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Value-Added Food Products from Fruits and Vegetables Training Material

"ENHANCING SOCIAL INCLUSION OF YOUTH THROUGH EMPLOYMENT IN AGRI-FOOD SECTOR"

PROJECT AGRIFOOD

Project Number:
2019-3-TR01-KA205-079155

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AGRI FOOD PROJECT

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INTRODUCTION

In this quickly changing world of knowledge the manufacturers are the ones who have to adapt consumers expectations and environment friendly production practices. “Back to natural” and “foods with extra value” are one of the trends in the current food market. This handbook goes through the export potential in European Union and gives an overview of the concept of value-added food processing.

The global COVID-19 pandemic cannot be ignored. The impact of COVID-19 on the food trends of the year 2020 has caused the acceleration of consumption of foods with health benefits. The sales in 2018 of foods with health benefits reached almost 800 billion euros globally, of which 20% corresponded to functional products. However, with the forecast of major declines in global economies for the coming year and with an eye to health, foods associated with the concept of health will enter to compete for the attention of consumers who are increasingly cautious and demanding. Below are the most relevant and accentuated by the postcovid situation:

Foods to strengthen the immune and digestive system: From adaptogenic supplements to yoghurts with bifidobacteria. Ingredients stand out, such as ashwagandha; mushrooms, such as shiitake and turkey tail; preparations like kimchi and sauerkraut; seasonings, such as citron vinegar; and fermented drinks, like kombucha and kefir. Why are consumers looking for them? To prevent disease through what you eat, benefit from natural anti-inflammatories, relieve stress and reduce anxiety.

Make the new more familiar: Prebiotics, probiotics and cannabiodiols as ingredients for general well-being, explaining their origin, process and benefits to the consumer, through a story. The tendency to generate a link, an emotion with the brand, prevails.

Balance between well-being and pleasure: It highlights the botanical and herbal concept in drinks and foods. New exotic tastes are combined to attract consumers the healthy way, for example breakfast cereals with cinnamon & turmeric or coconut & hibiscus. However, soft drinks and snacks market may be affected by the primacy of basic goods over premium products during the crisis.

Alternatives of natural origin, preferably vegetable: The search for substitutes will continue. The use of pseudocereals and vegetables will prevail for dry products such as flour and pasta; hybrids of plant and animal products in dairy and meat alternatives; algae as snacks, protein sources and raw materials for the elaboration of natural additives in the plant-based products industry; and insects as a source of protein, with the challenge of improving the solubility of the protein, and its sensory acceptance, to integrate it into foods.

A health crisis like the current one makes consumers more quality conscious, willing to pay more for whole and nutritious food. However, the derived economic situation also influences spending power. Therefore, society will increasingly analyze the cost-benefit ratio in its purchase decision. [1]

1. Current import situation for agri-food products to EU

The customs union between Turkey and the EU was a pioneering effort and has remained unique. The implementation of the customs union (CU) in 1995 marked a key moment in the trade relationship between the EU and Turkey. The CU with Turkey was the EU`s first substantial functioning CU with a non-member state and was one of the earliest attempts by the EU to share some of its legal system with another country. Under the CU, Turkey adopted the EU´s common external tariff (CET) for most industrial products, as well as for the industrial components of agricultural products, and both the EU and Turkey agreed to eliminate all customs duties, quantitative restrictions and charges with equivalent effect on their bilateral trade. [2]

For the year 2019 European Union (EU) agri-food trade value reached a record of EUR 270.5 billion. While EU agri-food imports rose slightly in 2019, a record growth came from Ukraine. Agri-food imports from third countries in 2019 accounted for EUR 119.3 billion, i.e. an increase of 2.5% compared to 2018. The five main origins for EU agri-food imports remained the same countries than in previous years, accounting for more than 35% of total agri-food imports, namely: the USA (11.8), Brazil (11.6), Ukraine (7.4), China (6.1) and Argentina (5.0). High levels of imports also continue to originate from Switzerland (4.7), Turkey (4.7) and Indonesia (4.1). The most important changes in EU agri-food partners in the beginning of 2020 is shown in Table 1.

Table 1. EU agri-food imports – most imporant changes per partner countries 2018-2020

	Yearly data			Monthly data		
PARTNER/PERIOD	**Share 2019**	**2018**	**2019**	**Jan 20 - May 20**	**Difference Jan 20 - May 20 to Jan 19 May 19**	
	%	**mio €**	**mio €**	**mio €**	**mio €**	**%**
Extra-EU27	**100,0**	**118.811**	**121.682**	**52.698**	**495**	**0,9**
Indonesia	3,2	4.177	3.903	2.184	561	34,5
Canada	1,7	1.627	2.052	1.124	496	79,0
Malaysia	1,5	1.799	1.784	996	300	43,1
Turkey	3,4	4.021	4.197	1.940	292	17,7
Côte d'Ivoire	2,7	3.125	3.265	1.667	239	16,8
Brazil	8,8	11.004	10.759	4.671	220	4,9
Morocco	1,9	2.215	2.304	1.468	154	11,7
Russian Federation	1,2	1.521	1.510	753	139	22,5
Peru	1,8	1.956	2.251	977	96	10,9
Argentina	3,6	4.387	4.357	1.697	87	5,4
Malawi	0,2	280	265	97	-63	-39,5
Mexico	1,0	1.023	1.187	404	-65	-13,8
New Zealand	1,3	1.706	1.554	603	-66	-9,8
Singapore	0,3	339	424	111	-71	-39,1
Nigeria	0,5	549	574	203	-81	-28,6
Australia	1,1	1.627	1.388	714	-130	-15,4
Ukraine	5,8	5.416	7.033	2.752	-217	-7,3
India	2,1	2.621	2.610	1.048	-240	-18,6
United States	8,4	10.389	10.204	4.427	-416	-8,6
United Kingdom	13,8	16.525	16.759	6.009	-807	-11,8
other countries	*35,6*	*42.504*	*43.302*	*18.852*	*69*	*-0,1*

Imports into the EU of tropical fruit and oilseeds other than soyabeans recorded the biggest rise in 2019. Looking at product categories, the highest increases in import values in 2019 (EUR million; % change since 2018) were recorded for tropical fruit (+752; +6%), oilseeds, other than soya beans (+747; +21%), vegetable oils other than palm and olive oil (+660; +30%), cereals other than wheat and rice (+461; +12%) and vegetables, fresh, chilled and dried (+335; +7%). Other significant increases were also recorded for beet and cane sugar (+327; +50%) and ethanol (+293; +90%). On the other hand, in 2019 imports fell back most (in EUR million, % change from 2018) for palm and palm kernel oil (-612; -11%); citrus fruit (-282, -13%), olive oil (-215; -36%), sheep and goat meat (-208, -20%) and oilseeds other than soya beans (-226; -4%). [3]

Table 2. EU agri-food imports by chosen product category 2018-2019

PARTNER/PERIOD	Jan 18 - Dec 18	Jan 19 - Dec 19	Difference Jan 19 - Dec 19 Jan 18 - Dec 18		Dec 18	Dec 19	Difference Dec 19 - Dec 18	
	mio €	mio €	%	mio €	mio €	mio €	mio €	%
All agri-food products	116,409	119,283	2,874	2,5	9,362	9,466	104	1,1
Commodities	46,849	48,383	1,534	3,3	4,006	3,808	-199	-0,5
Other primary	33,175	33,657	482	1,5	2,637	2,857	220	8,3
Processed	12,615	12,574	-41	-0,3	977	976	-1	-0,1
Food preparations	7,999	8,687	687	8,6	625	669	44	7
Beverages	3,298	3,248	-50	-1,5	196	239	42	21,6
Non-edible	12,473	12,735	262	2,1	921	918	-3	0,3
Citrus fruit	2,142	1,85	-282	-13	106	106	0	0
Fruit juces	2,198	2,023	-175	-8	143	137	-5	-4
Vegetables, fresh, chilled and dried	4,752	5,086	335	7	457	463	6	1
Tropical fruit, fresh or dried, nuts and spieces	13,525	14,277	752	6	1,043	1,225	182	17
Fruit, fresh or dried, excl. citrus & tropical fruit	6,765	6,79	23	0	614	660	46	8
Preparation of vegetables, fruit or nuts	3,274	3,437	163	5	258	290	31	12

During the first five months of 2020, EU agri-food trade (exports plus imports) reached a value of EUR 128.5 billion; i.e. 1.6% more than in January-May 2019. The current growth remained to be driven by higher agri-food exports which increased by 2.1% compared to the corresponding period in 2019, reaching EUR 75.8 billion. EU imports attained EUR 52.7 billion, 0.9% higher than the same five months period in 2019. However, the monthly values of EU exports and imports continued to fall in May 2020 by 7.5% and 4.5%, respectively, below the level of previous month, corresponding to the economic slowdown triggered by the COVID-19 pandemic. The top EU agri-food origins in the five months period include the UK, Brazil, USA, Ukraine and China. These countries have accounted for almost 40% of EU agri-food imports.

EU import increase is driven by fruits, palm oil, oilseeds and vegetable oils. The top EU agri-food import products in the first five months of 2020 included fruit (tropical and other than citrus), unroasted coffee and tea, oilcakes and palm and palm kernel oil. They have accounted for nearly 50% of EU agri-food imports. [3] According to the data form January to April 2020 the import value of fresh and dried tropical fruit experienced the largest growth when compared to January-April 2019, rising by €553 million. [4]

Table 3. EU agri-food imports – most important changes per chosen product categories 2018-2020

EU agri-food imports by chosen product category	Yearly data			Monthly data		
PRODUCT/PERIOD	Share 2019	2018	2019	Jan 20 - May 20	Difference Jan 20 - May 20 to Jan 19 May 19	
	%	mio €	mio €	mio €	mio €	%
EU	**100**	**118.811**	**121.682**	**52.698**	**495**	**0,9**
Tropical fruit, fresh or dried, nuts and spieces	10,6	12,187	12,876	5,95	531	9,8
Palm & palm kern oil	5	5,427	4,843	2,526	461	22,3
Oilseeds, other than soyabeans	3,5	3,595	4,297	1,986	423	27,1
Fruit, fresh or dried, citrus & tropical fruit	4,6	5,552	5,583	2,954	246	9,1
Citrus fruit	1,3	1,812	1,575	623	192	44,5
Vegetables, fresh, chilled and dried	3,8	4,268	4,606	2,238	-89	-3,8

As a result, the agri-food export surplus during the period January-May 2020 stood at EUR 23.1 billion, an increase by almost 5% compared to the corresponding period in 2019, despite the COVID-19 crisis. This net trade balance remained boosted by continued strong exports of pig meat, wheat and coarse grains. By contrast, the EU net trade balance further deteriorated to reach negative values for raw hides and skins, citrus fruit and ethanol. [5]

2. Value added food processing

As farmers seek to find ways to increase farm income, interest in adding value to farm products has grown tremendously. Value-added products are defined as having a change in the physical state or form of the product such as making strawberries into jam.

Value-added products are defined by USDA as having:

- A change in the physical state or form of the product (such as milling wheat into flour or making strawberries into jam).
- The production of a product in a manner that enhances its value (such as organically produced products).
- The physical segregation of an agricultural commodity or product in a manner that results in the enhancement of the value of that commodity or product (such as an identity preserved marketing system).

