global	Compliance with quality standards	High
3	Rice	Grains	Global	Quality control and certifications	Moderate to High

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4	Garments and Textiles	Apparel	International Fashion	Compliance with textile standards	Moderate to High
5	Jewellery	Fashion	Global Luxury Market	Quality and authenticity assurance	High
6	Ayurvedic and Herbal Products	Health and Wellness	Global	Compliance with health regulations	Moderate to High
7	Leather Goods	Fashion	Global	Compliance with quality standards	Moderate to High
8	Handicrafts	Art and Crafts	Global Decor Market	Unique designs and craftsmanship	Moderate to High
9	Processed Food Items	Food	Global	Packaging and labelling regulations	Moderate to High
10	Fruits and Vegetables	Food	Global	Adherence to agricultural standards	Moderate to High
11	Engineering Goods	Machinery	Global	Compliance with technical standards	Moderate to High
12	Pharmaceuticals	Healthcare	Global Pharmacy Market	Strict adherence to quality norms	High
13	Automobile Parts	Automotive	Global Automotive Market	Quality and safety certifications	Moderate to High
14	IT and Software Services	Technology	Global IT Market	Adherence to data protection laws	High
15	Organic Products	Food	Global Organic Market	Certification for organic standards	Moderate to High
16	Cotton and Yarn	Textiles	Global Textile Market	Quality control and certifications	Moderate to High
17	Granite and Marble	Construction	Global Construction Market	Compliance with industry standards	Moderate to High
18	Electronics and Electrical Goods	Electronics	Global Electronics Market	Compliance with technical standards	Moderate to High
19	Seafood	Food	Global	Adherence to seafood quality standards	Moderate to High
20	Teak and Wooden Furniture	Furniture	Global Furniture Market	Compliance with quality standards	Moderate to High

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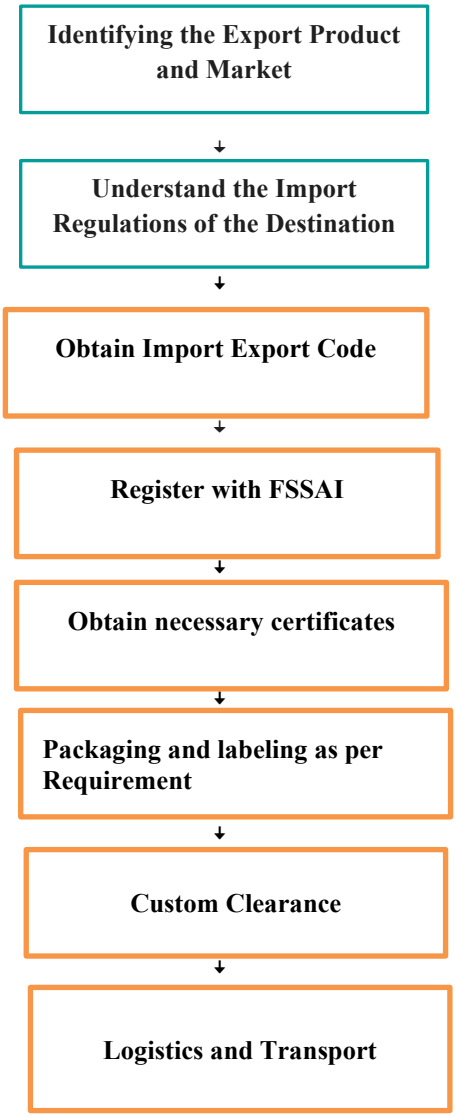
V. STEPS INVOLVED EXPORTING FOOD PRODUCTS FROM INDIA



Obtain Import Export Code

The first step in exporting food from India is to get an 10 digit Import Export Code (IEC) from the Directorate General of Foreign Trade (DGFT) To get an IEC code, the food industry needs to fill out a form, bring the documents they need, and pay a fee (21).

Register with FSSAI

Exporting industries must have to obtain a licence from the FSSAI (Food safety and standards authority of India) as food business operator. This licence can be obtained by online application as well as offline application. Many small importing countries accept food products only as per compliance of FSSAI (52,53).

