COLEAD

SECTOR STUDY

PROCESSED AVOCADO

Funded by
the European Union

This publication has been developed by the Fit For Market + programme, implemented by COLEAD within the framework of the Development Cooperation between the Organisation of African, Caribbean and Pacific States (OACPS) and the European Union (EU). It should be noted that the information presented does not necessarily reflect the views of the donors.

This publication has been developed by the New Export Trade Kenya programme is implemented by COLEAD, funded by the European Union (EU) and established in collaboration with the EU Delegation in Nairobi and Kenyan stakeholders. It should be noted that the information presented does not necessarily reflect the views of the donors.

This publication is part of a collection of COLEAD resources, which consists of online and offline educational and technical tools and materials. All of these tools and methods are the result of more than 20 years of experience and have been developed progressively through COLEAD's technical assistance programmes, notably in the framework of development cooperation between the OACPS and the EU.

The use of particular designations of countries or territories does not imply any judgement on the part of COLEAD concerning the legal status of these countries or territories, their authorities and institutions or the delimitation of their frontiers.

The content of this publication is provided in a "currently available" form. COLEAD makes no warranty, direct or implied, as to the accuracy, completeness, reliability or suitability of the information at a later date. COLEAD reserves the right to change the content of this publication at any time without notice. The content may contain errors, omissions or inaccuracies, and COLEAD cannot guarantee the accuracy or completeness of the content.

COLEAD cannot guarantee that the content of this publication will always be current or suitable for any particular purpose. Any use of the content is at the user's own risk and the user is solely responsible for the interpretation and use of the information provided.

COLEAD accepts no liability for any loss or damage of any kind arising from the use of, or inability to use, the content of this publication, including but not limited to direct, indirect, special, incidental or consequential damages, loss of profits, loss of data, loss of opportunity, loss of reputation, or any other economic or commercial loss.

This publication may contain hyperlinks. Links to non-COLEAD sites/platforms are provided solely for the information of COLEAD staff, its partner-beneficiaries, its funders and the general public. COLEAD cannot and does not guarantee the authenticity of information on the Internet. Links to non-COLEAD sites/platforms do not imply any official endorsement of, or responsibility for, the opinions, ideas, data or products presented on those sites, or any guarantee as to the validity of the information provided.

Unless otherwise stated, all material contained in this publication is the intellectual property of COLEAD and is protected by copyright or similar rights. As this content is compiled solely for educational and/or technical purposes, the publication may contain copyrighted material, the further use of which is not always specifically authorised by the copyright owner.

Mention of specific company or product names (whether or not indicated as registered) does not imply any intention to infringe proprietary rights and should not be construed as an endorsement or recommendation by COLEAD.

This publication is publicly available and may be freely used provided that the source is credited and/or the publication remains hosted on one of COLEAD's platforms. However, it is strictly forbidden for any third party to state or imply publicly that COLEAD is participating in, or has sponsored, approved or endorsed the manner or purpose of the use or reproduction of the information presented in this publication, without prior written consent from COLEAD. The use of the contents of this publication by any third party does not imply any affiliation and/or partnership with COLEAD.

Similarly, the use of any COLEAD trademark, official mark, official emblem or logo, or any other means of promotion or advertising, is strictly prohibited without the prior written consent of COLEAD. For more information, please contact COLEAD at network@colead.link.

FIT FOR MARKET+
NEXT KENYA EU
Funded by the European Union

This document is the avocado sector study. This study explores the technical and economic feasibility of different processing and waste valorisation activities. The chapters can be found as standalones here: resources.colead

Contents

1 AVOCADO OIL

This chapter has been developed by the Fit For Market +, implemented by COLEAD within the framework of the Development Cooperation between the Organisation of African, Caribbean and Pacific States (OACPS) and the European Union (EU).

This chapter has also been developed by the New Export Trade Kenya programme, implemented by COLEAD, funded by the European Union (EU) and established in collaboration with the EU Delegation in Nairobi and Kenyan stakeholders.

This chapter has been produced with the financial support of the EU and the OACPS. Its contents are the sole responsibility of COLEAD and can under no circumstances be regarded as reflecting the position of the EU or the OACPS. (more information).

Funded by
the European Union

Contents

1. Avocado oil

1.1 What is avocado oil?

Avocado oil[1] is oil that has been pressed largely from the flesh of avocadoes, although the peel and seeds can also be used; the parts of the avocado that are used will influence the quality of the oil (premium, medium or low).

Avocado oil has a mild taste, is nutritionally rich and has a high smoke point.[2] This makes it an ideal replacement for cooking oils such as sunflower oil, or even for olive oil in salads and sauces. Avocado oil tends to be sold as unrefined oil, which allows it to retain flavour and the mild green colour of avocado.

Avocado oil is also used in the beauty industry, in lotions, cosmetics, hair products, etc. In these applications the oil tends to be bleached and more refined and is pale yellow in colour.

Avocado oil is also sometimes used in the pharmaceutical sector, particularly in recipes for supplements. However, this use is not yet common. As there is currently a popular perception of avocado as a healthy fat, an increasing number of new innovations that use avocado oil are being brought to the market. These come in various formats, such as capsules or powders for smoothie mixes.

Estimates suggest that only a small share of avocado production globally is used to produce oil. This makes it a far smaller market than fresh avocadoes.

Figure 1. Uses of avocado oil

Source: Brand websites: from the left, Hellman's, The Body Shop, Metavo

1.2 Avocado oil's competitors

As avocado oil can be used in foods, cosmetics and pharmaceutical products, there are some direct competitors, from avocado-producing countries, and indirect competitors to consider.

Indirectly, avocado oil also competes more widely with premium oils that are perceived to have health benefits. Olive oil has the largest market share in this segment. Increasingly, however, a wider variety of oils are growing in popularity. Almond, macadamia and coconut oils are

1 Avocado oil can be sold as oil or butter under HS codes 15159091 and 15159099.

2 The temperature at which an oil or fat (especially one used for cooking) begins to emit smoke. Surpassing the smoke point can create undesirable burnt aromas and flavours.

popular in the food and cosmetics sector and are sometimes used in the pharmaceuticals sector for balms, ointments and supplements.

Shea butter is a major competitor in the cosmetics sector, along with premium fruit oils such as citrus and mango, tea tree oil, and floral oils such as magnolia, rose and citronella. In the pharmaceuticals sector, avocado oil competes against fish oils and new plant oils such as moringa, flaxseed and grapeseed.

A wide variety of floral, botanical, fruit and seed oils are being used in the cosmetics industry. As the variety of oils being used in cosmetics is increasing, so is the number of countries that can supply these oils (e.g. European Union countries, Morocco, Egypt, Turkey, etc.).

Figure 2. Example of a cosmetic product using avocado oil

Ingredients list:
Water, Butyrospermum Parkii Butter/Butyrospermum Parkii (Shea) Butter, Theobroma Cacao Seed Butter/Theobroma Cacao (Cocoa) Seed Butter, Stearyl Alcohol, Glycerin, Helianthus Annuus Seed Oil/ Helianthus Annuus (Sunflower) Seed Oil, Bertholletia Excelsa Seed Oil, Cetearyl Alcohol, Cetearyl Glucoside, Triethyl Citrate, Fragrance, **Persea Gratissima Oil/Persea Gratissima (Avocado) Oil,** Dimethicone, Oryza Sativa Bran Wax/Oryza Sativa (Rice) Bran Wax, Phenoxyethanol, Sodium Stearoyl Glutamate, Caprylyl Glycol, Xanthan Gum, Tocopherol, Citric Acid, Caramel, CI 19140/Yellow 5, CI 42090/Blue 1.

Source: The Body Shop website

2. Demand forecast

2.1 Market trends

Trends in developed markets, such as the growth in plant-based dietary choices, healthy food concepts and the demand for new products (e.g. low-carb, high-fat burgers), suggest that avocado oil will continue to grow in popularity.

Non-seed oils

Some recent dietary trends (such as the ketogenic diet, "gut health" protocols, etc.) have created a perception that seed oils, such as sunflower and safflower oils, are inflammatory. This has pushed shoppers who follow this way of eating to look for less well-known, non-seed oils. Coconut oil has benefitted greatly from this trend, with global demand skyrocketing over the last decade. More recently, a variety of different non-seed oils – including avocado oil, but also macadamia nut and almond oils – have become available. Traditionally, these oils have been used in salads or as cooking oils. Increasingly, food manufacturers are innovating to bring new products to the market that replace seed oils with non-seed options, such as avocado oil. Popcorn with avocado oil is one such example.