Local, value-added agricultural food production is seen as a critical strategy to sustain small farmers and their communities. The value of farm products can be increased by cleaning, cooling, cooking, combining, churning, culturing, grinding, extracting, fermenting, drying, handcrafting, packaging and distributing, as well as by adding information, education or entertainment. In addition to offering a higher return, value-added products can open new markets, create recognition for a farm and expand the market season. Small-scale processing can also make a positive contribution to a community. Often, ingredients needed for the final product are purchased locally, staff is hired locally and the product is sold locally. The money generated from these activities tend to circulate in the local economy and create spin-offs for other businesses. [37] In recent years, a increased emphasis on the addition of culture as a value is an evident phenomenon in the food market today that introduces an element of complexity.

To put it more simple - value-added food processing is something that you do to help earn more money from your farm products. For example, as a farmer, you process raw fruits or vegetables into a finished product that you can sell. Some people package value-added foods and some people sell fresh value-added foods.

Examples of how to make value-added food products include:

- Making salsa out of tomatoes.
- Making pesto out of basil.
- Making jam or jelly out of berries.
- Cutting up and packaging vegetables for easy cooking.

Sometimes non-farmers make “value-added foods” as well. These can include breads, cakes, sauces, or other processed foods. Often people make value-added foods from one ethnic tradition, such as special Chinese vegetable buns, Mexican salsa or other foods from your cooking tradition. [38]

It is possible to increase a business’ share of the food income by adding value to raw agricultural products, but adding value does not come free. It often means doing more work, hiring more staff, buying more machinery or supplies, and complying with more rules and regulations about buildings, packaging and labelling.

Have a plan. A comprehensive business plan that includes marketing and finances can help determine the feasibility of an enterprise. Developing a business plan helps operators define the planned business, create a road map for operating the business, set the goal that will be aimed for and satisfy lenders’ requests for information.

Trying to manage and grow a business without good records is like trying to find an address in a strange city without a road map. Without good records, the business is limited to making educated guesses about progress and whether or not goals are being met. Accessing capital for growth and product development may depend on having accurate cost and pricing figures for the production and marketing of products.

Lack of knowledge in marketing is often a big issue with producers. In marketing processed and value-added agricultural products, it is important to be innovative in product development and to produce products that meet the needs of target customers. When customer needs are satisfied, the chances of selling products to that customer are increased. A downfall of many producers is developing “me too” products. It makes good business sense to know what other competing products are available and determine if the market can accommodate another similar product. [37]

Questions to ask yourself before making a business plan:

- Do you want to start a value-added food business?
- Do you have an idea for a food that you can make with the vegetables, fruits or herbs that you grow?
- Do you have a special family recipe that everyone loves?
- Do you make a special ethnic product that is hard to find in local stores?
- Do you want to make more money from the foods you grow?
- Do you love your farm business and want to expand it?

If you answered ‘yes’ to any of these questions, you may want to start a value-added food business! [38]

Making food at home. It is allowed to use your home kitchen to prepare food for selling. There are rules on the types of foods and production process you have to follow.

What foods can you make at home. The state or local health department can advise you on the legality of home food processing. You cannot make “potentially hazardous” foods at your home kitchen. Many potentially hazardous foods usually need to be kept cold and often include fresh meat or dairy products. Pickled products are also considered potentially hazardous because of the acid content. Study food safety rules in your local authority. [38]

Tips:

- Buyers often prefer to buy directly from growers when possible. [38] Think about marketing and creating a website to promote your products. Website makes you more reliable for clients and customers abroad.
- Be aware to fill the contracts and inform your client when climate has influenced your product quality or volume. Your client expects you to communicate pro-actively and respect an agreement. [39]
- Be creative, add new and innovative flavoring to traditional recipe.
- Add your personal story to your product. [38]
- New generations craves for exotic tastes, so potentially you have a lot to offer for Europe.

3. Value-added food products with high export potential

Europe is the largest importer of processed fruit and vegetables in the world, absorbing more than 40% of the global supplies. European imports of processed fruit and vegetables have increased every year in volume in the 2014–2018 period. Around 50% of Europe's imports originating from outside the EU come from developing countries. In addition, most intra-European trade is made of re-exports of processed fruit and vegetables originally coming from developing countries.

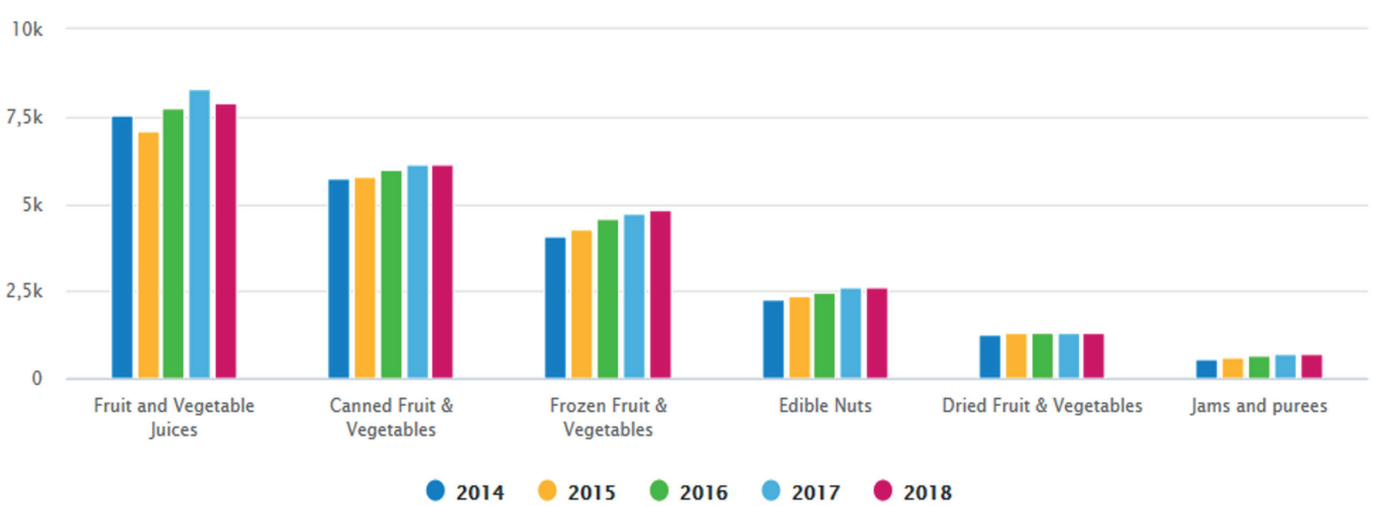


Figure 1. European imports of processed fruit and vegetables by sector

In the next five years, European imports of processed fruit and vegetable are expected to increase at an annual growth rate between 2% and 3%, depending on product categories. Imports of edible nuts and frozen fruit are expected to expand the most, while fruit juices the least.

The numbers of European consumers refraining from eating meat and those adopting a vegetarian or vegan diet are growing. This includes the flexitarian diet, which comprises mostly plant-based foods but allows for some meat and other animal products in moderation. Mintel reports that the UK is the European leader in new vegan product launches. Around 16% of new food launches in the UK in 2018 were vegan, doubling from 8% in 2017. Germany follows in second place with 10% of new food launches being vegan. Processed fruit and vegetable producers are also taking advantage of the vegan trend, reformulating and creating new products. For example, jackfruit and coconut are now frequently used as meat substitutes, so many companies are creating new products using these ingredients.

The growing consumer interest in vegan diets is helping to fuel demand for healthy snacks, such as nuts and nut products, including almond and cashew nut butters, as well as drinks, such as nut milks. The rationale behind it, is that consumers on vegan and vegetarian diets must still meet their protein needs and deal with lactose intolerance while not consuming animal protein. [6]

As Europe is not self-sufficient in processed fruit and vegetables the agricaltural products retain an important place in imports. European countries do not have suitable agro-climatic conditions to cultivate tropical fruit and vegetables, so they depend heavily on imports from tropical and semi-tropical countries. Only a few types of processed fruit and vegetables are more significantly produced in Europe. The strongest import dependency is in dried fruit and edible nuts, where the share of domestic production in total consumption is smaller than 10%.

Examples of processed fruit and vegetables produced in Europe include:

- Apple juice (Poland)
- Vegetable juices, canned tomato and tomato purees (Italy)
- Canned peaches and apricots (Greece and Spain)
- Table olives (Greece, Italy and Spain)
- Frozen vegetables (Belgium)
- Frozen berries (Poland)

- Frozen sour cherries (Hungary and Poland)
- Prunes and jams (France)

Still, none of these is produced in sufficient volume to fully meet European demand, and Europe's domestic fruit and vegetables production does not show any tendency towards increasing volumes. [7]

3.1. Dryed Fruits and Vegetables

Plant-based foods, including fruits, vegetables, seeds, beans, spices, etc., are important components of a healthy diet, and their sufficient regular consumption could help to prevent certain major diseases such as cancer and cardiovascular diseases, etc. According to the combined report of World Health Organization and Food and Agriculture Organization, it was recommended that a daily minimum consumption of 400 g of fruits and vegetables may help to minimize the occurrence of chronic diseases along with the mitigation of micronutrient deficiencies. Fresh plant-based foods may not be available all year round for consumption and the long-term storage of fresh foods could be challenging due to high water content, unavailability of cold-storage facilities and possibility of nutritional deterioration. Consequently, drying of such foods may allow their long-term consumption and eases handling, transportation, and storage. [8]

The European dehydrated food market is forecasted to register a CAGR (Compound Annual Rate of Growth) of 4.10 % during the forecast period (2020 – 2025). Rising demand for food products with longer shelf life coupled with the increasing demand for non-seasonal products and increasing demand of food manufacturers for preserving food products that can be used as an ingredient for prolonged periods of time are fueling the

demand of dehydrated food market. In addition, rising demand for ready-to-eat foods due to the demand for convenience food items has further boosted the market growth. The evolving retail landscape and product innovations, in terms of packaging, format, and flavors, have been significantly contributing to the growth of the market. However, factors such as the high maintenance cost of different dehydrator machinery, along with the less availability and awareness of other advanced technologies, such as freeze-drying and vacuum drying, are limiting the growth of the market. [9]

The European market for dried tropical fruit is growing. Consumption of dried tropical fruit is driven by various factors, such as a consumer trend towards healthy snacking and new product applications such as fruit snacks. The Netherlands, the United Kingdom, Germany and growing markets such as Poland and Austria offer you opportunities. New product development and implementation of food safety and social responsibility standards in your company can give you great competitive advantages.

Between 2013 and 2017, European imports of dried tropical fruit grew in value at an average annual rate of 11%, but decreased in quantity at an average annual rate of 7%. When adding the import of dried mangoes, dried pineapples and other dried tropical fruit that isn't included in the statistical codes, European imports of dried tropical fruit can be roughly estimated at just over 25 thousand tonnes. In addition, European imports of candied tropical fruit are estimated to be just above 5 thousand tonnes.

Import prices of dried tropical fruit in Europe have slightly increased in the last five years. Imports from developing countries are growing fast. In the 2013-2017 period, they grew even faster (+16%) than imports from other European countries.

A large share of imported dried tropical fruit is re-exported within Europe. After importing the bulk product, dried fruit is often repacked into retail packaging, or the product is simply re-exported in bulk.