Identifying the Export Product and Market

Identification of the product to be exported and the market is crucial for the food processing industry before attempting to export Indian food. Exporter should conduct market analysis to discover the need for the product in the intended market, the rivalry, the selling prices, and also should adhere to legal guidelines. Along with this, ensuring profitability in fruit and vegetable exports, requires the food processing industry to examine the production and distribution expenses also (19,22).

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Understand the Import Regulations of the Destination Country

It is imperative to comprehend the import regulations of the destination country in order to commence the exportation of food products from India and also comply with each country's regulations and standards regarding food imports in order to avoid any legal issues. The exporter ought to conduct a thorough investigation of the import regulations of the destination nation and ensure that their food products conform to the prescribed standards (17,19).

Obtain Necessary Certifications

Certifications from various regulatory bodies are required for the industry to export Indian agricultural and processed foods. Different products and markets may require different certifications. Some of the most common certifications required are Phyto Sanitary certificate, Health certificate, Halal certificate and Kosher certificate (23)

Packaging and Labelling

The food industry must ensure that the packaging and labelling of goods comply with the governing laws of the country of origin. Name and address of the producer, ingredients, net weight, production date, and dietary data should be on the label. Fruit and vegetable exports need to reach their destination in good shape and therefore because the food packaging needs to be sturdy and suitable for transportation (21).

Logistics and Transportation

To ensure timely delivery and minimize costs, the food processing industry should carefully plan logistics and transportation of products. It is recommended that they select a dependable logistics partner who possesses expertise in agricultural exports and adheres to the legal regulations of the importing nation. It is essential that perishable items are transported in temperature-controlled containers (24).

Custom Clearance

The goods have to clear the customs of the country they came from. In order to avoid delays and penalties, the food processing industry should ensure that all the required documents, certifications, and licences are in order. The legal guidelines of the country importing the product should be followed for agricultural exports, such as labelling and packaging specifications (25, 26).

Licence, registration and certification (Food Regulatory Compliances) required to

Food Safety and Standards Authority of India (FSSAI) Licence

FSSAI is the regulatory body that oversees food safety and hygiene in India. All food businesses in India must have a FSSAI licence, even if they're shipping food. The FSSAI certificate guarantees that the food items adhere to the stipulated safety guidelines and are suitable for consumption. Depending on the type of licence, its validity is for one to five years (27).

Export Import (EXIM) Registration

Businesses that engage in import and export activities are required to register themselves for the Export Import (EXIM) registration. The registration is issued by the Directorate General of Foreign Trade (DGFT) and must be renewed every year. The EXIM registration assists in tracking the business's export and import activities and ensures compliance with the rules and laws (20,22).

Importer-Exporter Code (IEC) Registration

Businesses involved in agricultural and processed food export activities must register under the Importer-Exporter Code. The DGFT issues the IEC registration, which is necessary for the goods' customs clearance. A ten-digit number is used for the IEC registration (29)

Halal Certification

Food products intended for consumption by Muslim consumers must have a Halal certification. Food products prepared and packaged according to Islamic dietary laws are guaranteed for the quality by the Halal certification. A thorough inspection of the entire manufacturing process is required for the certification to be issued (28).

Organic Certification:

Food products that are produced using organic methods require certification. Organic certification ensures that food products are free of chemical fertilisers, pesticides, and other harmful substances. The National Program for Organic Production or a third-party certification agency accredited by the Agricultural and Processed Food Products Export Development Authority (APEDA) is authorised to issue organic certificate (22).

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Certificate of Origin

The authenticity of organic products is bolstered by India's organic certification. Farmers or organizations practicing organic farming need to have organic certification. In India, North America, and the European Union, Indian organic certified products are accepted. A premium price for the produce is achieved by the certification, which serves as an assurance of credibility (30).

Health Certificate

The Government of India has a policy for importing and exporting goods. They test them for microbes and other things, and they need to have a Health Certificate with them. d a Health Certificate is essential during export or import things for the following reasons (46):

a. A health certificate that shows that the Government of the exporting country has looked at this particular goods consignment.

b. This certificate says that food from animals or plants that can be exported is safe for people to eat.

c. The health certificate is evidence that the food was made according to the food legislation.

d. This document shows that the food was made by a legitimate company.