Source: Brand website for Westfalia

Avocado oil has also been used to replace Medium Chain Triglyceride (MCT) oils such as coconut oil or even butter in drinks such as keto coffee. Keto coffee is a sugar-free coffee that has added butter or MCT oil and is well-loved in the ketogenic diet.

Oil infusions

Oil infusions are oils such as olive oil or avocado oil with added herbs, fruits or spices, or added aromas and/or flavours. These give the oil a distinct flavour that can enhance salads, marinades or sauces, for example. The variety of infusions available on the market is growing. Olive oil is now available in a variety of different infusions. Avocado oil, which has a subtler flavour, has followed the trend, with lemon-infused avocado oil amongst the first new product introductions. This development could help to solve a key issue facing avocado oil: a lack of clarity about how it should be used. Avocado oil can also withstand high temperatures and so is well suited to cooking.

Source: Brand website for Westfalia

Plant-based sauces and dressings

Plant-based eating is growing in popularity. To cater to this trend, many food manufacturers are creating versions of well-loved products that are vegan and contain healthier fats. For example, avocado mayonnaise, sauces and salad dressings have recently been introduced to retail stores in many markets (e.g. AH in the Netherlands, Edeka in Germany; Tesco in the UK, etc.)

Source: Brand website for Better Body Foods

Natural oils

Many cosmetics manufacturers are replacing synthetic oils with natural oils. These can include floral, herbal or even nut and fruit butters. Shoppers may perceive these oils as "safer" than synthetic oils, with more authentic ingredients. Avocado oil is used in both professional and consumer products in the cosmetics industry and is prized for its nutrient content, for its performance as a moisturiser and for its value in marketing.

Source: Brand website for Skinfood

Plant-based supplements

Plant-based eating and the growth of veganism has increased interest in natural, plant-based supplements. There are some instances where avocado oil has been marketed as a supplement in capsule form, or even as an oil for smoothies. This is still a relatively small trend; it will be important to monitor developments to better assess the size of the opportunity.

Source: Brand website for Swanson

2.2 Importing countries

Premium oils (foods)

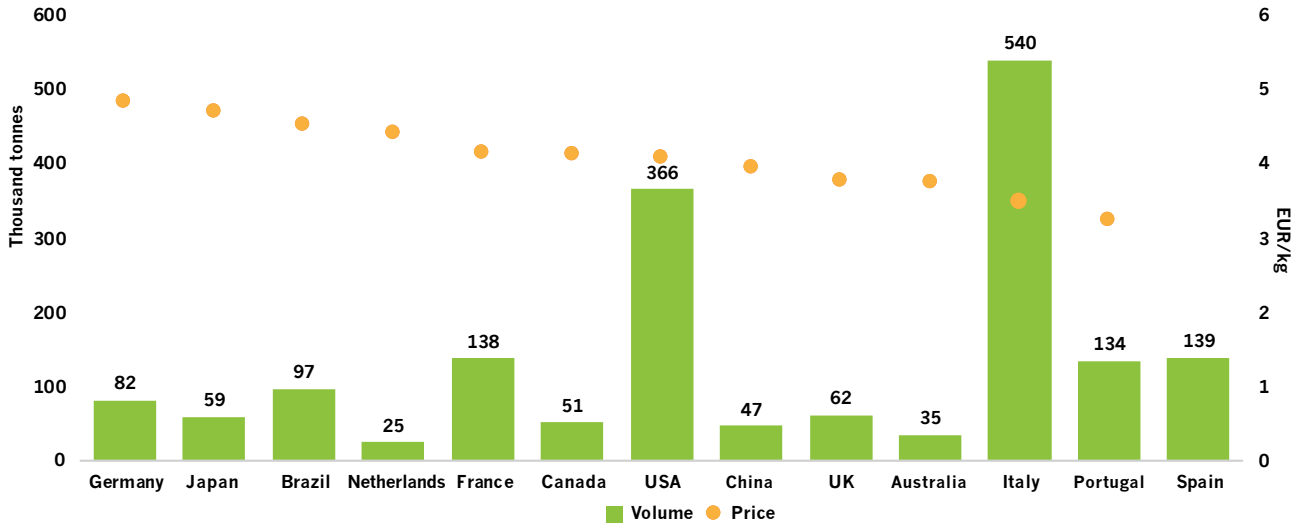
Avocado oil export statistics are difficult to find. However, it is possible to draw some conclusions from assessing the demand for olive oil and avocadoes. This data is more readily available and gives a sense of the potential demand in the market.

Figure 3 shows the average price per kilogram of olive oil paid by the 13 largest olive oil-importing nations, in order of the price paid per kilogram. Together, these countries are responsible for 90% of total olive oil imports. Within the EU, Germany, the Netherlands and France are large, premium olive-importing countries: they import large volumes of olive oil and pay a price that is higher than the global average, which is roughly €4,000 per ton. The Netherlands is a net importer of olive oil, meaning that it is also a large consumer. These countries could also be large, premium markets for suppliers of healthy oils such as cold pressed avocado oil.

Italy and Spain have large olive oil markets. However, as avocado consumption is low in these countries there could be challenges in supplying avocado oil to these markets.

2. Demand forecast

Figure 3. Olive oil imports and prices in 2021



Source: ITC Trade Map, https://intracen.org/resources/tools/trade-map

Countries with high demand for avocadoes

Another interesting opportunity for avocado oil suppliers is in converting a high demand for avocadoes into a demand for healthy avocado oil. Figure 4 shows the 10 countries that are responsible for 80% of avocado imports globally, by volume of avocado imports and price paid per kilogram.

The global average price for avocadoes is €2,646 per ton, which is greatly affected by the USA, the largest importer globally. Germany, France, Japan, the United Kingdom and the Netherlands all pay above the global average price for avocadoes. These are thus both large and premium markets for avocadoes and therefore could also be potential markets for avocado oil.

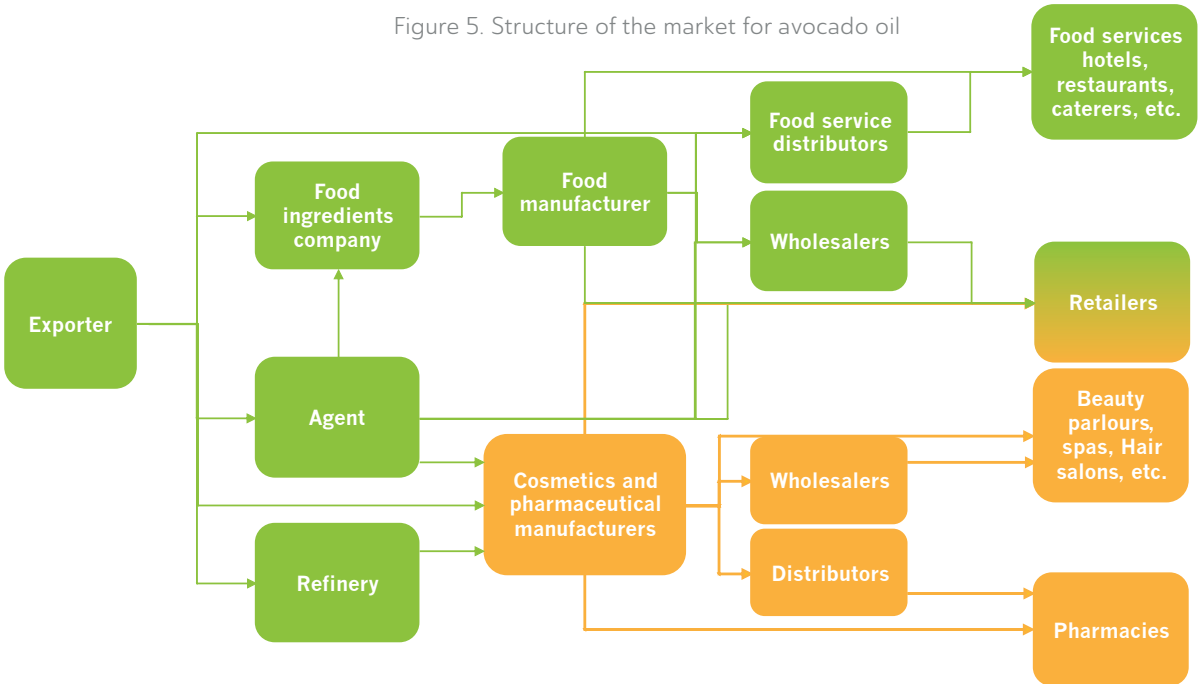
Figure 4. Avocado imports and prices in 2021

Source: ITC Trade Map, https://intracen.org/resources/tools/trade-map

This analysis also shows that a few EU-based countries – Germany, France and the Netherlands – are large premium markets for both olive oil and avocadoes. This suggests that these countries represent a good opportunity for suppliers of avocado oil.