It is expected that imports of tropical dried fruit will continue to increase in the coming years, especially in the segment of naturally dried tropical fruit with no added sugar. This expected increase will be driven by the growing demand for healthy food and particularly by the popularity of healthy snacks, such as dried fruit and nut mixtures, and dried fruit bars.[10]

Europe is the largest market for dried mushrooms and fungi in the world, representing around 30% of the total world imports in value. Large importing markets such as Germany, France, Italy and Poland offer opportunities for exporters from developing countries.
For suppliers from developing countries, opportunities can be found in exports of premium-priced wild mushrooms such as wild porcini, chanterelles and truffles, or in exotic mushrooms with health benefits such as shiitake, maitake, cordyceps or reishi mushrooms. For detailed good hygiene practices, please refer to the Codex Alimentarius Code of Hygienic Practice for Dehydrated Fruits and Vegetables including Edible Fungi. Also invest into drying technology and knowledge transfer. Every type of dried mushrooms requires a specific approach in terms of drying technology. [11]

The Europe freeze-dried food market is projected to grow at a CAGR of 8.27% during the forecast period (2020 – 2025). The ease of the technique in processing heat-sensitive food products, like fruits and vegetables, and providing them with a prolonged shelf life, without hampering the original properties, is the major driving factor for the Europe

freeze-dried food market. Moreover, the consumers are attracted to these products, as the foods prepared using the freeze-dried technology are easy to store, convenient to handle, and have a short preparation time. The rising interest and participation in outdoor sports, owing to the awareness about health and wellness, and increasing interest in expedition activities and adventures are a major factor driving the sales of freeze-dried food across the region.

Countries like the Netherlands, United Kingdom, and Germany accounted for the largest importers of dried tropical fruits due to the growing demand for healthy snacking and new product applications such as fruit snacks across the globe. In 2017, The Netherlands, United Kingdom, and Germany accounted for approximately half of the total imports. Moreover, with companies developing new products and implementing food safety and social responsibility standards to achieve a competitive advantage, there is an increased demand for freeze-dried products in the region. [12]

Tips:

- Knowledge is important. Study different drying techniques and experience depending what you want to dry. As there are a lot of ways for food drying, you might consider to look into newer inventions for food drying like power ultrasound drying or infrared rotating drum dryer.
- Freeze-drying comes with more costs, but it has better sensory quality and nutritional value in terms of vitamins and natural antioxidants which corresponds to growing demand of healthy snacks by public.
- Find your own market niche by using local superfoods, vegetables or fruit to dry. Be creative.

3.2. Fermented Foods

Fermentation is making a `comeback` in western markets, with growing demand supported by consumer perceptions of it as a `natural` and `healthy` food preservation method. [13] Major drivers driving the global fermented products market include health benefits that it offers. Apart from being a taste enhancer in everyday foods, fermented foods also have numerous health benefits which is triggering market growth globally. Fermented foods are rich in antioxidants which prevents free radicals to attack the human body and help in digestion as they have pre- and probiotic properties in them. They are also a source of natural nutrients such as vitamins and minerals. In addition, rising awareness about GMO products is also triggering market growth for organic fermented products. Also lack of use of preservatives in fermented products reduces their shelf-life due to which they cannot be stored for a longer period of time. This is acting as a major restraint to the global pickle market. [14]

Fermentation also appeals to millennial consumers, who are seeking out novel taste and texture experiences and international cuisines. European consumers are increasingly experimenting with the ´exotic´ flavours in Korean Kimchi or cultured drinks like Kombucha and Lassi. Fermentation is mostly used in the dairy aisle in Europe. But, with growing demand for plant-based options and an increased uptake of flexitarian diets, it is surely ready to make a growth in plant-based diet. For example in order to help food makers meet this need, DuPont is launching Danisco Vege Cultures, a new portfolio of cultures specially formulated for the plant-based fermented products market. [13]

What is what? Fermentation refers to an aerobic or unaerobic process involving the application of microorganisms feeding on the starch and sugar present in the food to produce different metabolites, e.g. lactic acid, acetic acid, ethanol etc.

Term pickling involves preserving foodstuffs under high acid concentration, enabling their preservation for over two years without refrigeration. There are different types of pickles that fall into two categories on fermentation aspect basis:

- Unfermented pickles: produced by two methods: (i) “salt-stock pickle” that use a concentrated brine (up to 16% salt) where preservation is due to salt and not to fermentation, and (ii) “vinegared pickles” where raw materials are packed in vinegar (acetic acid), salt and sometimes added sugar to help develop different flavor and texture in pickles. Unfermented pickles are usually pasteurized by heating.

- Fermented pickles: there are two types of fermented pickles (sour or sweet pickles): (i) sour fermented pickles made by submerging raw materials in a dilute brine (2–5% salt). Naturally occurring bacteria grow over 1–2 weeks to produce lactic acid, which then prevents the growth of food poisoning bacteria and other spoilage microorganisms. The amount of added salt controls the type and rate of the fermentation, and (ii) in sweet fermented pickles, they are preserved by a combination of lactic or acetic acid, sugar and spices.

Most Lacto-fermented foods are made from raw vegetables and without heat treatment. Lacto-fermentation may sound complicated and confusing, but it is actually rather simple. And no, it has nothing to do with dairy! Lacto actually refers to lactic acid. All fruits and vegetables have beneficial bacteria such as Lactobacillus, Lactococcus etc. on the surface. In an anaerobic (oxygen-free) environment, these bacteria break down the sugars found in food into lactic acid. This lowers pH, inhibits growht of harmful bacteria and acts as a preservative.

Scientists believe that the possible health benefits of fermented foods are because they are a source of pre- and probiotics, which help to keep our gut healthy. What's more, recent research has been attributing the health of our gut (microbes in our gut) to mental health. So, getting more fermented foods in may benefit both your physical and mental health. Many fermented foods, like sauerkraut and tempeh, also contain prebiotics.

What is what? Prebiotics are a special form of dietary fiber that acts as a "fertilizer" for the good bacteria in your gut. **Probiotics** are live bacteria that can be found in your cut and in fermented foods. These good bacteria, in turn, produce certain substances that acidify the colon (a very good thing) and serve as a nutrition source for the colon's own cells. It is important to bear in mind, however, that the term "probiotic" is not accepted as a legal term as it infers a health benefit. The term has been ruled to be misleading to consumers and therefore is not accepted by Regulatory Authorities in the European Union.

Probiotics in food may give you an opportunity to use **'novel food'** designation. Given their long history of use, can probiotics – intended to be marketed as food in the EU – be considered as traditional and not novel foods? In short, not exactly, and to answer these questions, there are at least two main aspects to consider, which all determine the level of information required by the European Food and Safety Authority (EFSA) for the evaluation of safety of a novel food prior entry to the EU market.

"Novel food" refers to any food that European consumers have not eaten on a significant level prior to 15th May 1997. A "traditional food" is defined as a novel food derived from primary production that has been consumed safely for at least 25 years, as part of the customary diet of a significant number of people in at least one country outside the EU. The traditional food route was freshly introduced in the new , Novel Food Regulation (EU) 2015/2283 which came into force on 1st January 2018, offering a welcoming and exciting option for the industry. It is therefore essential to understand that, in the context of the novel food regulation, a food may be considered "novel" on the basis that, although it is a "traditional" food in other parts of the world, it is new to the EU market. [15]

The Europe packed pickles market is expected to grow at a CAGR of 3.2% during 2019-2025. Based on geography, Germany is having the largest pickle market in Europe and accounted the largest market share, and total imports were from the Netherlands and Turkey. [16] Cucumbers, cabbage, olives, onions, and peppers account for the largest volume of vegetables and fruits that are commercially processed worldwide. Lesser quantities of tomatoes, cauliflower, carrots, melon rinds, okra, artichokes, beans, and other produce also are pickled. [17] Pickled cucumber is a most common pickled food. Among continents, European countries sold the highest worth of exported pickles during 2018 accounting for almost half (47.5%) of the global total. [18] Europe is the largest market for table olives in the world, accounting for more than 45% of total world imports. European imports of table olives are growing. Large importing and consuming markets

such as Germany, France and the United Kingdom, or growing markets such as Belgium or the Netherlands offer the best opportunities for developing country exporters. The main growth drivers are the growing consumer interest in the Mediterranean diet and in naturally processed table olives. [19]

Switching from pickled to fermented food is possible if there are products to offer. At the current post-COVID situation, as people have started looking for healthier alternatives in food market, it is right time to make the turn. For a manufacturer, this is a great way to enter an underused market segment.

Mushrooms have been popular in recent years for their nutritional value and their wide range of healthy applications. This renewable and easily cultivated resource also allows the production of new ingredients using fermentation. In both large and small companies, new products based on mushroom fermentation are constantly being developed. [22] Often grouped as vegetables, mushrooms are a rich source of nutrients such as vitamins, selenium, and potassium. They are fat-free, cholesterol-free, and are very low in sodium and gluten content. The market for mushrooms is projected to grow significantly in most regions of the world in the next five years. The most common mushrooms are button, shiitake, oyster and then come others (winter mushrooms, paddy straw mushrooms, milky mushrooms, and reishi mushrooms). [23]

Tips:

- Spontaneous fermented products are valuable sources of microorganisms that can be used in many food processes as starter cultures. The lactic acid bacteria isolated in this process can be exploited by industries to develop new foods and therefore to enter new markets. The use of selected starter cultures guarantees good organoleptic characteristics and food safety (no growth of pathogens). [24]
- Do not forget the safety. Adapting proper regulations and starter system safeguards during the manufacture of kimchi and chongkukjang, which are popularly consumed Korean traditional fermented foods, is helping to ensure that these foods are acceptably safe as well as healthy. [25]
- As most table olives offered on market are prepared or preserved by vinegar or acetic acid, you might concider fermenting. Olives are brined, as opposed to being strictly lacto-fermented. After the oleic acid is leached out, you can do a fermentation with the olives, or just leave them in a standard brine. Most olives are not sold unprocessed, so to get whole unprocessed olives you will probably need access to an olive tree.
- Emphasize fermentation on package to make your product health benefits recognizable.
- Use creativity to come up with new recipes. For example one of the newcomers on the market is fermented garlic aka black garlic that has become a warmly accepted in public.
- In Africa there are fermented foods from cassava are gari, fufu, lafun, chickwanghe, agbelima, attieke and kivunde. Sweet potatoes can be fermented into soy sauce, vinegar, lacto-juices, lacto-pickles and sochu. Most of these fermented food products are functional foods rich in phytochemicals, dietary fibres, anti-oxidant compounds (b-carotene, anthocyanin, etc) and probiotic components (lactic acid bacteria and yeasts).
- Find your local traditional or novel mushrooms or vegetables to develope a recipie for fermentation. [26]
- There is a whole new word of opportunities in fermented nuts and nut cheese for the vegan food. Although other fermented vegetable products have been deeply investigated, there are few data about the fermentative processes of nut-based products and the microbial consortia able to colonize these products are not yet studied. [24]

- Consider organic, niche market. Implementing organic production and becoming certified can be expensive. In the current market the return on investment may not be high. On the other hand it can increase yields and improve quality.