VI. FOOD FRAUDS AND FUTURE PROSPECTS TO PREVENT FOOD FRAUDS BY ANALYTICAL TECHNIQUES FOOD FRAUDS

Food fraud is the deception of consumers through intentional adulteration of food e.g., by substituting one product for another; by using unapproved enhancements or additives; misrepresenting something (e.g., country of origin); by misbranding or counterfeiting; and or by stolen food shipments and/or intentional contamination with a variety of chemicals, biological agents or other substances harmful to private– or public–health. The process of food fraud is usually characterized by an action (generally deception using food, otherwise, to rob consumers' wallets), a motivation (mainly for economic gain provoked by greed or gain), and there is always an effect (typically economic and consumers' health vulnerability or threat). Food fraud is more likely to occur when there is an opportunity such as no control measures, weak internal control systems, and little fear of exposure and or likelihood of detection. Types of food frauds are as below:

Table02: Types of Food Frauds

S. No.	Type of food fraud	Remarks
1	Substitution or adulteration	Substituting a high-value ingredient or component of a product with one of lesser value can occur, including instances during the growth of plants or animals, such as the artificial feeding of bees during periods of nectar availability. This practice may involve the deceptive introduction of non-genuine substances or the unauthorized removal or replacement of genuine components without the knowledge of the buyer.
2	Dilution	Mixing a high-value liquid component with a lower-value liquid component.
3	Masking or Mislabelling	Making false claims on packaging for money (hiding or tampering with information about where something came from)
4	Unapproved enhancement	To add ingredients in food products that are not disclosed in order to improve their quality.
5	Concealment	Hiding the low quality of food ingredients or product
6	Counterfeiting	Stealing food product trademarks, concepts for packaging, recipes, manufacturing processes, etc. in order to make money
7	Grey market production (overruns, theft or diversion)	Sale of excess unreported product

Application of Chromatography and spectroscopy techniques in food fraud analysis

Chromatography and spectroscopy play a crucial role in authenticating and detecting food fraud and adulteration by identifying contaminants, pesticides, and harmful substances, ensuring food security. They also provide insights into the metabolic pathways and interactions of bioactive compounds within biological systems. (31,45).

Review revealed that food fraud detection methods are often coerced to one or more detection strategies. Recent analytical techniques can be used to avoid food fraud, and the exporter should be prepared to adopt International

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Standards and focus on recent trends and updates in importing country markets. Future research is necessary for authoritative and augmented benefits in food fraud detection.

Table 03: Analytical techniques used for detection of adulteration and identification of Food Frauds

S. No.	Chromatographic Methods	Role in Food fraud Identification	Advantages	Limitations
1	Liquid chromatography–mass spectrometry (LC–MS [32,33]	For detecting adulteration and mycotoxin residue in several food items, including vegetables, fruits, seafood, edible oils, and meat products	High sensitivity and specificity for detecting adulteration in several food items	Need a skill operator , high operation cost, high amount of solvent used,
2	Thin Layer Chromatography (TLC) [49]	Suitable for detection of adulteration related to food safety in edible oil and foods items	Low cost equipment , easy operation, versatile uses , rapid separation	Volatile compound cannot separated, corrosive solvent also used
3	Column Chromatography[50,51]	For detection of ingredients and minor / major components in foods	Different types of mixture can be separated, mobile phase can be chosen as per application	High amount of solvent used, long separation time, not suitable for volatile compound
4	Gas Liquid Chromatography [52,53]	For detection of composition of oil and trans fat content in food	Separation based on boiling point of component , suitable for both qualitative and quantitative analysis , low cost equipment	Inert gases used, not fit for PPM level analysis, non-volatile compound cannot separated, and detection is relative to standards.
5	Electrophoretic techniques[34,36]	Suitable for fraud detection in milk and milk products	It has a high efficiency of separation. It provides sample analysis in a short period of time. It produces fewer waste products. It is a simple strategy to use. The experiment can be performed with a small amount of sample.	During electrophoresis, gels can melt, the buffer can run out, and various genetic materials can run in unanticipated manners. Heat is dissipated by the capillary tube's narrow diameter, resulting in greater diffusion. As a result, the resolution is not always accurate.
6	Polymerase chain reaction (PCR)[35,47]	To find adulteration in a wide range of foods, including dairy goods, meat products, marine products, spices, oils, and nutritional supplements	• Highly specific: PCR can distinguish DNA sequences by just one nucleotide, making it a very accurate technique. • Sensitive: PCR is a very useful technique when the amount of DNA sample is limited because it allows the detection of even a single copy of a specific DNA	• . Contamination: The PCR technique is very susceptible to contamination from other sources of DNA or RNA or the environment. This can mislead data