2.3 Market structure

Figure 5. Structure of the market for avocado oil



The many potential end markets for avocado oil mean that there are many actors in the chain. There is also a variety of routes that the product can follow to market (Figure 5).

It is possible for an exporter to trade directly with food manufacturers and with cosmetic and pharmaceutical companies. This is more likely for premium oils rather than crude oil, which needs to be refined.

European manufacturers increasingly prefer to partner with ingredients companies or agents based in Europe. These partner companies tend to be specialists importing and distributing natural ingredients. Some specialist importers of avocado oil in the EU are De Lange, Gustav Hees and SanaBio (cosmetics).[3]

Some European manufacturers are able to use refined oils in their final products. This is most common in the cosmetics sector, with companies sourcing refined avocado oil from specialist oil refineries in the EU. Companies in the Netherlands, Italy and Germany play an important role in sourcing crude oil and then refining these oils for cosmetics.

In the food sector, Westfalia plays an important role in importing and distributing their own branded and bottled avocado oil into the EU and the UK. Westfalia is therefore a hybrid actor that is both an exporter and a food ingredients company, marketing both avocado products and dried mango. This hybrid structure allows a good distribution network for the Westfalia avocado oil brand, especially in the UK and in British supermarkets abroad (e.g. Spinneys in Dubai).

Manufacturers producing foods, cosmetics or pharmaceutical products bottle and package the oils or use them as ingredients in new products such as salad dressings, or in cosmetics and supplements. The finished products then follow existing distribution routes to households. In the case of foods, this might be via retail stores, while cosmetic and pharmaceutical manufacturers rely on retail and pharmacies to distribute their products to households. Finally, products that have been designed for professional beauty services such as spas and hair salons reach the market through specialist distributors.

3 Sourced from Confederation of British Industry (CBI) (2021) Entering the European Market for Avocado Oil. https://www.cbi.eu/market-information/natural-ingredients-cosmetics/avocado-oil/market-entry

3. Regulatory and quality requirements

3.1 Product specifications

Table 1. Product specifications for avocado oil

Item	Specification
Appearance	Pale green, thick
Flavour	Subtle hints of avocado
Shelf life	12–19 months
Storage conditions	Store at room temperature, out of direct sunlight and control exposure to oxygen.
Variety	Hass avocadoes are preferred for extra virgin oil Crude oil can be produced using other varieties
Acidity	This is especially important. Requirements are set by buyers of extra virgin oil.
Packaging	Bulk oil: 210 litre drums

3.2 Food safety and quality management

Mould and yeast control

Warmth creates good conditions for mould and yeasts to grow in ripening avocadoes. Processors need to be mindful of this and take steps to control mould and yeast in the ripening room and should screen fruit entering the processing steps.

Quality management standards: cosmetics and pharmaceuticals

Cosmetic and pharmaceutical product manufacturers expect suppliers to have very high quality standards. This assists them in creating safe products, which is especially important for cosmetics, medicines and supplements.

3.3 Sustainability and certifications

Organic certification

Organic certification is generally a benefit for products that are ready to eat, such as salad dressing. Buyers are thus willing to pay a slight premium for the organic certification.

Buyers who are sourcing raw materials for processed food products such as sauces and dressings are unlikely to be looking for and willing to pay a premium for an organic certification.

Quality management certification

Having good quality management standards in place indicates to buyers that a supplier is reliable and professional. Some useful standards to consider are:

- Good Agricultural Collection Practices (GACP)
- Good Manufacturing Practices (GMP)
- ISO 22000, ISO 9001:2015 from the International Organisation for Standardisation (ISO)
- Food Safety System Certification (FSSC 22000)
- Hazard Analysis and Critical; Control Points system (HACCP)
- British Retail Consortium (BRC) for those trading with buyers in the UK

Sustainability and environmental certification

Sustainable production and especially environmental sustainability is a growing concern for buyers of avocadoes and avocado products, particularly branded avocado products such as avocado oil or individually quick frozen (IQF) products that are sold as packaged goods to shoppers. When avocado oil, IQF and pulp are used as raw materials to make packaged foods, cosmetics or pharmaceuticals, the avocado content is less visible and so sustainability or environmental claims may be less important to buyers. The end use of the product and the role it will ultimately play in finished products is an important distinction for sellers to make when considering sustainability or environmental certification.

Nevertheless, applying sustainable production practices can have some value even where sellers process and market IQF, pulp and oil for further processing. It communicates to buyers that the processor is organised, professional and strategic. These are important signals for importers who are increasingly looking to focus their attention on fewer, more reliable, better integrated suppliers. However, it is important to recognise that using more sustainable production practices might not guarantee that sellers will be able to earn a higher price on the market, but it may help new regions or suppliers to differentiate themselves in the global marketplace. This is especially true if new suppliers are able to claim better sustainability credentials, such as lower water usage or a smaller impact on potable water availability.

4. Supply

4.1 Supplying markets

South American supply

Mexico and Peru are large suppliers of both fresh avocado and avocado oil. They are well organised, competitive countries in avocado oil production and sales. As most Mexican avocadoes are shipped to the USA, this is likely the focus of their export efforts for avocado oil. Peru, on the other hand, is a leading supplier of avocadoes to the EU.

Colombia and Chile are also developing as suppliers of avocado oil, albeit on a smaller and less organised scale than Mexico, Peru and the leading suppliers from Africa, South Africa and Kenya.

In general, South American suppliers, perhaps with the exception of Colombia, face several sustainability challenges that pose risks for buyers in the EU. All of the countries face water scarcity in the avocado production areas. Farmers need access to large quantities of water to produce avocadoes, but the areas where these trees grow tend to be relatively dry. Climate change is only worsening the challenge. In Mexico, for example, several recent avocado harvests have been poor due to insufficient rainfall.

African supply

South Africa and Kenya are well integrated into the global supply chains for both fresh avocadoes and avocado oil. A study carried out by Confederation of British Industry (CBI)[4] suggested that nearly 10% of South African avocadoes were processed into avocado oil in 2018. The study also suggested that most buyers are satisfied with the supply and general reputation of South African and Kenyan avocado oil. Tanzania is a smaller, newer supplier.

Other

New Zealand, Australia and the USA also have established avocado oil businesses.

Indirect competitors: food, cosmetics and pharmaceuticals

Spain, Italy, Portugal, Greece and Tunisia are responsible for 90% of global exports of olive oil. These countries are organised and have very active trade promotion agencies that market olive oil from their respective countries. The manufacturers in these countries are actively innovating. They have introduced a variety of blends and oil infusions to the market in order to remain relevant and to maintain their status in the industry. These countries are formidable competitors.

4 CBI (2023). The European market potential for avocadoes. https://www.cbi.eu/market-information/fresh-fruit-vegetables/avocados/market-potential#:~:text=The%20supply%20of%20avocados%20is,strong%20consumer%20demand%20for%20avocados.

4.2 Pricing

Avocado oil prices are quite variable, depending on the grade and the level of quality. Crude oil prices are in the region of €5 to €5.50 per kg at Free on Board (FOB). However, some industry stakeholders and reports suggest that pricing for extra virgin oil and refined cosmetics grade oil can be as high as €30 per kg FOB.[5]

4.3 Seasonality

Avocado oil has a relatively short shelf life (18 months) when compared to IQF and high pressure pasteurised and frozen pulp. When avocado oil is stored, it oxidises. This causes the product to increase in acidity, which is not favourable for food or premium usage. The product is still sellable, but as time moves on from harvest it continue to lose value.