- **Fermented vegetables, the tastiest classic blends:**
  - Fermented Carrots with Dill
  - Fermented Onions and Garlic
  - Homemade Pickles with Dill
  - Kimchi
  - Sauerkraut with Carrots [27]

- **Examples for novel fermented blends**
  - Mixed veggie superfoods: cabbage, red cabbage, jalapenos, onions, carrots, kale[28]
  - Fermented Salsa
  - Celeriac, apple and mustard seed kraut
  - Indian spiced carrot kraut
  - Lime pickle
  - Chrain. This Jewish-Russian condiment of fermented beetroot and horseradish is ideal alongside smoked fish or in place of horseradish – with cold roast beef, for example
  - Kimchi
  - Fermented tomatoes and tomato sauce [29]

3.3. Jams and purees

Europe is the largest market for jams, jellies, purées and marmalades in the world, representing around 50% of the total world imports. Green label, ethical claims, fair trades, convenience, and health credentials are the most prominent attributes for market growth. Along with new jam and jelly products that contain health attributes and various taste profiles. [30]

- **Jam** is made by cooking the whole fruit, pieces of fruit, fruit pulp or fruit purée usually with added sweeteners.
- **Jelly** is made from fruit juice, usually with added sweeteners.
- **Marmalade** is prepared by cooking citrus fruit to obtain a gelled consistency.
- **Purée** is the edible part of the whole fruit, if appropriate, less the peel, skin and seeds pips, which has been reduced to a purée by sieving or other processes.

The most common sweetener used is sugar, but honey, concentrated juice and other sweeteners may also be used. The most common gelling agent used in the production is pectin. Purées can be used as final products (very frequently as infant foods) but also as a raw material for the production of jams and marmalades and other applications. In international trade, it is also very common that purées are traded as concentrates.

The total European imports of jams, jellies, purées and marmalades increased over the last five years. The annual import growth rate was 6% in quantity and 7% in value. The growth rate of imports from developing countries was higher than from European countries. The largest European importer of jams, jellies, purées and marmalades from developing countries is the Netherlands, with Turkey as a main partner from a developing country.

France, Germany, the United Kingdom and the Netherlands are already known countries of destination. The main supplier to Germany was Austria, while the main supplier to France was Italy. Major market opportunities can also be found on growing markets such as in the Scandinavian and Baltic countries. Central and Eastern European countries are expected to show a strong increase in their imports of jams, jellies, purées and marmalades compared to western Europe in the coming years.

Products with a rising demand are chestnut purée, hazelnut paste, berry jams and tropical fruit preparations such as mango purée. Demand for hazelnut paste and chestnut purée on the European market has increased in such rate that the majority of suppliers from developing countries (except Turkey) currently do not have enough capacity to supply those products. Therefore, investment in hazelnut and chestnut production can provide new opportunities in the long term. Berry fruit and tropical fruit preparations are in greatest demand. The leading supplier of jams, jellies, purées and marmalades from a developing country is Turkey (mostly hazelnut paste), followed by Serbia (plum paste), Costa Rica (tropical jams and purées) and Mexico (mango paste and other purees).

For suppliers from developing countries, new opportunities can be found in the export of fruit preparations made from berry fruit and in the export of tropical fruit products with high Brix concentrations. Supplying purées to producers of infant foods, especially in the organic segment, is also promising segment of market.

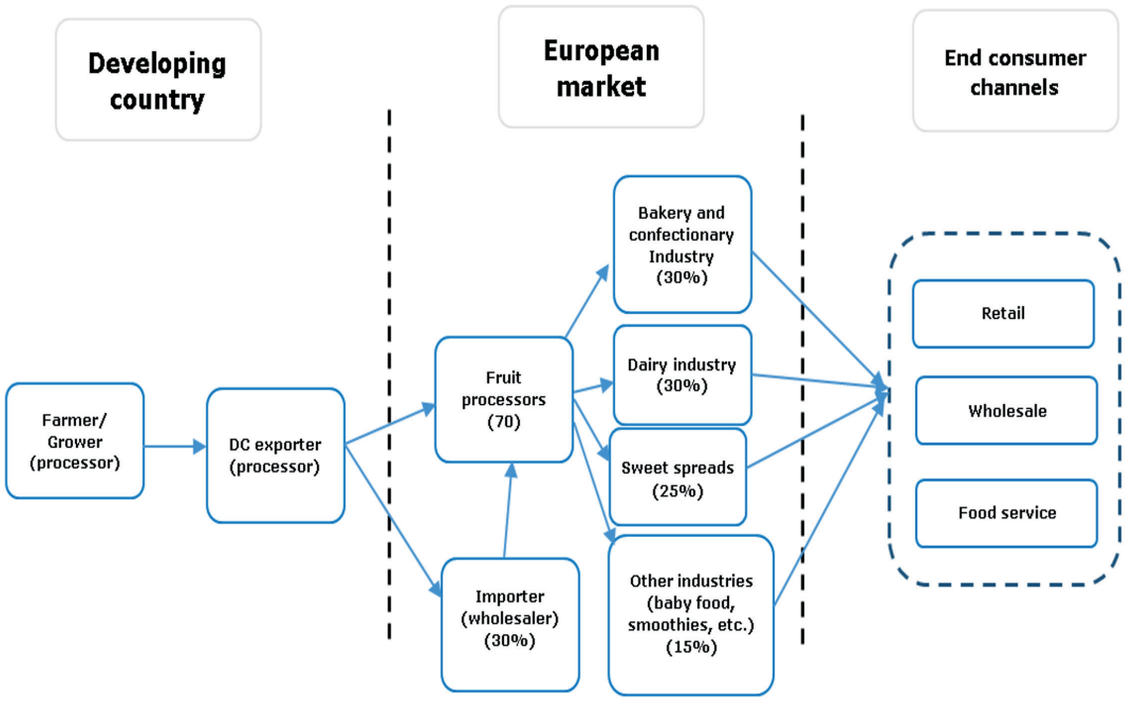


Figure 2. European market channels for jams, jellies, purées and marmalade

Jams as favourite breakfast spread. The most popular flavours of jams, jellies, purées and marmalades in Europe include strawberry, hazelnut, apricot, orange, raspberry, cherry and fig. The consumption of fruit spreads plays an important role in many European countries where people view breakfast as the most important meal of the day. The main drivers influencing the increasing consumption of jams, jellies, purées and marmalades are the increasingly positive image of healthy vegetarian breakfast alternatives. In addition, the current fast-paced lifestyle and growing preference for convenience food positively influence the consumption of fruit spreads

Specific trends for jams, jellies, purées and marmalades include the following:

- Low-sugar products are in demand on the European market. This trend also affects the market for jams, jellies, purées and marmalades, and consumers are increasingly searching for 100% fruit products, “low-sugar” and “low-calorie” fruit spreads.
- The consumption of superfruit is likely to increase, so the consumption of berry fruit spreads without added sugar is expected to increase too.
- In addition to low sugar, the most frequent labels for other categories of fruit spreads in retail packaging are “organic”, “no additives/preservatives”, “low/no/reduced allergens” and “gluten-free”.
- Glass containers are a very popular choice and the trend is clearly moving towards smaller sizes that cater for consumer needs such as due to smaller households.
- Locally sourced produce is still very much a trend and this also applies to the fruit jam market. Products that offer added value for the consumer are also becoming increasingly important. Examples of these products include fruit spreads with a particularly high fruit content and finely sieved cream spreads that contain no seeds or pieces of fruit. [31]

Tips:

- In targeting your markets, make a distinction between production countries that import jams, jellies, purées and marmalades as raw materials on the one hand and consuming countries which import for their own consumption on the other. In the second category, more attention should be paid to developments in the retail sector and local consumption trends. In addition to targeting suppliers in the retail segment, consider exporting to industrial suppliers such as the bakery, confectionary and baby food industries.
- One of the largest consumers is the bakery and confectionary industry. This industry regularly invests in research and development of different fruit preparations in order to meet the industry demand for fruit preparations and fruit fillings which are stable at room temperature and which can be used in convenient new products. If targeting this segment, cooperate closely with your target companies and offer your technological solutions.
- High-fruit, low-sugar and organic fruit spreads are gaining popularity in Europe. Consider offering those types of products to selected import markets such as France or the Baltic countries. [31]

- Consider replacing added sugar in your products with other sweetening ingredients. An interesting alternative is using concentrated fruit juice as a natural sweetener in jams and dried fruit. Other possible sweetening agents include lucuma powder, mesquite, stevia, banana puree and tree syrups, such as maple, birch, agave, yacon and others. [36]

Famous France jam St Dalfor - no cane sugar, no preservatives, no artificial colours, all natural.

- Fruits such as raspberries and blueberries can be infused with special ingredients such as spices, herbs, honey, chia seeds etc. in order to produce low-sugar, sugar-free jams with something extra for health and taste.

3.4. Clean Label

Rising consumer awareness of food production and health has revolutionized - food producers are trying to fulfill consumer demands and expectations. Clean label is a consumer driven movement, demanding a return to real food and transparency through authenticity. Food products containing natural, familiar, simple ingredients that are easy to recognize, understand, and pronounce. No artificial ingredients or synthetic chemicals. The clean label movement started in USA has become well known and required by European consumer.

The early days of the clean label trend could be summed up in one word — simplicity. Today, clean label has many definitions, and manufacturers have moved beyond focusing on ingredient statements to bringing transparency to their production practices and supply chain. With the growing familiarity and understanding of ingredients, claims, on-pack certifications and increased curiosity, consumers are spending that extra time to equip themselves with information. This is driving the increasing focus of ingredients being acceptable, nutritional, functional and sustainable.

The different generations of consumers interact with food and beverages differently, with different decision-making parameters and needs. The younger millennials (24 to 28 years of age) are more likely to lean toward product messages such as 'made with real ingredients, 'all natural/100% natural,' 'no added sugar,' 'organic' and 'no additives or preservatives.'

While the older boomers (65+ years) are more likely to gravitate toward nutritionals and tangibles such as 'no added sugar,' 'no added salt,' 'no artificial preservatives' and 'no additives or preservatives,' a new addition to the boomers was their focus on 'made with real' as well. The health pillar comprises mental and emotional well-being, healthy weight, balanced diet and an active lifestyle. Safety is defined as actual product safety as well as avoiding artificial ingredients and chemicals in food.