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			template. • Versatile: The PCR technique can be used for various applications like genetic testing, criminal investigations, and paternity tests. • Rapid and efficient: PCR can efficiently and rapidly amplify a small amount of DNA sample to million copies in just a few hours.	interpretation. • Cost and complexity: PCR can be expensive and requires expert knowledge for high-throughput projects. • Lack of novel information: Since PCR can only amplify and target specific DNA sequences targeted by the primers, PCR provides limited information and cannot detect novel DNA sequences. • Inhibition from sample content: The whole PCR cycle can be disrupted by inhibitors that co-purify with DNA, such as heme from blood samples, reducing the sensitivity of the process. • 5. Errors in amplification: alterations in DNA sequences can lead to inaccurate amplification and hence, false results.
7.	E-nose and e-tongue for food fraud detection [37]	To evaluate the quality of a wide range of food items, including edible oils, honey, milk products, beverages, and more	Compact device , High portability, High Reliability, High Versatility	High Cost, long time between successive test, insensibility to some spices
8.	Electrical impedance spectroscopy (EIS) [38,39]	Used to find adulteration in a variety of food items, such as honey, meat, fruits and vegetables and milk	EIS is a cheap and fast way to find out if food has been adulterated. Possible for on-board implementation.	Accuracy depend on different factors, complex computation, not – universal
9.	Raman spectroscopy (RS) [29, 41]	To detect the adulteration of honey	This method works with both liquid and solid materials	Cannot be used for metals or alloys.

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		with different types of sugar	without much preparation, This method works with both liquid and solid materials without much preparation, This method works with both liquid and solid materials without much preparation	The detection needs a sensitive and highly optimized instrumentation. Fluorescence of impurities or of the sample itself can hide the Raman spectrum. Some compounds fluoresce when irradiated by the laser beam.Sample heating through the intense laser radiation can destroy the sample or cover the Raman spectrum.
10.	NMR spectroscopy [43]	To evaluate the quality of food and has a lot of promise for analysing the biological and physical characteristics of food ingredients	A wide range of food substances is evaluated qualitatively by NMR, Online food quality assessment systems may also incorporate it, NMR is a fast way to evaluate the quality of food and has a lot of promise for analysing the biological and physical characteristics of food ingredients, it helps retain liquid or solid samples for future studies	Increasing the sensitivity and detection limit is still necessary for reliable results. The high price of the equipment also prevents its use as a large-scale detection strategy, NMR spectroscopy does not support the analysis of higher molecular weight molecules because of the complexity and difficulty in interpreting the spectra Only nuclei with magnetic moments can be analysed.
11	gas chromatography and mass spectroscopy (GC-MS) [44,48]	Food quality can be assessed in terms of aroma, freshness, physical appearance, taste, color and pesticides content	GC-MS technique can be used to detect and monitor different parameters of food quality as well as food adulteration, highly sensitive technique that can detect analytes in trace amounts, highly accurate technique that can provide precise quantitative results, can be used to analyse a wide range of compounds, including volatile and semi-volatile organic compounds, inorganic ions, and biomolecules	Requires a clean and pure sample for accurate results, Analytes must be volatile or semi-volatile, which limits its applications for non-volatile compounds., Expensive and requires specialized training to operate and maintain the equipment.
12	Fourier transform infrared (FTIR) [40,42]	Used in different areas for detection of adulteration in food,	Rapid and reliable techniques employed in ensuring food quality, pivotal tool for	Difficulty in identifying complex samples, Limited to