As a result, seasonality is important, especially if a company intends to market a premium grade avocado oil. Firstly, to maximise shelf life, buyers tend to source avocado oil from those countries in production or at the end of their season. They are therefore more likely to seek to source oil from South Africa, Peru, Kenya and Mexico during the EU summer months (Figure 6).

Figure 6. Global sourcing chart for fresh avocadoes

	J	F	M	A	M	J	J	A	S	O	N	D
Peru												
South Africa												
Kenya												
Chile												
Mexico												
Colombia												

Note: Green shading indicates avocado production months.

4.4 Variety

There is no specific variety strictly required for avocado oil production. However, premium virgin avocado oil requires a variety with a low pH. Hass avocadoes produce a good quality oil that is suitable for this market.

Local varieties can be used to make avocado oil. However, these tend to have a higher pH, which is not suitable for the virgin avocado oil market. Avocado oil with a higher pH can be sold to refiners, but prices are lower.

5 Based on authors' interviews with suppliers and importers.

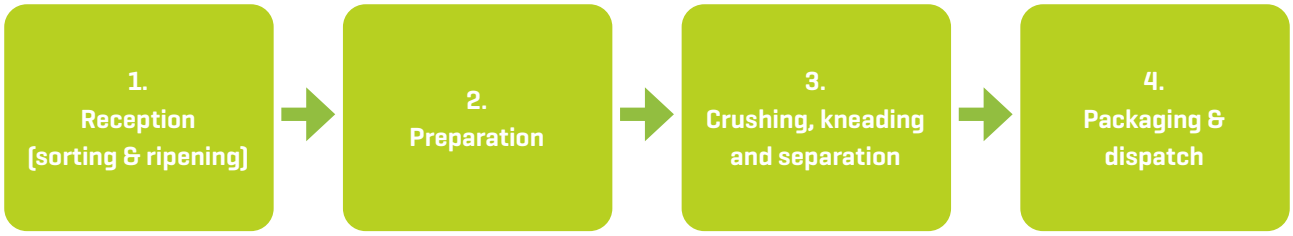
5. Production

5.1 Production process

There are three different methods for oil extraction from avocadoes: chemical extraction, mechanical extraction and cold-pressed. The cold-pressed method is the newest and the most in-demand. Cold pressing preserves the flavours and colour of the product, which is preferred in the food market as it compares to olive oil. It is also cheaper, simpler and better for the environment.

The production process shown in Figure 7 reflects cold-pressed production.

Figure 7. Production process



In ***step 1, reception***, avocadoes are received at the factory and sorted to ensure that the quality standards set for the product are met. Ideally, the avocadoes will be ripened after reception. A ripening room would be used and the process might include the use of ethylene.

In ***step 2, preparation***, the avocadoes are now ripe. They are washed to remove any potential contaminants, dirt or residues that could get into the final product. Once clean, any remaining stems are removed, the avocadoes are partially peeled and the seed, or pit, is scooped out. Some peel, typically 10%, is allowed to remain on the flesh as it contains oils and adds to the slightly green colour and the flavour that customers expect from cold pressed avocado oil.

In ***step 3, crushing, kneading and separation***, the avocadoes are mechanically crushed and kneaded to create a smooth paste. Water is added to the paste and it is then spun in a centrifuge to separate the solids from the liquids. Small strategically placed holes in the centrifuge allow the liquids to be removed and collected in a separate container. The solids remaining in the centrifuge, from the pulp and the skin, are then discarded. The liquid contains the oil and the water, which naturally separate to allow the oil to be skimmed off the top.

In ***step 4, packaging and dispatch***, the avocado oil is packed into bulk packaging. Typically this is 210 litre (191 kg) bulk drums. Alternately, if a branded consumer-ready product is being sold, the oil is bottled. This can be done manually, but in most commercial cases is mechanised. The product is now ready for dispatch.

5.2 Production technology

Avocado oil can be cold pressed using four to five pieces of equipment. Table 2 gives the estimated costs of the production line.

Step 1: Destoner or crusher: In the production of extra virgin oil, a destoner is used to cut the avocado in half and remove the pit. The fruit is then ready for scooping out, or removal of the flesh from the skin, which tends to be done manually to preserve the quality of the fruit. In the production of crude oil, a crusher is used instead. This allows the entire fruit to be crushed with skin and pit. It creates a lower grade of oil that is sold to refineries.

Step 2: A heat exchanger is often used to increase the temperature of the fruit and prepare it for mixing.

Step 3: Mixing group: This equipment is used for mechanical mixing Of the avocado to produce a smooth paste.

Step 4: Decanter: This machine spins the avocado paste allowing the oil to separate out. The waste water and solids are left behind. It is also possible to use a three-phase decanter to separate the waste water from the solids.

Step 5: Separator (Figure 8): In this final step, the oil is spun to remove any possible remaining water. This ensures a clear, consistent product. This is especially important for extra virgin avocado oil.

Table 2. Estimated costs of an avocado oil production line sourced from Italy

Capacity	Cost
3 tons per hour	€300,000
12 tons per hour	€600,000

Figure 8. Separator from Italian equipment supplier

Source: Images sourced from supplier Amenduni

5.3 Production economics

The variety of the fruit and the time in the season affects the amount of oil that can be extracted from each ton of fresh fruit. Hass avocadoes are the benchmark as they have more flesh than other varieties and are high in oil. On average, Hass avocadoes provide oil equivalent to 10% of the initial fresh fruit weight, including the pit and skin (see Table 3).

It is important to note that the oil content of the fruit varies throughout the season. Early in the season the oil content can be lower than 10%. Later in the season this rises and more oil can be extracted. Nevertheless, over the course of the season most processing plants extract 10% oil from the fresh fruit. This equates to 100 kg of oil for every ton of fresh fruit selected for processing.

Local varieties[6] tend to have bigger pits or are lower in oil. Experience in producing avocado oil commercially from local varieties suggests that less oil can be extracted, typically in the range of 5–8% oil. This means that for every ton of fresh fruit, 50–80 kg of oil can be extracted.

Table 3. Comparison of oil extracted for different varieties, per ton of fresh fruit

	Fresh Fruit (tonnes)	Oil extraction rate from whole fruit	Oil extracted from 1 tonne of fresh fruit (kg)
Hass	1	10%	100
Local variety (high estimate)	1	8%	80
Local variety (low estimate)	1	5%	50

Fruit quality, ripeness and variety

While it is possible to use blemished fruit for avocado oil production, a good quality oil requires a better quality fruit. The more damaged the fruit, the lower the quality of the oil and so the lower the price. Premium sellers must ensure that the fruit they use is a good quality.

The ripeness of the fruit also matters. Firstly, fruit should be ripe but not overly ripe, which can result in damaged fruit. Ripeness also affects the amount of oil that can be pressed from the flesh. Earlier in the season processors are able to extract less oil than later in the season.

Scale of sourcing

Large processors of oils tend to export in bulk. The product is then shipped in a 20-foot container, which can carry about 20 tons of finished oil. To achieve this scale, a typical avocado processing plant that uses Hass avocadoes would need to source approximately 200,000 tons of fresh fruit (Table 4).

For local varieties, which tend to have a lower oil content, even more fruit would need to be sourced. Based on an estimated oil content of about 5–8% of the fresh fruit for these varieties, factories would need to process up to 400,000 tons of fresh fruit to fill a container. Many countries do not produce enough fruit to achieve this volume.

6 There are many varieties of avocado that are not suitable for export, e.g., Kienyeji in Kenya. Also, in many countries there are varieties that do not have a specific name as they are not generally commercially grown. The pH, pit size and oil content are generally unknown.

Table 4. Fresh fruit requirements to produce enough oil to fill one container

	Fresh fruit (kg)	Oil extraction rate from whole fruit	Oil extracted (kg)
Hass	200,000	10%	20,000
Local variety (high estimate)	250,000	8%	20,000
Local variety (low estimate)	400,000	5%	20,000

Sourcing these volumes of fruit can be a challenge even in countries where the fresh logistics are well organised. In these markets, waste is low and there is strong competition for fresh fruit. For example, if waste is 10% (which is very likely), then collectively the country would need to be exporting 2 million tons of fresh fruit to be able to produce and ship a container of avocado oil made purely from waste. This is highly unlikely for smaller countries. The challenge also is even greater in countries with a local fresh market, which can absorb lower grade fruit.