Things like GMOs, growth hormones, pesticides, etc. are top concerns that are fueling the clean eating movement. Despite the potential benefits of processed foods, such as longer shelf life, convenience and fortification, only 16% of global shoppers believe processed foods and beverages can make a food and beverage safer, and nearly 30% think they may be contaminated through processing facilities and storage. [40]

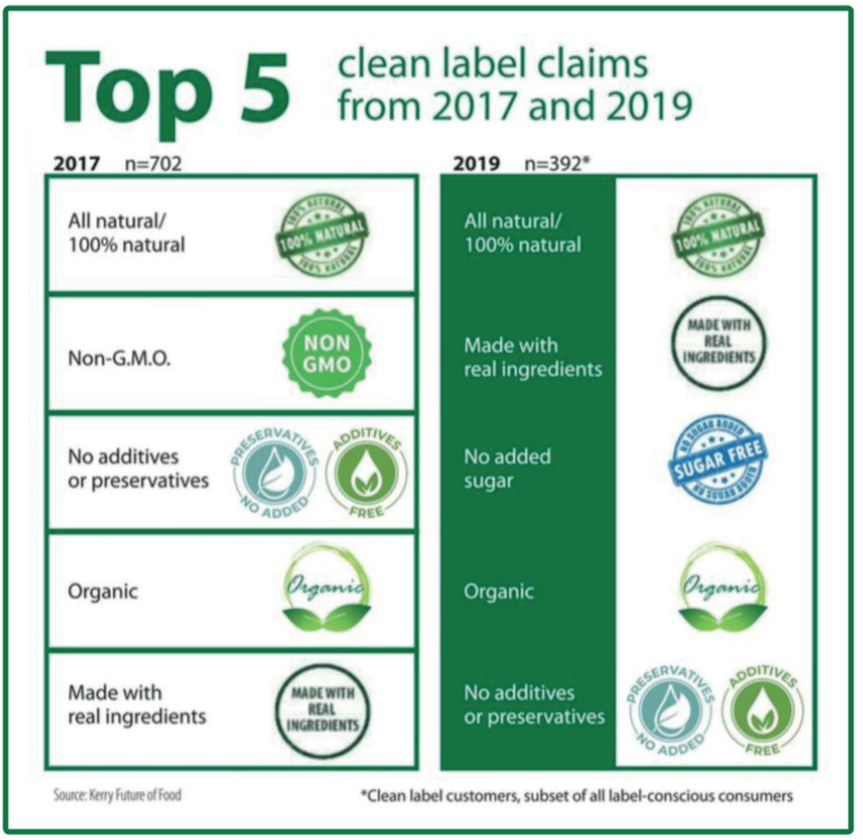


Figure 3. Top 5 clean label claims

75% of consumers will pay extra for clean label ingredients. A study conducted in 2017 showed as many as 75 percent of consumers are happy to pay a higher retail price for a food or drink product made with ingredients they recognize and trust. [41]

Thank you for picking up this handbook and hope you found the information needed. At current market situation following key words like natural, organic, healthy, low sugar are still if even not more important than before. Sustainable small scale farming is important for local community, for nature and customers who care. Use your potential with creativity to explore full opportunities of European market.

4. Production techologies

4.1. Fermentation technologies

Fermented food products are produced widely using different techniques, raw materials, and microorganisms. However, there are basically only four types of fermentation processes involved in the product development, namely, alcoholic, lactic acid, acetic acid, and alkali fermentation, as described below. Lactic acid fermentation is mainly carried out by lactic acid bacteria (LAB). Examples include fermented cereals, kimchi, sauerkraut, and gundruk. Alcohol fermentation contributes to the production of ethanol. Yeasts are the predominant organisms, for example, wines, beers, vodka, whiskey, brandy, and bread. Acetic acid fermentation is produced from the Acetobacter species. Acetobacter converts alcohol to acetic acid in the presence of oxygen (e.g., vinegar). Alkaline fermentation takes place during the fermentation of soybeans, fish, and seeds, popularly used as a condiment. [43]

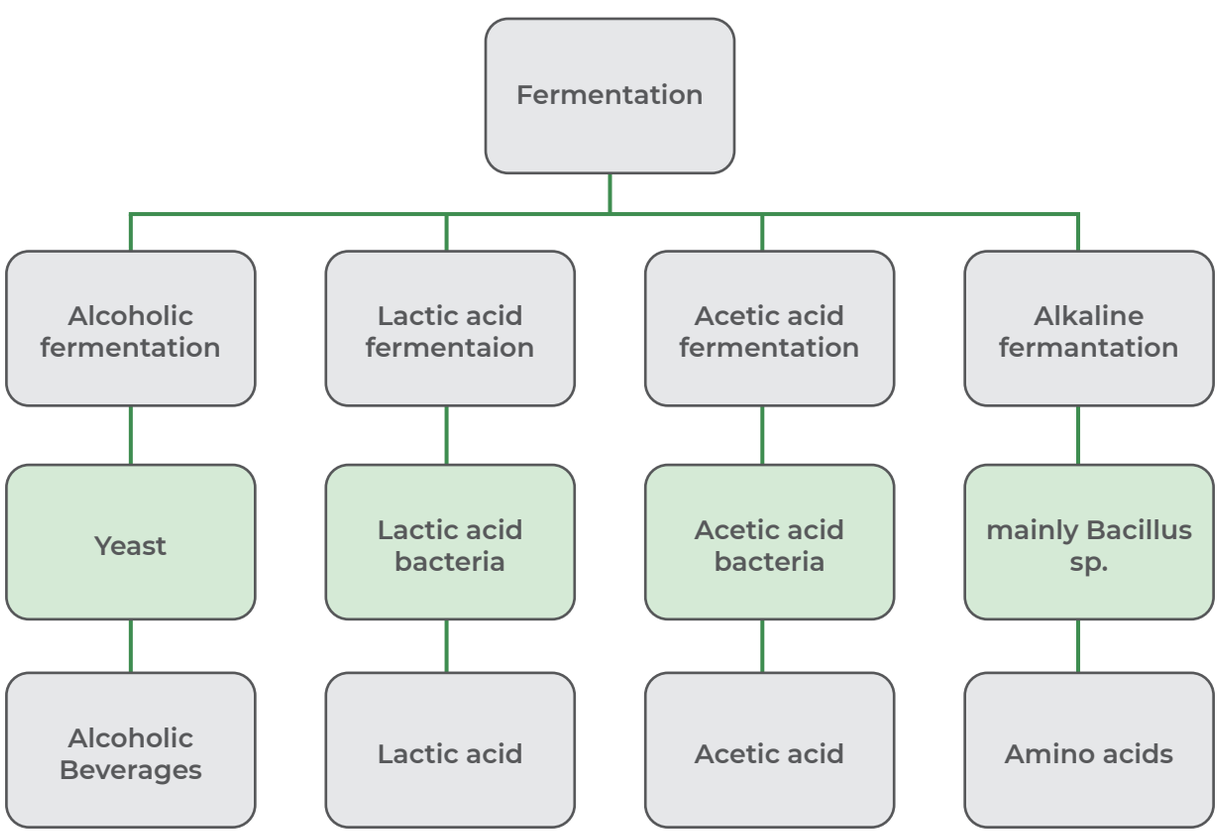


Figure 4. Schematic representation of the common types of fermentation, the microorganisms involved, and the end products. [43]

Starting fermentation growth can be accomplished in three basic ways:

- Spontaneous or natural – allowing the natural fermenting microorganisms on the vegetables to grow. This technique allows for the natural sequential growth of fermenting organisms. It can be the most unpredictable method but can allow for the most developed and complex flavors since more fermenters are present.
- Back-slopping – adding live bacteria from a fermented product to start other batches. In back-slopping, the initial fermentation stage is shortened since fermenting microorganisms are already growing and the risk of fermentation failure is lower. However, the natural sequence of fermentation is disrupted and flavor development may not be as complex. The acidity of the back-slop can also affect the success of fermentation initiation with the high acidity leading to poor fermentation or producing softer textured product.
- Culture Inoculation – a specific bacteria culture is added to start the fermentation. Culture inoculation is done less in home-based fermentations and more in the industry to ensure consistent fermentation. Vegetables are usually heat treated prior to inoculation to ensure only starter culture bacteria are present and growing. If a culture is used in home fermentations, be sure to follow the directions accompanying the culture. However, culture inoculation may result in a less complex flavored product especially if the culture contains only a few fermenters.

Salt

Salt provides many functions in the fermentation process:

- Allows needed water and sugars to be pulled from the vegetables which are used as nutrients by fermenting organisms.
- Favors the growth of fermenting organisms over spoilage bacteria, yeast and mold as well as harmful bacteria.
- Allows for crisper vegetables by hardening the plant pectins and decreases the activity of pectinase, an enzyme that makes vegetables mushy.
- Allows for longer fermentation by slowing the fermentation process and decreasing the chance of undesirable mold growth.
- Gives flavor to the final product. Salt concentration is very important in fermentation, therefore salt amounts should be measured carefully and a tested recipe should be followed.

Salt concentrations in vegetable fermentations can vary from 1- 15% and are specific for the vegetable being fermented. Sauerkraut fermentation, for instance, occurs ideally under salt concentrations of 2.25–2.5% while pickle fermentation is achieved in salt concentrations of 3-5% for low-salt pickles and 5-16% in high-salt pickles.

Vegetables

Choose vegetables that are free from damage and disease. Damaged areas on the vegetables are susceptible to bacterial, yeast and mold contamination and growth. Growth of these unwanted microorganisms can negatively affect the quality of the product and the fermentation process. Certain vegetable varieties and sizes will ferment better than others. For instance, small pickling cucumbers will ferment more efficiently than larger cucumbers. Large salad cucumbers do not ferment well and do not make good quality product. Selection of cabbage: King Cole, Bravo, Krautman, Sanibel and Danish hybrids of cabbage are better for making sauerkraut as they contain larger amounts of sugar for fermenting. In general, larger heads of cabbage contain more sugar and would be more suitable for fermenting. However, smaller heads of cabbage can also be used successfully. The cabbage core should be removed since the fermented core can cause sliminess.

Spices

It is important that you follow tested and proven recipes. Many of the tested and proven recipes have spice addition options that will allow you to personalize your fermentation. Choose whole fresh or freshly dried spices. Ground and flaked dried spices can be difficult to use since they can float to the top of the fermentation and may mold over time. Older dried spices have a higher chance of mold content when compared to fresh spices or newly dried spices.

Container Choice

Not all container materials are suitable for fermentation. Fermentation occurs in salty, acidic conditions. Metal, except for highgrade commercial stainless steel, can degrade and pit so is usually not recommended. Ceramic crocks and plastic containers are more suitable. Any food container chosen should be easy to clean and free from deep scratches, chips or pits that can harbor harmful bacteria or can affect the fermentation. Wooden containers have been used to ferment vegetables but can be difficult to keep clean and

sanitary. Containers and other equipment should be washed in hot soapy water before using. Do not use chlorine bleach to sanitize the equipment as the remaining chlorine and chloramine residues on the equipment could inhibit the growth of fermenting organisms. If chlorine bleach is used, the equipment should be rinsed thoroughly to remove any residual chemicals.

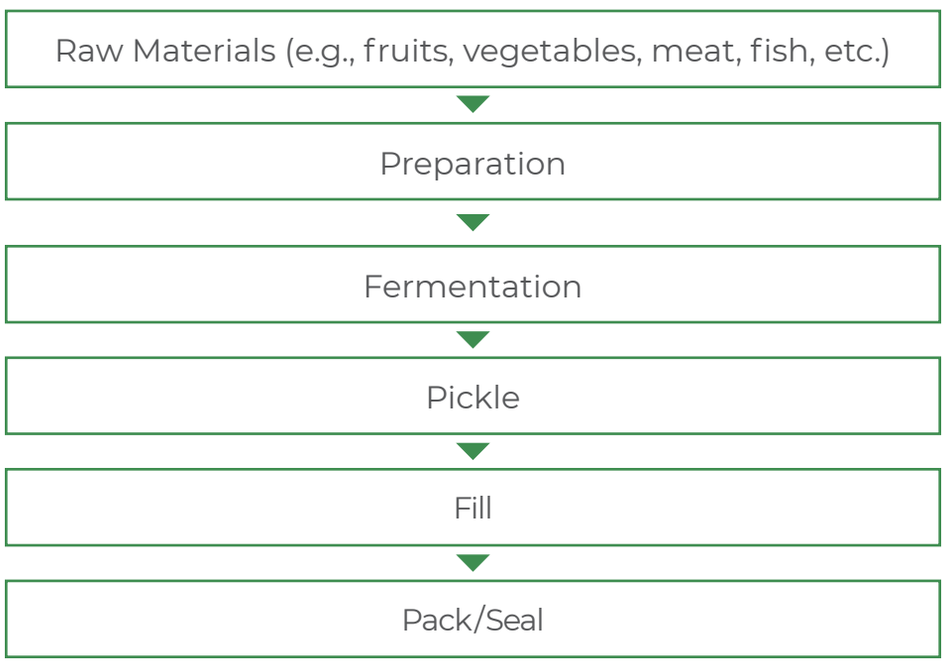


Figure 5. Technological scheme for production of fermented foods [42]

Recipe: Fermented carrots

Ingredients	Amount, g
Carrot	1 000
Chilli pepper	50
Ginger	10
Lime juice	25
Salt	15
Sugar	5
Garlic	10

Instructions:

1. Chop or grate carrot to desired size and shape.
2. Chop or grate ginger, chilli pepper and garlic.
3. Add salt, sugar and lime juice.
4. Mix well and rub with hands.
5. Let it stand for about 10-15 minutes.
6. Put obtained mix in a suitable container to ferment. When filling the container make sure to fill it tightly and do not leave air caps.
7. After filling, squeeze the mix until liquid appears on top.
8. Leave some room on top of the container for additional liquid separation.
9. Ferment at room temperature according to preferred taste.
10. When desired taste is obtained keep fermented carrots refrigerated.
11. Enjoy!