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		for molecules purity in pharmaceutical sector	studying the adulteration of food and other biological matrices, provides useful information related to secondary structure of the metabolites, degree of unsaturation	identifying functional groups, challenging to identify all the components accurately

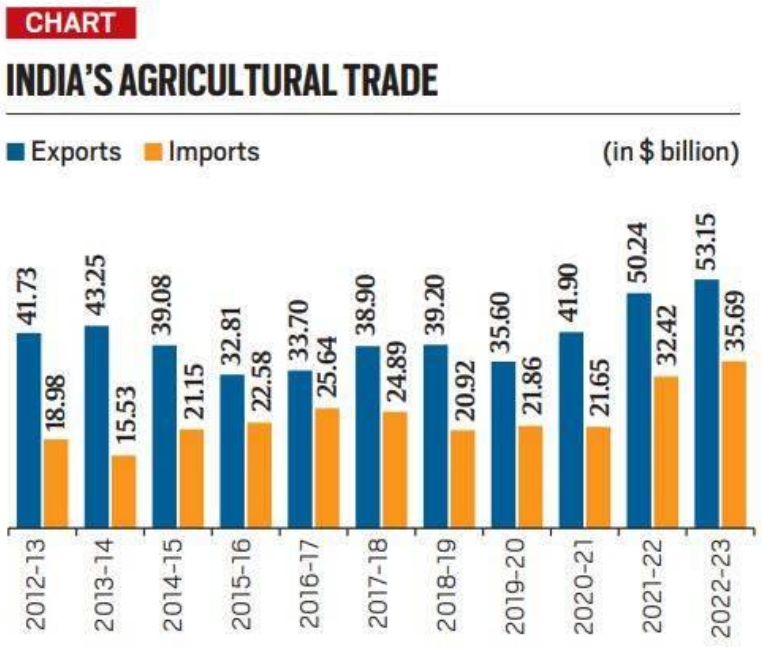

Figure 01: India's agriculture trade in last 10 years (55)