The bulk market, which is open to lower product quality and could be open to oils produced from local avocado varieties, is thus not a likely market for most processors in Africa, as they are unlikely to be able to access the volume of fruit needed to trade.

If a processor can produce a premium oil from Hass avocadoes, they may be able to market their product to niche buyers who are looking for smaller volumes of avocado oil. These buyers could be cosmetics companies or even food manufacturers who are looking to make claims around the origin, flavour, quality or social and environmental responsibility of the product. If a processor can only source local avocado varieties, they should consider producing avocado oil for the local market. In local markets, the smaller production volumes, the lower quality and shorter shelf life are not likely to be major disadvantages.

6. Proposed options for marketing strategy

6.1 Key opportunities and challenges

Table 5. Opportunities and challenges

Opportunities	Challenges
▪ Increasing use in food products and cosmetics ▪ Steady growth in demand for all avocado products, including oils ▪ Demand in premium markets: Germany, Netherlands, France ▪ Many positive market trends supporting growth ▪ Relatively simple production process ▪ Comparably more affordable production technology ▪ Opportunities for sale of low-grade crude oil and premium high quality extra virgin oil ▪ Local varieties can be processed	▪ Many alternatives to avocado oil ▪ Strong, organised olive oil competitors ▪ Competition from affordable seed oils ▪ Cosmetics market is trend driven and uncertain ▪ Small percentage of avocado oil used in cosmetic formulations ▪ Short shelf life compared to alternative oils due to oxidation ▪ Requires careful quality management for a premium product ▪ Sustainability challenges for avocado production pose a risk to oils ▪ Established, large avocado oil producer competitors that can meet supply requirements ▪ Difficult to source large quantities of fresh fruit required for a container of product

6.2 Ingredients for success

Match quality to the right market

Companies have several options in the choice of the end market they will supply. It is even possible for companies to start by producing a low-grade, low-cost crude oil and then graduate to producing a high quality, extra virgin oil. Producing different grades of oil at different times of the year is also possible. It is important that companies are aware of the quality standards required for each market and that they work towards meeting the quality and pricing standards in those markets. Companies with access to quality Hass avocadoes should consider whether the quality standards needed to produce extra virgin oil are attainable for their factory. If not, is supplying crude oil a more workable model? However, for companies producing IQF avocado and avocado pulp, a high-quality avocado oil may be more achievable as the quality management system needed to produce a low acidity, high-quality avocado oil will already be in place.

Scale (bulk market)

The most significant barrier to succeeding in producing and marketing avocado oil for export is sourcing a large enough volume of fresh fruit. This requires skills in finding and securing fruit from growers or from fresh packhouses. It may require sourcing from other regions in

the country, looking to neighbouring countries, or even exploring the feasibility of using local varieties. Some companies might consider working with other producers of avocado oil so that they can meet the volume requirements. These could be local or even regional suppliers (e.g. Kenya and Tanzania).

Niche, premium strategy (export)

As most new producing countries are currently unlikely to achieve the volumes to sell to bulk buyers, they could be a better match for premium niche markets. In this case, focusing on premium buyers who are looking for a high quality, extra virgin product could be sensible. The marketing strategy would be first and foremost one of mastering sourcing, production and marketing of a premium product. This includes looking for differentiating marketing stories that can attract premium buyers, such as, for example, community sourcing stories, environmental factors that enable a reliably premium, nutritious product, niche certifications and endorsements. This strategy may be interesting to premium cosmetics houses as well as to premium oil and salad dressing companies.

Local markets

In markets without sufficient fresh fruit to produce bulk oil in containers, companies can consider the local market. This would require finding partners who are interested in bottling the oil, or in processing it to produce products such as margarine, sauces or beauty products. Companies looking to develop their own bottled oil brands should be aware that developing a brand, while developing the market for avocado oil, requires patience and skills in marketing. It is also important to assess whether local varieties of avocado oil will be acceptable to the market, whether this is the local, international crude or extra virgin oil market.

6.3 Conclusion

The avocado oil market provides opportunities for companies in many different contexts, with different grades of fruit available and for those who are interested in local or international markets. The growth in the market and the growth in innovations suggest that there is potential in both the food and cosmetics sectors.

Making a success of an avocado oil business requires companies to be very aware of the grade of product they wish to produce and then to proactively take steps to achieve the grade and pricing. This can allow companies to explore the impact of using local varieties on demand for their products.

Sourcing sufficient fresh fruit is a key area of focus for any company looking to build an avocado oil business. Without scale, companies must ask whether the export market is achievable.

2 FROZEN AVOCADO (IQF)

This chapter has been developed by the Fit For Market +, implemented by COLEAD within the framework of the Development Cooperation between the Organisation of African, Caribbean and Pacific States (OACPS) and the European Union (EU).

This chapter has also been developed by the New Export Trade Kenya programme, implemented by COLEAD, funded by the European Union (EU) and established in collaboration with the EU Delegation in Nairobi and Kenyan stakeholders.

This chapter has been produced with the financial support of the EU and the OACPS. Its contents are the sole responsibility of COLEAD and can under no circumstances be regarded as reflecting the position of the EU or the OACPS. (more information).

Funded by
the European Union

Contents

1. Individually quick-frozen (IQF) avocado

1.1 What is IQF avocado?

Individually quick-frozen (IQF) avocadoes are slices, dices and halves of ripe avocados that are rapidly frozen. This creates a frozen product that is made of separate pieces that at a later stage can be defrosted. IQF avocadoes are mainly used in the same way as fresh avocado or, less often, as an ingredient in processed food products.

IQF avocado pieces are particularly important to the food services sector (restaurants, hotels, delicatessens, etc.) Once defrosted, IQF cubes, slices or even halves are used as a fresh ingredient in guacamole, salads or smoothies, on burgers or to replace burger buns, or in many other prepared dishes (Figure 1). IQF pieces can also be found in retail stores. This allows home cooks to prepare similar meals as in the food services sector, or to enjoy homemade smoothies and green juices.

Figure 1. Common end uses of IQF avocado

1.2 IQF avocado's competitors

IQF avocado has a longer shelf life and can withstand rougher handling than fresh avocadoes. This makes it an ideal substitute for fresh, ripe avocado. This is very beneficial in the food services sector, where demand is unpredictable and there is great pressure to minimise waste of ingredients. This makes fresh avocado the direct competitor to IQF avocado.

Sometimes IQF avocado replaces avocado pulp in recipes. It is also possible to use frozen or, more commonly, high pressure pasteurised chunky pulp to replace IQF cubes when making products such as guacamole. Chunky avocado pulp is thus a competing product.

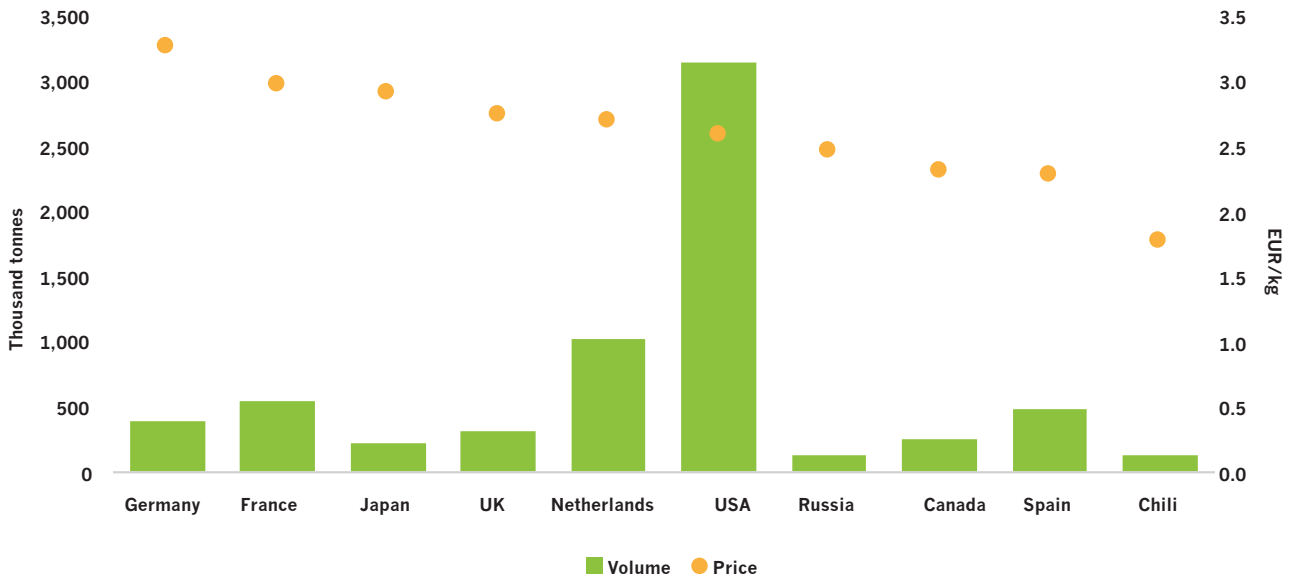
2. Demand forecast

As IQF avocado is used to replace fresh avocado, the sales of fresh avocado is the best predictor of the demand for IQF product. Globally, the USA is the largest importer of fresh avocado. In 2021, the USA imported three times more avocado than the next closest importer by volume, the Netherlands. The Netherlands and Spain re-export the bulk of these imports. In the case of the Netherlands, 97% of imports were re-exported across the EU.[1]