Recipe: Classical kimchi (Baechu kimchi)

Ingredients	Amount, g
Napa cabbage	2 000
Salt for salting	240
Ginger	30
Garlic	45
Chilli powder (gochugaru)	80
Fish sauce	15
Sugar	15
Salt	15
Leek	120
Daikon	80

Instructions:

1. Chop napa cabbage. Firstly cut napa in quarters and remove the stem. After that chop quarters making cuts about every 5 cm.
2. Put chopped napa cabbage into suitable container and add salt. Rub napa cabbage with salt until it softens a bit.
3. Add water until everything is under water and cover everything with something heavy that puts slight pressure on the chopped napa cabbage.
4. Wait about 4-6 hours.
5. Strain napa cabbage from salty water and rinse it with cold water to remove excess saltiness.
6. Clean ginger and garlic.
7. Weight together ginger, garlic, chilli powder, fish sauce, salt and sugar. Blend them together until you have an even paste. If needed, add small amount of water.
8. Chop leek and daikon preferably to similar size pieces as napa cabbage. You can also grate daikon.
9. Squeeze rinsed napa cabbage pieces gently to remove excess water. Then add the paste and chopped leek and daikon.
10. Mix everything well.
11. Put obtained kimchi in suitable containers to ferment. When filling the container make sure to fill it tightly and do not leave air caps.
12. After filling, squeeze the kimchi until liquid appears on top.
13. Leave some room on top of the container for additional liquid separation.
14. Ferment at room temperature according to preferred taste.
15. When desired taste is obtained keep kimchi refrigerated.
16. Enjoy

4.2. Innovative jams and purees

Jams and jellies contains about 60% of sugar. In addition to providing sweet taste, sugar interacts with water andhydrocolloids affecting sol-gel transition, contributes to total soluble solids (TSS) and participates in caramelization and/or Maillard reaction [44]. Therefore sugar reduction is also affecting technological properties of jam production.

Fruits and berries are a natural source of pectin, a polysaccharide that is the main factor influencing the consistency of jam. While keeping the sugar content low it might be necessary to add some extra thickeners. One of the possibilities is to use addition of extra pectine or some other fibers that help to improve the texture but also enhance the nutritional properties. In the western diet lack of fibers is one of the main concerns. Unlike commercial fruit jams, fibre-enriched gels study has shown that it can be declared as “source of fibre”, and are the basis for the production of healthy confectionery jams with this label claim. Furthermore, the possibility of using fibre from non-fruit sources allows to increase the insoluble fraction of fibre in the final product. Particularly favourable results were obtained with the mix of psyllium with another type of fibre. Therefore, gels with pectin enriched with psyllium mixed with apple, bamboo or wheat fibre seem to be the most recommendable for further development of healthy confectionery jams. [32] Fruit dietary fiber can be used as a stabiliser instead commercial thickeners. A study was conducted where physical and sensorial properties of strawberry jams using fruit dietary fibre as a stabiliser were evaluated and compared with those made with a commercial thickener. The physical results were good and sensory evaluation indicated that high fruit dietary fibre jams were as acceptable as conventional jams. [33]

Besides fibers, chia seeds are another possibility to increase the viscosity of the jams and same time they provide other health benefits. Chia seeds are again rich in fiber but also in omega-fatty acids. Chia seeds are also rich in differnet minerals like calcium, phosphorus, magnesium and manganese.

The sweetness of jam witout any added sugars depends on the sweetness of raw materials. While it might be easy to receive the desired sweetness for jams made of figs and dates it is more difficult with berries. To increase sweetness of jams there are other possibilites besided sugar addition.

1) Use of juice concentrates (e.g. bananana, grapes etc)
2) Use of intensive sweeteners (stevia, sucralose etc)
3) Use of sugar alcohols (polyols)

As some studies have shown, probiotics can be used in jams. Fruit jams have been shown to be a suitable carrier for the delivery of probiotics. Blueberries are a good candidate for producing a novel and healthy non-dairy probiotic food which could effectively deliver probiotic L. plantarum, L. fermentum, P. acidilactici and P. pentosaceus strains under refrigerated conditions, and may have the ability for a possible industrial application in the production of lacto-fermented blueberry jam. [34] Also peach jam has shown to be potential carrier of Lb. rhamnosus probiotic strains either at refrigerated conditions or at room temperature. [35]

4.3. Drying technologies

Drying is the process wherein moisture is removed from the food material as a result of concurrent heat and mass transfer. Heat is applied through conduction, convection and radiation to force water to vaporises, whilst removal of vapours is achieved by employing forced air. Foods such as fruits and vegetables have a high moisture content of more than 80% which makes them highly susceptible to spoilage causing bacteria. Dehydration preserves food in a stable and safe condition by reducing water activity, extending the shelf life much longer than that of fresh produce. Considering the perishable nature of fruits and vegetables it is necessary to preserve them and drying is one such method to do it especially in developing countries like India where cold storage facilities are poorly established. [47]. Energy utilization and nature of dried items are basic parameters in the choice of drying process. An ideal drying system for the arrangement of value dried out items is savvy as it shortens the drying time and makes least contamination the item. To diminish the energy use and operational cost new measurements came up in drying procedures. [48]

Convective drying: Convective method of drying is employed to remove water from the food substances through the application of heat in equipment meant for drying. Hot air is allowed to pass through the product in a manner to transfer the heat to the food and moisture is removed.

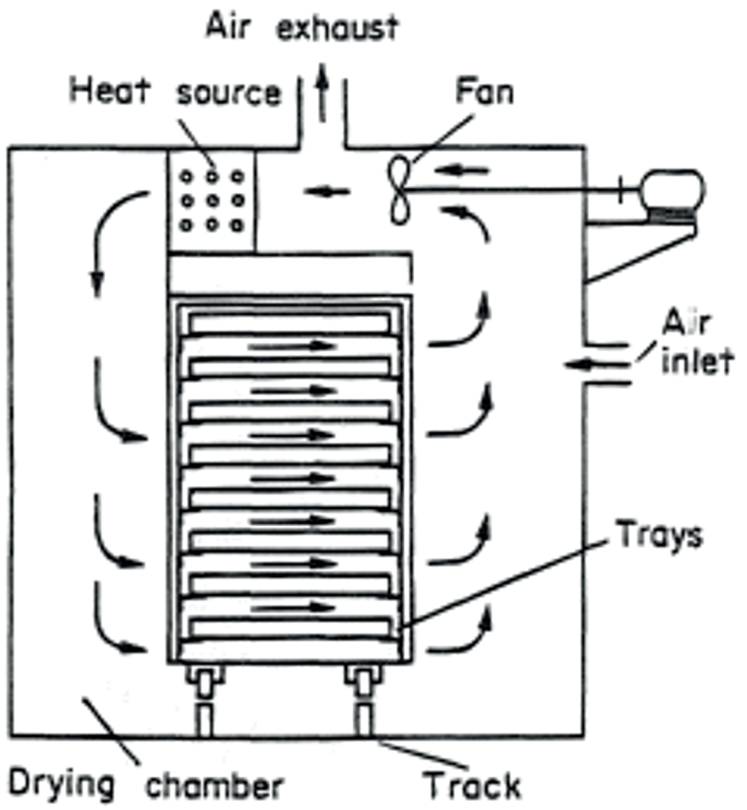


Figure 6. Scheme of conventional drying [49]

Freeze-drying (or lyophilisation) is a drying method, largely employed in the food industry. It consists in the freezing of the product, followed by sublimation of the ice at reduced pressure. Among drying processes, freeze-drying is considered to be the gentlest one, as it causes negligible damage to the product microstructure, allowing fast rehydration rates and high rehydration capacity, and good preservation of the physical chemical properties. [45]

Freeze-dryers are regularly designed with four basic components: a drying chamber, a vacuum pump, a heat source, and a condenser (Figure 7). The correct selection and operation of these components are critical to reach the benefits of the lyophilization process and depend on the requirements of each product. [46]

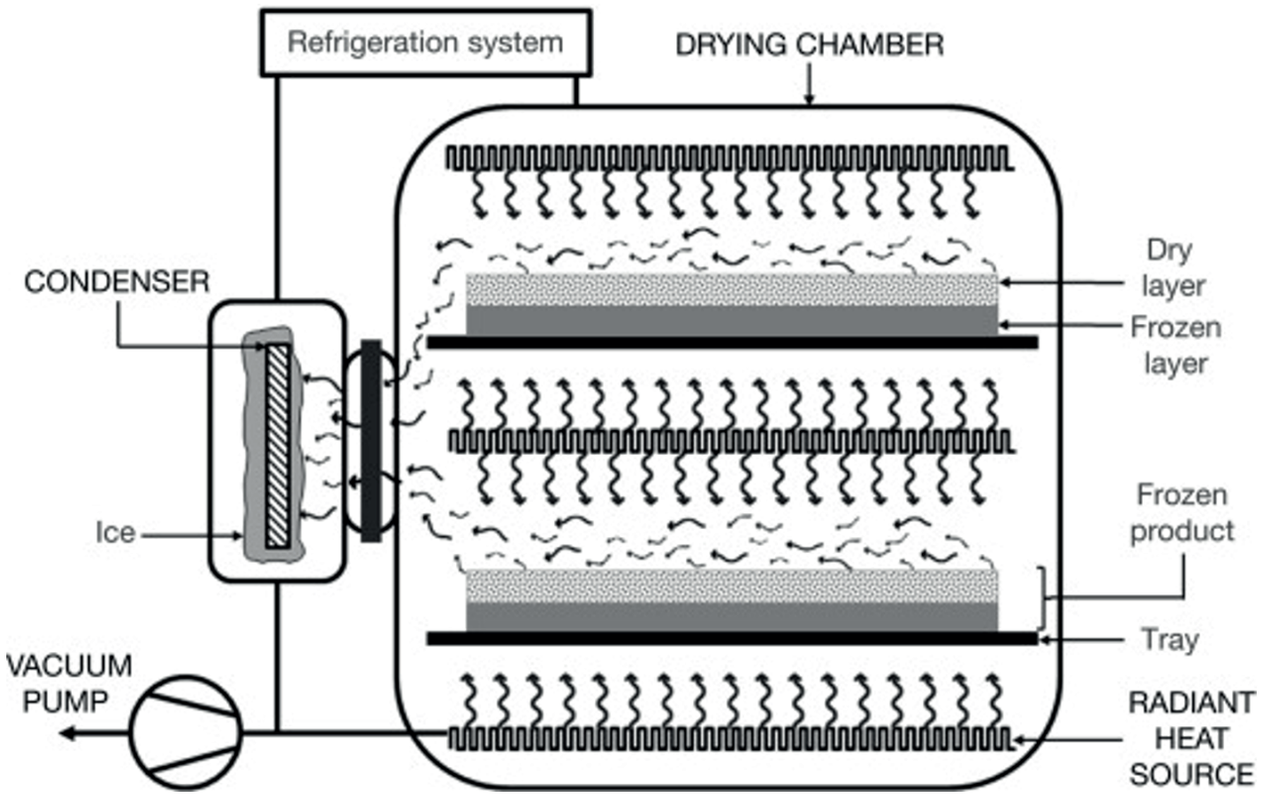


Figure 7. Basic components of a typical freeze-dryer system [46]

Table 4, presented below is giving an overview of different drying methods and mechanicms behind it. Also, the advatages and misadvantages of differenr menthods are brought out.