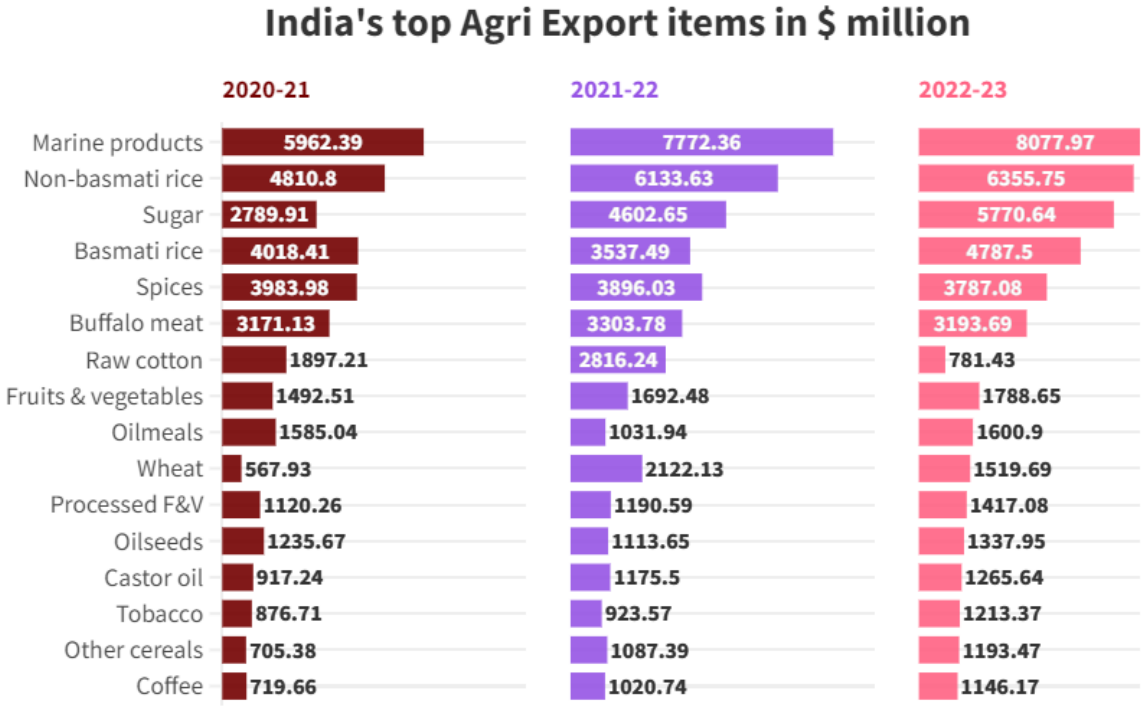

Figure 02: India's Top Export Agriculture Product

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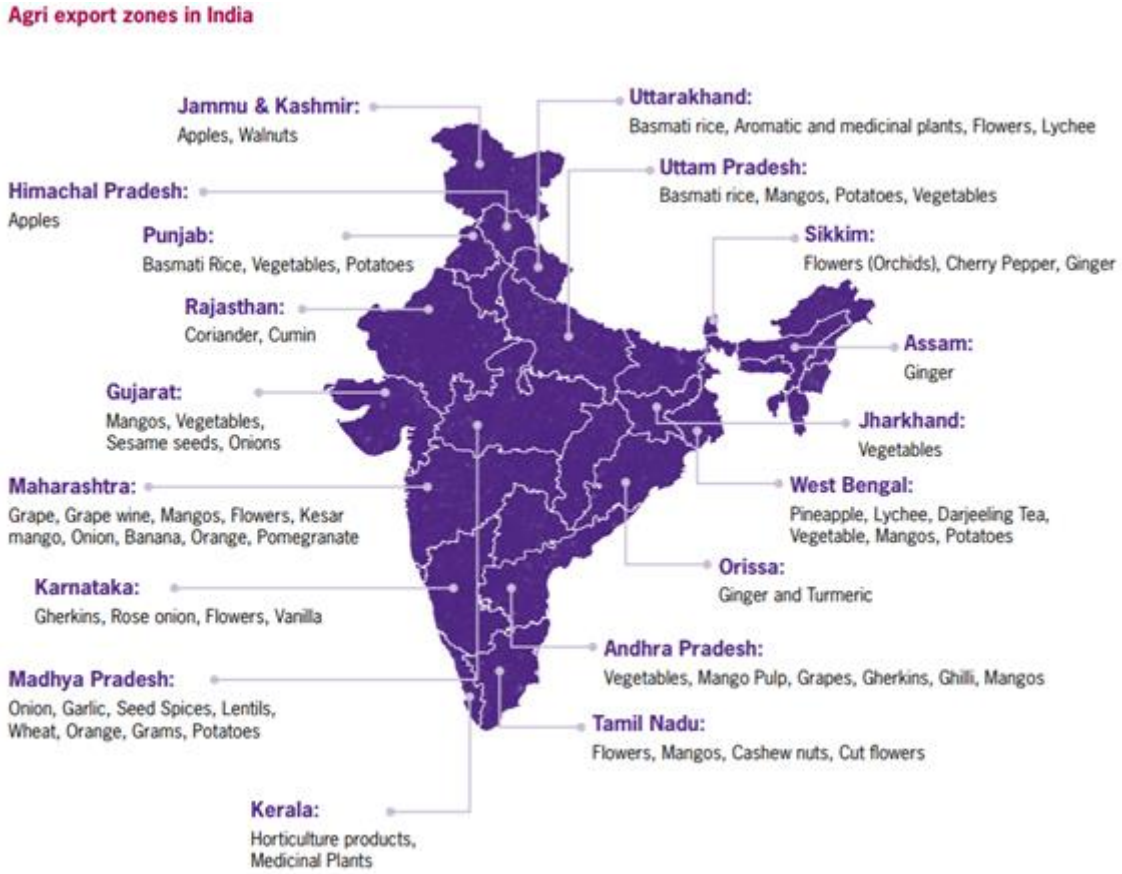

Figure 03: Major agriculture export zone in India (56)