By comparison, France, Germany and the United Kingdom are significantly larger consumers of fresh avocado. The foods services sectors in these countries are also very large and organised. Germany and France import fresh avocado at some of the highest average global prices; Germany imported fresh avocado for €3.26 per kg (€3,258 per ton) Free on Board (FOB) (Figure 2).[2] These high prices for fresh avocado create opportunities for IQF processors to achieve higher prices, or to compete more effectively against fresh avocado.

The role of the Netherlands in redistribution of products across the EU should not be underestimated. Belgium is also a significant player in frozen produce and has some of the EU's largest IQF factories for potatoes and vegetables. Many food manufacturers and food service companies prefer to work with suppliers who can offer a "one-stop shop" for their ingredients. However, as avocadoes do not grow in Europe, suppliers will need to source avocadoes should a client request this. This might create opportunities for IQF avocado suppliers.

Figure 2. Fresh avocado imports and related prices in 2021.
Source: ITC Trade Map https://intracen.org/resources/tools/trade-map



1 Data sourced from ITC Trade Map https://www.trademap.org/Index.aspx

2 Data sourced from ITC Trade Map https://intracen.org/resources/tools/trade-map

2.1 Market trends

Trends in developed markets suggest that IQF avocado products will continue to be popular. Some important trends suggesting continued growth in demand for IQF avocado are plant-based eating, novel and healthy food concepts, low-carb, high-fat burgers and Tex-Mex going mainstream.

Plant-based eating

Source: Prêt a Manger Facebook page

IQF avocado is well suited to blending into green smoothies and juices. In 2020, the EU-funded Smart Protein project found that the plant-based food industry in the EU grew 49% between 2018–2020.

The trend in plant-based eating has driven growth in new plant-based food alternatives, with many shoppers increasing their consumption of vegetables and fruits while reducing meat consumption. Plant-based eating has made a number of new dishes popular. Poke bowls, "green goddess" bowls, green juices and smoothies are now well-known dishes that often use avocado. IQF avocado pieces can be available year-round, ensuring that this core ingredient is continuously available, especially in the food services sector.

Novel food concepts

The popularity of avocados has created many opportunities for innovation. Avocado fries are one such innovative concept. This product uses avocado slices that are dipped in breadcrumbs.

Source: The Avocado Show brand website

Avocado burgers

Source: Canva

Avocado is a popular ingredient for burgers, with slices and halves used as toppings. In rare cases, the buns have been replaced with avocado halves to create a low-carbohydrate version of this popular fast food.

Tex-Mex goes mainstream

Guacamole is now a common product on supermarket shelves. Many suppliers use pulp to create a base for guacamole, but the smooth texture this creates in many cases does not feel "authentic" and fresh. To create texture, some manufacturers have added IQF diced avocado. This gives the product more bite and a more natural texture.

However, to meet the need for texture some pulp producers are supplying chunky pulp instead. This provides the body of pulp and the natural texture that matches the recipes with IQF. This poses a potential threat to IQF suppliers.

Source: the Walmart Retail website

2.2 Importing countries

There is considerable similarity between fresh avocadoes and IQF avocadoes. Both the consumption and the import statistics are helpful in identifying which countries are most likely to be large importers of IQF avocadoes, as well as where there are opportunities for the future.

The Netherlands and Spain are the leading importers of fresh avocadoes in the EU, although the Netherlands re-exports most fresh avocadoes. The importers in the Netherlands therefore play a key role in distribution of avocado products across Europe. In Spain, the IQF product is also used in guacamole production.

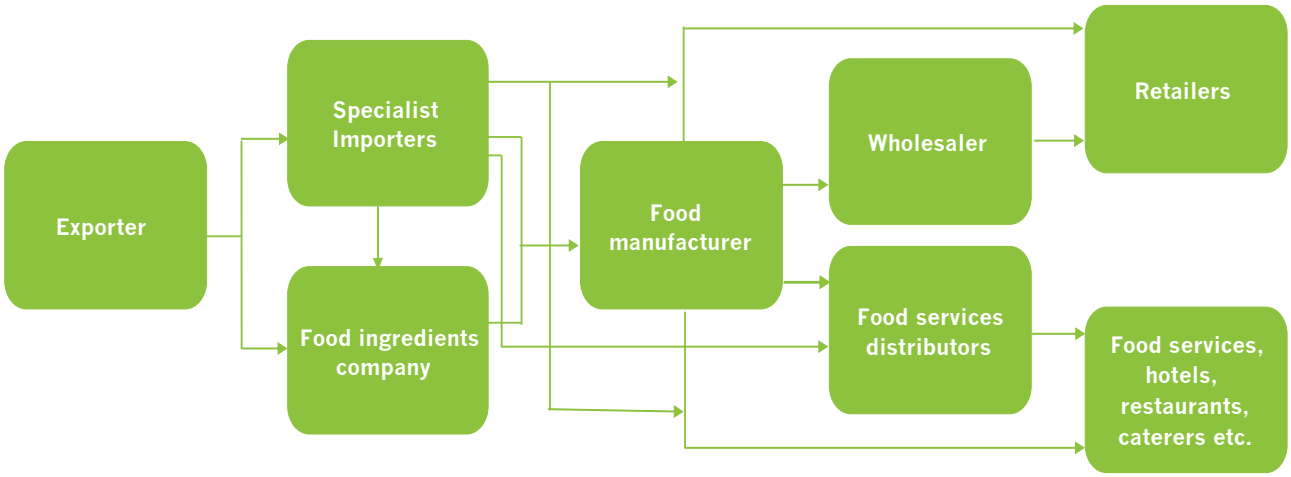
France, Germany and the UK are also large importers of fresh avocadoes, although they have a relatively low consumption per capita when compared to Scandinavian countries (Table 1). There could be opportunities to use IQF avocado products to increase consumption, especially in the food services sector.

Table 1. Import and consumption per capita for EU countries

Country	Imports (tonnes)	Consumption (tonnes)	Consumption per capita (kg per person)
The Netherlands	378,761	10,503	0.60
Spain	214,202	189,777	4.00
France	181,609	149,282	2.21
Germany	120,986	104,873	1,26
United Kingdom	114,273	107,662	1.60
Scandinavia (Sweden, Denmark, Norway, Finland)	65,041	64,775	2.39
Italy	41,655	39,711	0.67

2.3 Market structure

Figure 3. IQF avocado market structure



Specialist importers and food service distributors play a critical role in this value chain (Figure 3).

Several specialist importers (in the EU and elsewhere) import IQF product from around the world. They then sell IQF product to distributors, to food manufacturers or even to retailers. These suppliers also introduce innovative products with interesting new flavours or blends, such as hummus and avocado or avocado mayonnaise.

As so much of the IQF product is used in the food services sector, food services distributors play an important role in the supply chain. They supply goods to hotels, restaurants, caterers and quality healthy fast food/ready-to-eat cafes such as Prêt a Manger in the UK, France and Belgium; La Place in the Netherlands, retailers who produce ready to eat food in their own outlets (e.g. Monoprix in France), or even independent small cafes.