Table 4. Characteristics of selected conventional drying methods. [46]

Drying Method	Drying Agent	Feed Type	Mechanism	Advantages	Disadvantages	Application
Convective drying (CD)	hot drying air	Solids-fruits, vegetables, fruit and vegetable pomace	Moisture exchange between the food product and the hot air flowing through the drying chamber	Long shelf-life, simple design; Easy operation; Low cost	High inlet gas temperature or very dry gas; Long drying time, exposure to oxidation; Generates off flavors; Crust formation on the product surface due to the high temperatures	Food industry; Vegetable and fruit dry products; Pomace processing—functional ingredients production

Drying Method	Drying Agent	Feed Type	Mechanism	Advantages	Disadvantages	Application
Spray drying (SD)	hot drying gas (usually air)	Liquid- i.e., juices, purée, solutions, vegetable milk	Transformation of liquid product into dry powder form in one-step processing operation	Low moisture content and high-quality products; Long shelf-life; Similar size and shape of dried material; Continuous operation Lower cost than freeze-drying	Might lead to bioactive compounds loss and stickiness due to the high temperature, equipment size, products with large fat content require a defat process, high installation cost	Powder production; Microencapsu-lation; Production ofinstant powders
Freeze-drying (FD)		Liquid- i.e., juices, purée, solutions, vegetable milk	Two steps process: (1) freezing the water from the raw material; (2) heating of the frozen solid to induce the moisture sublimation	Prevents oxidation damages; Minimize chemical compounds changes; Minimal shrinkage and shift of soluble solids; Retention of volatile compounds; Maintenance of porous structure	Very high facilities cost; Slow and expensive process	Production of heat-sensitive compounds i.e., vitamins, microbial cultures, and antibiotics; Production of high-quality products with high final cost: exotic fruits, vegetables, soup ingredients, mushrooms, and juices
Osmotic dehydrati-on (OD)	sugar, salt (sodium chloride) solutions, concent-rate juices, polyols solutions	Fruits, vegetables	Moisture reduction by immersion of the raw material in a high osmotic pressure solution → moisture transfer from the food to the solution driven by the difference in osmotic pressure	Maintenance of the physicochemi-cal and sensory parameters; When carried out in concent-rated juices might enhance product quality	High final moisture content; Usually needs further drying; High content of sugar or salt in the product when dehydrated in this type of solution; Difficulty in predicting final chemical composition when dehydrated in concentrated juices	Fruit chips production; Production of dried fruits i.e., plums as a pre-treatment before further drying
Intermit-tent drying	hot air, microwave power, vacuum and infrared	Fruits, vegetables	Intermittent microwave heating is led by applying microwave energy as sequential pulses, where power ratio has an important role in drying kinetics	Protect bioacti-ve compounds, color, texture; reduce the browning effe-cts and enhan-ce the shelf life	Higher power ratio can damage important compounds such as ascorbic acid.	Plant-based food material; Fruits: kiwi, papaya, banana, guava, carrot, etc.

5. Successful practices in producing value-added food products from fruits and vegetables

5.1. Practices in the Europe

The organic market in Europe continues to grow. Spain continues to be the country with the largest organic area in Europe, followed by France. Globally, European countries account for the highest shares of organic food sales as a percentage of their respective food markets. Denmark is the first country to surpass the ten percent mark and has the highest organic share (11.5 percent) worldwide [50]. The most popular organic segment is fruit and vegetables. A producer who can take advantage of this growing market share will succeed. For example, the Lithuanian manufacturer's brand Auga, whose selection includes both pickled and ready-to-eat ecological vegetables.

Organic ready-to-eat black beans, no brine

Organic ready-to-eat kidney beans, no brine

Organic ready-to-eat chickpeas, no brine

Organic ready-to-eat brown lentils, no brine

Organic champignons marinated

Organic champignons in brine

Similar to most other packaged food categories in Sweden, processed fruit and vegetables has received a significant boost from the COVID-19 pandemic. More at-home food preparation and cooking in light of moves to remote working and studying has seen a spike in sales of all types of processed fruit and vegetables [53].

In Germany the increased time spent at home has particularly stimulated demand for frozen fruit and frozen processed vegetables in 2020, with many consumers stockpiling frozen products during the lockdown in spring. Consumers' demand for healthy and convenient products to integrate into their everyday diet remain a major driver for sales of processed fruit and vegetables. Private label, led by Aldi and Rewe, dominates in processed fruit and vegetables, partly as a result of the major sales share of the category held by discounters as a distribution channel [54].

Whether the business is small or large, wholesomeness and naturalness are increasingly important for the consumer.

5.2. Practices in Estonia

Estonia is concidering itself more and more as a green country practicing organic farming. In 2019 almost 23% of all of the agricultural land was farmes following organic practices. It is one of the highest in Europe. Organic production in more expensive but it also enables a higher procing for your products.

One of the most successful agricultural companies in Estonia is Kadarbiku Farm. Kadarbiku Farm is situated in Tuula Village in the Saue Rural Municipality, Harju County. They started farming on these lands back in 1989, and the family business Kadarbiku Köögivili OÜ was established in 2004. Kadarbiku Farm specialises in growing and processing vegetables. They have 250 ha of our own arable land, 700 ha of land in use, where we grow carrots, cabbages, beetroot and various summer vegetables. Kadarbiku has gained wider recognition thanks to its vegetable juices and smoothies. They produce more than a million litres of juice per year using the vegetables we grew ourselves and imported fruit mixtures. All juices are made from freshly pressed fruits and vegetables and are only slightly pasteurised in order to preserve all the good vitamins. No preservatives, colouring agents or sweeteners are added to Kadarbiku juices.

Orkla company is a leading food company in Estonia which ows among others Põltsamaa brand from year 1920. Põltsamaa´s advertising slogan “Genuine and good” and is known to all Estonians. A large and well-known manufacturer is also Salvest from year 1946. The product range of these companies is broadly similar. Pickeled cucumber has the widest products range, also very loved are different vegetable salads, following tomato sauces and kechups, sauerkraut and not to forget jarred peas. Toome salad is one of the most known vegetable salads in Estonia (fresh cucumber, onion, carrot, rapeseed oil, salt, sugar, acidity regulator, spices). Mostly in winter Estonians consume jarred pumpkin salad (pumpkin, drinking water, sugar, acidity regulator, spice flavorings, carrot and pumpkin concentrate). Most loved jams are classical strawberry and raspberry jams. And of course apple jam is a favorite for some. Exotic jams such as orange, apricot have become more popular. Blackcurrant, blueberry, cloudberry and lingonberry jam are loved from local berry jams. New hits from Salvest are ecological pear and mango puree in a 400 gram jars.

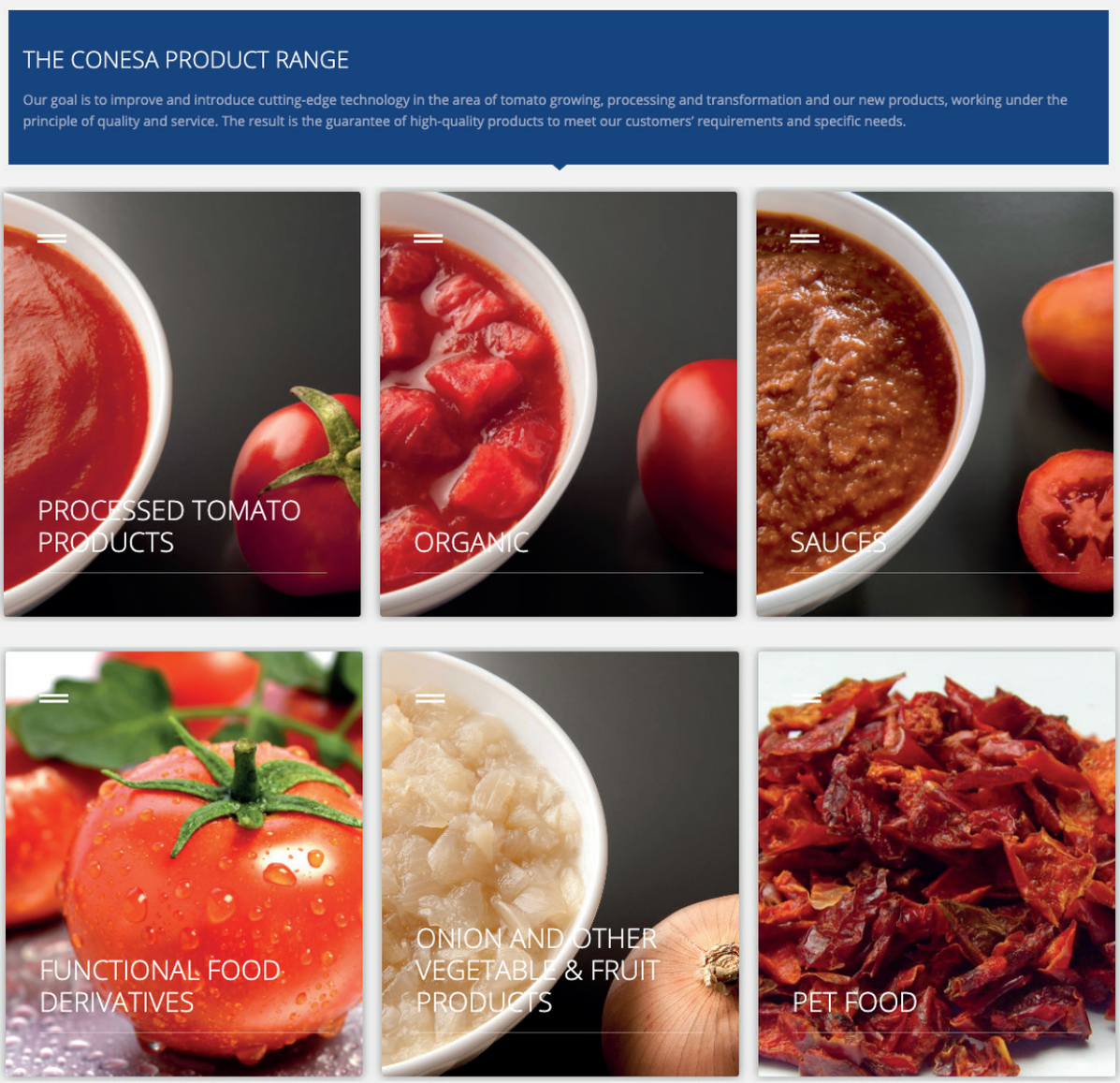
Another good example is Estonian company named RootBioMe, which offers flavored, fermented and freeze-dried Jerusalem artichoke chips with added lactic acid bacteria. These products are made in collaboration with researchers from the University of Tartu.