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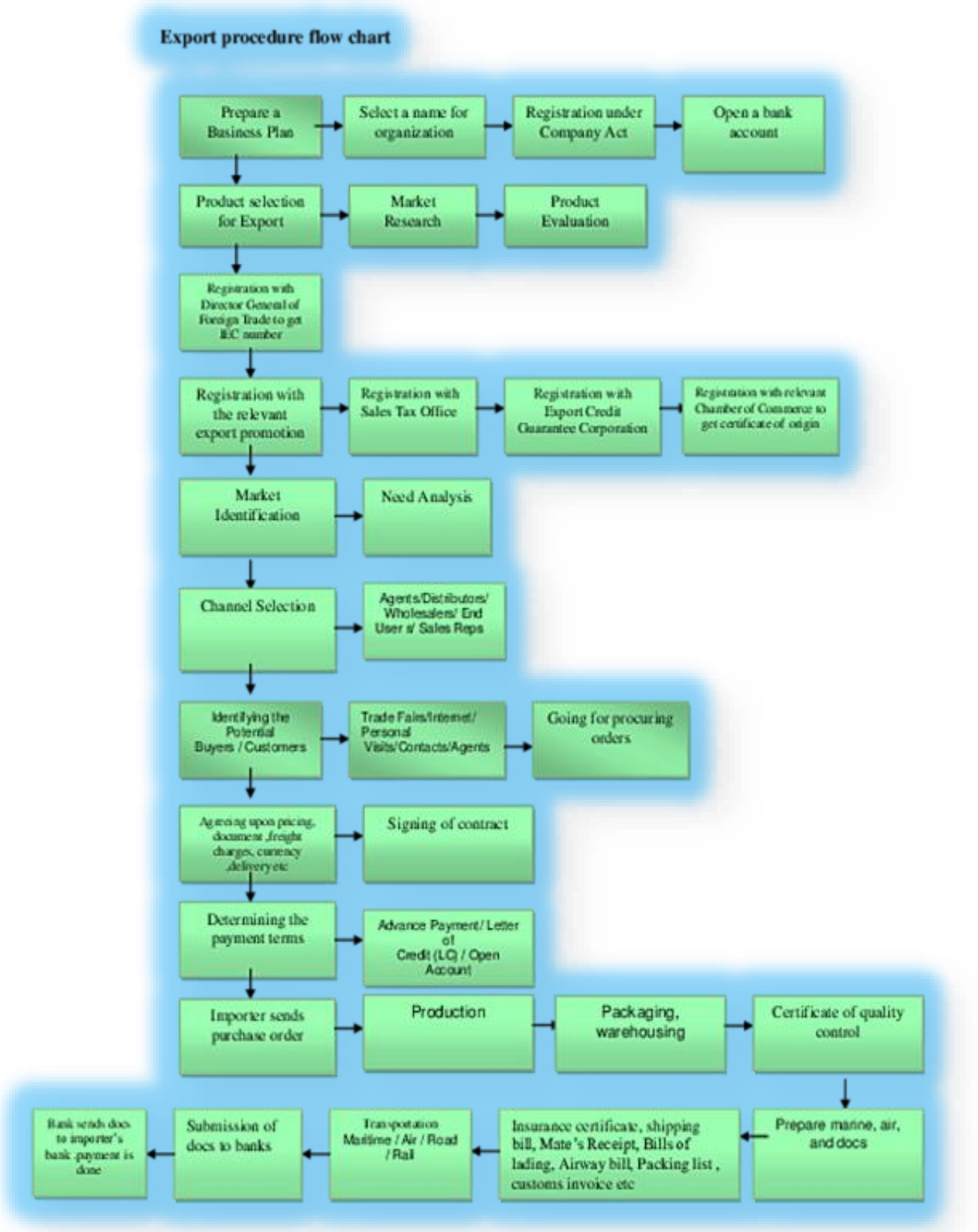

Figure- 04: Export Process Flow Chart

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VII. CONCLUSION

Food safety remains a critical challenge for India's food exports, especially in light of recent concerns such as the presence of ethylene oxide in spices, which have drawn international attention. Although regulatory measures are in place, the number of notifications under the Rapid Alert System for Food and Feed (RASFF) continues to rise. For importing nations, food safety takes precedence over cost, compelling Indian exporters to meet stringent standards. With its abundance of high-quality food products, India holds strong potential to enhance its economy through exports. To combat food fraud and maintain global compliance, the adoption of advanced analytical technologies is crucial.

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