3. Regulatory and quality requirements

3.1 Product specifications

Table 2. Typical key product specifications for IQF avocado

Item	Specification
Ingredients	Avocado (99.9%), Stabiliser – ascorbic acid, citric acid, salt
Variety	Hass
Appearance	Characteristic shades of green, typical of fresh avocadoes
Shape	Slices, dices (15 mm x 15 mm) or halves
Freezing process	IQF
Shelf life	18–24 months
Preservatives	Zero, a clean label product is required
Storage conditions	-18°C
Packaging	1 kg bags, with six 1 kg bags per carton, and 84 cartons per pallet.

3.2 Food safety and quality management

IQF avocado slices, dices and halves are often purchased with the aim of presenting dishes in restaurants, hotels and other food services outlets as healthier and more "premium" products. Quality is thus very important and food safety certifications are greatly valued by buyers in the EU. Companies without certification might find it challenging to market their product for export without investing in systems and certification. Some respected and desirable certifications are:

- International Featured Standards(IFS)
- British Retail Consortium (BRC)
- FSSC 22000
- An equivalent standard

3.3 Sustainability and certifications

Specific certifications over and above food safety are not required. Nevertheless, they do assist with marketing especially when competing as a new supplier. The certifications provide reassurance to importers that the supplier is organised and professional. This in turn signals that quality and food safety is being well managed.

Some certifications specifically mentioned by buyers are Rainforest Alliance and Global Gap. However, as certification preferences are specific to each buyer, suppliers should ensure they are familiar with the strategies of the importers to understand the types of certifications that will be impactful and provide added value.

Organic certification of IQF avocado is less important than in the fresh market and is not essential. Nevertheless, there is growing interest in organic product in the EU. This could provide a useful entry point to build a relationship with new buyers or access new markets.

4. Supply

4.1 Supplying markets

IQF technology is expensive and shutting down the line requires time-consuming deep cleaning. The business case therefore relies on a long period of production. Those countries with long avocado harvest seasons are better able to create a business case to make the costly investment. Investors in countries with a short harvest season struggle to build a sensible business case and need to rely on sourcing other fruits and vegetables that can be frozen outside the avocado season. This is a more complex business model, which can be discouraging to potential investors. The result is that relatively few countries participate in the production and export of IQF products. The leading suppliers of IQF avocado are Peru, Mexico and South Africa.

Peru

Peru has a long fresh avocado production season. The avocadoes produced in the country are grown at altitude and have a lower oil content than the avocadoes grown in other parts of South America, Africa and even Spain.

Peru also has a large, established IQF sector. This makes it less challenging to build a case for processing avocadoes alongside established products such as vegetables, mango and pineapple. The avocadoes can be added to an existing programme and can be marketed alongside the better known, more mainstream products. As a result, Peru has more than 30 companies producing IQF avocadoes.

Mexico

There are several large, established companies processing IQF avocadoes in Mexico. These companies have the advantage of a year-round season, which has several benefits. Firstly, companies can produce at a large enough scale to support the considerable investment costs. Secondly, they can develop and afford the specialised skills needed to run a successful IQF plant. Finally, they can be more flexible and more responsive to the market. For example, if there is an oversupply of diced avocado, they can change their strategy and focus on slices or halves.

Mexico has a strong relationship with the USA and focuses on this market.

South Africa

South African processors are able to source avocado from different growing regions, allowing a year-round production cycle. The local market is also well developed, with high demand for IQF product in the food services sector. Both the year-round availability of raw materials and the large local market assist in companies being able to afford the IQF technology.

4.2 Pricing

Pricing of IQF product is difficult to determine. Asian suppliers have been quoting prices as low as €2 per kg (FOB) for buyers of very large volumes. This assumes that the product is available at this price and that the quality will be acceptable. Often this is not the case.

Retail prices in the EU (approximately €9 per kg) suggest that the real import price for IQF product is likely to be about €4.50 per kg landed in the EU. This then allows for companies to pack the product, to distribute it and for retail margins.

Organic product is not widely available in retail stores. However, with the premium on organic fresh product being 20–40% it is reasonable to assume that at least a 20% premium is possible for organic IQF avocado. However, this would be a far smaller share of the market.

4.3 Seasonality

IQF avocadoes have a lengthy shelf life of 18–24 months. This means the product is available year-round (see Table 3 for avocado production seasons). Nevertheless, buyers prefer stock that has been packed recently over that which is ageing. This provides buyers with more time to be able to market the product.

Because IQF avocado can be used to replace fresh avocado and vice versa, the availability and prices of fresh avocado in retail stores and in the food services sector affects the demand for IQF in the food services sector and in households. When fresh avocado is readily available and prices are low, smaller restaurants, juice bars and delis in the food services sector are more likely to purchase fresh produce. However, when availability is lower and prices are higher, they are more likely to use IQF products.

Table 3. Avocado production seasons by IQF avocado exporting country

	J	F	M	A	M	J	J	A	S	O	N	D
Viet Nam					■	■	■					
China	■	■	■						■	■	■	■
Peru			■	■	■	■	■	■	■			
South Africa				■	■	■	■	■	■			
Chile								■	■	■	■	■
Mexico	■	■	■	■	■	■	■	■	■	■	■	■
Spain	■	■	■	■	■							

Note: Green shading indicates avocado production months.

4.4 Variety

It is possible to produce IQF avocado using several of the available export and local varieties of avocado. However, as Hass is the best known and most available variety in the fresh market, it has become the benchmark for buyers. This makes it the most marketable variety, with most importers reluctant to test alternatives.

For suppliers, Hass avocadoes are also easier to process. They are sufficiently large, robust enough to withstand handling and have sufficient flesh for processing. This makes processing Hass avocadoes far more profitable than some varieties that are prone to bruising, or which have large pips. The same level of technology and effort is needed to process each ton of avocado irrespective of the variety. However, as less waste is produced when processing Hass avocadoes, the same effort delivers a larger amount of IQF product.

5. Production

5.1 Production process

Figure 4. Production process for IQF avocado

In ***step 1, reception,*** avocadoes arrive at the processing plant and are sorted so that damaged avocadoes can be discarded, ripe avocadoes can be moved to production and unripe avocadoes stored for ripening (Figure 4).

In ***step 2, preparation,*** the ripe avocadoes are washed to remove any potential contaminants, dirt or residues that could remain in the final product. Some processors, especially those who are focused on the US market, put fruit that has not been rejected at the factory gate through a hot water bath or in a steaming chamber. This is called blanching. The blanching step kills any pathogens and ensures a safe product that has an even lower chance of being contaminated. However, the extra heat does increase costs and, if not done well, can affect the quality of the fruit.

Once clean, any remaining stems are removed, the avocadoes are peeled and the seed (pit) is removed. The avocado fruit is then cut to the required shape and size. This could be small dices, slices or halves depending on the requirements of the buyer. This is typically done manually to prevent browning. However, some processors use cutting machines to remove the pit and cut the fruit to size.

In ***step 3, stabilisation,*** the avocado is treated to prevent browning. When avocado comes in to contact with air, it turns brown due to oxidation. IQF pieces are not shipped in vacuum sealed, airtight packaging and have a long shelf life of 18–24 months, so oxidation is possible. To prevent it, the avocado pieces are often treated with antioxidants such as citric and ascorbic acid, as well as a salt solution. Each processor determines whether this is required and if so, the specific blend of these antioxidants they will use.

In ***step 4, freezing,*** the product is quick frozen in a specialised freezing tunnel.

In ***step 5, packaging and dispatch,*** the frozen avocado is packed into bags. Finally, the product is passed through a metal detector before being returned to chilled storage at -18°C. It is then dispatched to airports or ports depending on the location of the end customer.

5.2 Production technology

Multi fruit washer: A bubble washer uses bubbles to agitate fruit and remove any solid particles clinging to the outer skin. Chlorine is often added to the water to chemically remove pathogens.

Cutter and dicer: Most IQF fruit is cut using an automated cutting machine. Two sets of cutting machines are required to cut the fruit in half before the fruit is manually destoned (pit removal) and scooped out. As the flesh is scooped out of the skin, the avocado does not require further peeling. If slices or dices are required, the fruit then undergoes a second cutting step.

Freezing (IQF) line: This consists of a long flat bed, with a conveyor belt. Cold air is blown over the fruit, resulting in the product rapidly freezing.

Dosage machine: This allows for automatic dosing of the IQF product into packaging (bags or boxes).

Freezer: A freezer is required to store the IQF product before it is dispatched.