However, Nonna Organic OÜ offers organic freeze-dried Jerusalem artichoke flour, which has high inulin fibre content and therefore a prebiotic effect.

MEKI brand from Freezedry OÜ offers different types of freeze-dried products from berries to mushrooms. Freeze-dried berries are consumed on their own or used for preparation of tea. As the price of the products is quite high due to the expensive production processe, it´s till more of a niche product.

5.3. Practices in Spain

Spanish consumers began to stock up on shelf stable vegetables shortly before the COVID-19 lockdown period began. Consumers planned their purchases and these types of product were included in many shopping baskets. Shelf stable tomatoes is also set register an increase in retail sales in 2020 due to the lockdown of consumer foodservice and consumers being forced to cook more at home. Tomatoes are a key ingredient in many popular dishes in Spain, including gazpacho, garlic/tomato bread drizzled with olive oil, bean stews and a variety of sauces [55]. The leading Spanish tomato processing company Conesa Group has its own organic and functional food segment [56].



Examples of family businesses and creative new products can be found in each country. Huerto Gourmet from Spain is a pioneer in the production and packaging of fresh Spanish lemon caviar (finger lime) and directly involved in the hotel and restaurant sector.

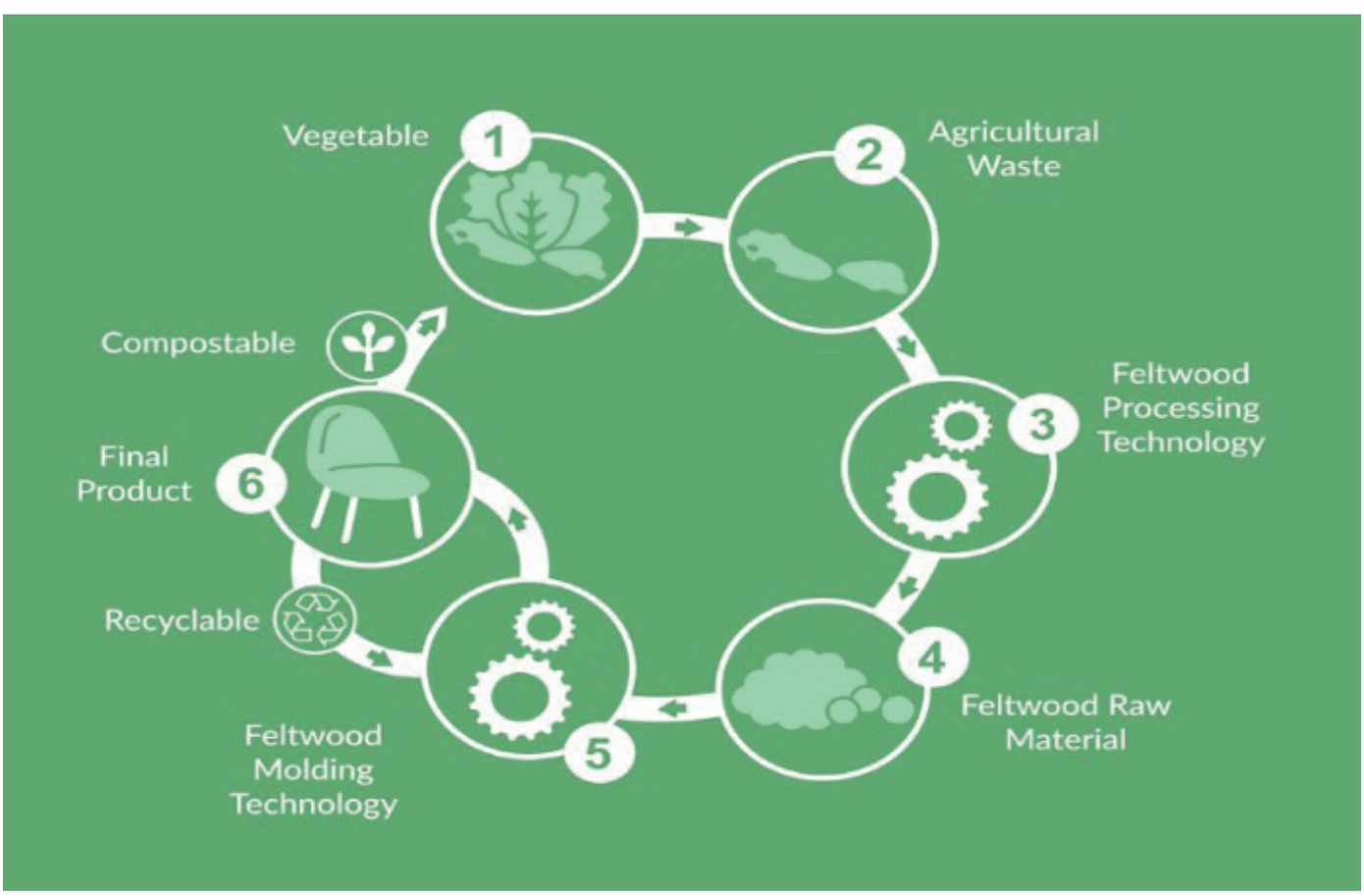
Toñifruit is dedicated to the production of quality organic citrus fruits, in the southeast of Spain, for 4 generations back in the 19th century, when the Pedro Rubio Andreo and Maria Fulgencia Martinez Aledo family started to grow lemon trees in a traditional way.

Another successful big venture that grew out of a family business is Marín Giménez, founded in 1957 as a family vegetable canned company, is nowadays a reference within the sector, due to its renewed technology for pieced fruit in aseptic packaging and the continuous development of new tailor made products for each client. Marín Giménez currently supplies its products to the dairy, beverage, marmalades and baby food sectors. However, Marín Giménez has recently incorporated to its range of products Individually Quick Frozen (IQF) fruit processing by using cryogenic technology.

MarínGiménez
fruit solutions

Since 1958, Cazorla Group is working to continue being an example of quality and innovation in the olive sector producing a wide range of tastes. Equipped with the newest machinery and technology and under strict supervision of qualified personnel, Cazorla Group prepare to offer products whose food safety and durability are guaranteed with an annual processing capacity of 51,000,000 kg of olives.

Alongside large and family businesses have emerged startups. By contrast, the start-up company Feltwood in Zaragoza, Spain, is approaching agriculture on the other hand. Feltwood develops technologies to produce ecological industrial materials, composed of 100% vegetable fibers, using agricultural waste products.



5.4. Practices in Turkey

According to Agriculture and Rural Development Support Institution (TKDK), processed fruit and vegetables (for example; tomato and paprika paste, grape molasses, marmalade, jam, pickle, fruit and vegetable juices, conserve, vinegar, brine and hazelnut paste etc.), processed meat, dried fruit and vegetables, olive and olive products, boza, salep, spices, traditional foods, rock salt, herbal teas, sesame oil, sauce and bone broth are one of the most important value-added food products in Turkey [57]. Turkey's export potential of value-added agricultural products is increasing. The number of countries exported tomato paste and canned food has increased and then annual exports in processed fruits and vegetables approached the limit of 1.5 billion dollars. Canned vegetables, which are the biggest items in exports, increased by 6% to 120 million dollars, tomato paste increased by 13% to 106 million dollars, and fruit juice exports were 111 million dollars [58].

Turkey's exports of high value-added agricultural products increased rapidly, the production of processed fresh vegetables and fruits adds flavor to world cuisine. Exports are made to 190 countries, mainly to European countries. The export share in the conservation grew from 1 billion 550 thousand dollars to 1.6 billion dollars. Among the products we export are sunflower oil, canola oil, corn oil, frying oil, canned fruits, canned vegetables, various pickles, gherkins, jalapeno pickles, capers, roasted peppers, roasted eggplant, ajvar sauce, tomato paste, tomato products, ketchup. mayonnaise, pasta sauces, pizza sauces, dip sauces, meat sauces and salad dressings [59].

Pickles

According to data Aegean Exporters' Association, Turkey has sold pickles to 98 countries in 2019. 217 million 638 thousand dollars were earned in return for this sale. Pickle exports in the first 4 months of this year increased by 30% compared to the same period last year, reaching 76 million dollars. During this period, the most exported product was **pickled peppers** with $ 34 million, followed by **pickled gherkins** with $ 26 million and mixed vegetable pickles with $ 11 million. Due to the new type of coronavirus (Covid-19), demand for both fresh fruits and vegetables and processed products has increased in many countries, especially European countries [60]. There are many small and big scale pickle producers such as Tat, Penguen, Aysan, Yöre and Melis etc. in Turkey

Fruit and vegetable juices

Turkey's juice exports broke a record in 2020 with 322 million 800 thousand dollars. In terms of variety, **apple juice** and **apple concentrate** were mostly exported. While especially peach, cherry, apricot and mixed fruit nectars are consumed in the domestic market, apple juices have gained importance in exports. The increasing demand for apple, pomegranate, tomato and grape juice and especially 100% fruit juice in the domestic market in line with the changing trends in recent years has brought these products to a significant position in the domestic market [61]. Cappy, Dimes, Pınar, Juss and Aroma are one of the most popular fruit and vegetable juice company brands in Turkey.

Jams and marmalades

Turkey was exported jams, jellies and marmalades to 135 countries, earning 36 million 818 thousand dollars. Most of the exports were made to Iraq. Total production of jam in Turkey is around 150 thousand tons. Jam consumption per person is around 2.5 kilograms per year when considered together with home production [62]. Jam is a delicious and energizing product that can be made with any fruit. In Turkey, raspberry, strawberry, cherry and apricot jam are frequently consumed.

Dried fruit and vegetables

It is reported that exports of raisins, dried apricots and dried figs exceeded the $ 1 billion threshold in the 2019-2020 season. It was stated that the exports of raisins, apricots and figs reached 1 billion 5 million dollars, corresponding to 414 thousand 878 tons in the 2019-20 season. According to the data of Aegean Exporters Union, 80% of Turkey's exports of raisins was done to the European Union countries, England was the country with the highest demand [63].

Tea

According to the information compiled from the data of the Eastern Black Sea Exporters Union (DKİB), 2 thousand 753 tons of tea were exported in the January-August period. During this period, the amount of tea exported increased 15% compared to the same period last year. On a value basis, tea exports increased by 33% compared to the same period of the previous year and reached 10 million 772 thousand dollars.

Spices

Turkey's spice exports in 2020 increased by 15% over the previous year rose to 201 million 735 thousand dollars. According to data compiled by Aegean Exporters' Association of Turkey, spices (such as bay, thyme and cumin) earned 175 million 542 thousand dollars in 2019.

Hazelnut paste

Most of the exported hazelnuts are in a raw material form, the foreign currency input provided can be considered as high. However, the economic return can be increased 6-7 times by processing and by adding added value [64]. Hazelnut paste products are produced by sorting the hazelnuts collected in the season, separating from their shells and roasting. Then, the roasted hazelnuts are pounded, and products such as hazelnut oil are added to the puree and delivered to our tables.

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