Table 4 compares the investment cost and energy use for a 2–3 tons per hour plant from Europe versus China.

Table 4. Estimated investment costs for a 3 ton per hour production line

Equipment	Estimated cost Of line sourced from EU	Quoted cost of line sourced from China	Power installed
Production hall 500 m^2, cold storage, office, and toilet/changing room, excluded development of surrounding area	€400,000	€400,000	
Multi fruit washer, capacity circa 3 tons/ hour	€30,000	€14,200	6.0 kW/2.2 kW
6 stainless steel tables for 38 cutters & peelers and conveyor belt for transport to cutters	€15,000	€12,000	1.5 kW/ 0.75 kW
Dicer, capacity 2–3 tons/hour, comprising 3 groups of adjustable knives	€35,000	€14,700	1.1 kW/ 2.2 kW
Freezer, capacity 3 tons/hour, comprising start-up and training on site	€450,000	€223,110	220 v/50 hz single phase 380 v/50 hz three phase 11.2 kW and 62 kW Suppliers from the EU claim 30% energy saving
2 screw elevators, incl. collection hoppers and adjustable speed gear drives	€15,000	€12,300	4 kW/1 kW
Separation vibrator for rejection of slivers	€13,500	€3,900	1 kW/ 0.5 kW
Plant service, comprising water treatment plant, control panel, air compressor, set of sundry items	€27,000	€27,000	5.0 kW
Automatic 20 kg dosage packaging machine, manual tools for box sealing and labelling	€35,000	€39,500	1.0 kW/1 kW
Refrigeration container storage	€15,000	€15,000	
Two diesel-electric generator sets, 350 kVA new ZA	€60,000	€60,000	
Ammonia refrigeration plant	€300,000		10 kW

2 x 40 ft freezer rooms + 4 x 20 ft fridge rooms		€38,000	8 kW
Spare parts	€40,000	€30,000	
Shipping cost to West Africa	€34,000	€30,000	
Cost of erection, commissioning of equipment on site	€30,000	€30,000	
Subtotal	€1,499,500	€1,029,710	
Various cost and unexpected 10%	€149,950	€102,971	
Total estimated cost	€1,649,450	€1,132,681	
Total power installed			334.6 kW/110.8 kW

Source: Sourced from different independent suppliers

The total estimated investment costs are around €1.15 million for a line from China, commissioned and with training provided. A line with a similar capacity but sourced from Europe would cost approximately €1.65 million (Figure 5).[3]

Energy usage and power supply of the factory

The total energy usage of the factory for the line from China is estimated at 110.8 kW, compared to the line from Europe requiring 334.6 kW. This excludes the cold storage for ripening avocado prior to processing as well as energy needed for storing the finished product.

One of the most critical parts of the production is the supply of the energy. In principle it is cheaper to run most equipment on locally provided electricity than on electricity generated by a diesel generator. However, the electricity needed for the refrigeration plant may exceed what can be supplied locally. This can be due to power outages or restrictions on the amount of energy the factory can use, for example. This is a real risk to an IQF factory as the frozen product will defrost or the freezing cycle will be interrupted. For this reason, the calculations above include a diesel generator and a spare.

Figure 5. Example of an IQF line from the EU

Source: www.octofrost.com

3 It is possible to source a smaller IQF line from China. A 500 kg per hour line would produce 300 kg of finished product and costs about €170,000.

5.3 Production economics

There are several factors that must be well controlled in order to succeed in IQF production. The first is managing the conversion from fresh fruit to final product.

Conversion ratios

A skilled IQF facility is able to convert 50–60% of their avocado to a final product.

Next, we will consider the impact of increased waste levels on the profitability of an imaginary business that is processing 1 ton of fresh avocado.

Table 5 outlines five possible scenarios. In scenario 1, the factory is poor at converting fresh avocadoes to IQF product. They only manage to convert 40% of the fresh avocado and so produce 400 kg of IQF pieces. If they achieve a price of €4 per kg for the IQF they produce, they will earn €1,600.

All five scenarios assume that the factory uses the same process, technology staff and energy to process the product. With an assumed production cost of €1,000, in scenario 1 the factory achieves €600 profit, which is a 38% gross margin.

Scenarios 2 to 6 assume that the only factor that changes is the percentage of the fresh avocado that becomes IQF product. In each scenario, the factory gets better at selecting, handling and processing the fresh fruit so that the final product produced rises from 40% to 60%.

Table 5. The impact of various conversion ratios on profitability

		Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Volume	Total weight at reception (kg)	1,000	1,000	1,000	1,000	1,000
	% flesh recovered	40	45	50	55	60
	Final volume processed (kg)	400	450	500	550	600
Revenue	Sales price per kg	€4	€4	€4	€4	€4
	Total revenue	€1,600	€1,800	€2,000	€2,200	€2,400
Costs	Total costs (assumed)	€1,000	€1,000	€1,000	€1,000	€1,000
Margin	Gross margin (revenue)	€600	€800	€1,000	€1,200	€1,400
	Gross margin %	38	44	50	55	58

These scenarios clearly show that the factory is able to increase their gross margin purely by being more careful with the fruit. This might incur some costs as more careful handling might need the company to invest in training, or even in higher wages to attract more skilled staff. However, it could be worth their while to do so. In reality, most IQF avocado factories target 50% as the minimum standard.

5. Production

Operations and logistics

An IQF plant needs to run for 24 hours a day to avoid having to deep clean equipment. As a consequence, a 3 ton per hour line would produce 72 tons of finished product per day. If the factory is relatively successful at managing waste and can convert 50% of the fresh fruit to final product, they would need to source 144 tons of fresh fruit per day. Over a four-month season, this would mean that 17,280 tons of fresh fruit need to be sourced and processed. This rises to 50,400 tons per year if the factory runs year-round (Table 6).

Table 6. Estimated fresh fruit requirements per day and for varying season lengths

	Scenario 1 (4 months)	Scenario 2 (6 months)	Scenario 3 (12 months)
Production capacity per hour in tons	3	3	3
Daily production volume (tons)	72	72	72
Total number of days	120	180	350
Total annual volume (tons)	8,640	12,960	25,200
Conversion ratio from fresh to IQF	50%	50%	50%
Fresh product required (tons)	17,280	25,920	50,400

This business model requires a large volume of quality fresh fruit, so the factory would need to be in a location where this can be sourced. This fruit also needs to be relatively affordable. At this scale, the logistics needed to source and manage the incoming fruit on a continuous basis are very important, requiring skills at sourcing from different growing regions (as is done in South Africa), or an ability to competitively source and import produce, as in Spain and the USA.

A factory that produces using a 3 ton per hour line and which is reasonably good at turning fresh fruit into IQF product (50%) could produce up to 2880 tons of product per month. That is equivalent to 144 20-foot containers of IQF product, a very large volume. This can be absorbed by the global market, but it requires that the company is flexible and responsive to the market's needs. Being able to sell some of this product locally would also be very helpful.

The long shelf life of IQF product is helpful as it gives companies some time to market their product. However, it also means that competitors are able to offer IQF product outside of their harvest season. Being aware of the market and competitors is thus crucial to being able to succeed.

6. Proposed options for marketing strategy

6.1 Key opportunities and challenges

Table 7. Opportunities and challenges

Opportunities	Challenges
▪ Growing interest in avocadoes in Europe, USA and in parts of Asia ▪ IQF avocadoes solve real challenges in the food services sector – waste, shelf life and handling concerns ▪ Relatively few suppliers due to high investment costs and requirements for scale ▪ Certifications offer opportunities for consideration from buyers.	▪ High cost of equipment ▪ Requires excellent logistics and cold chain management ▪ Existing suppliers are very skilled at IQF and have access to client relationships from marketing other IQF products ▪ The large scale of production in Mexico and Peru make these countries very competitive. ▪ Requires excellent sourcing and factory operations ▪ Large volume of fresh fruit needs to be sourced and processed per day and per season ▪ Short seasons, or few production programmes make profitable business challenging, if not impossible ▪ Reliable energy and good management of energy is required to ensure continuous cooling.

6.2 Ingredients for success

Investment capital

The high investment costs for this model require that the investor be skilled at accessing finance, or that they have sufficiently large cash reserves to self-finance the investment.

Operate at a large scale

Being able to afford the technology and compete with established IQF suppliers has implications for potential investors in IQF production. The best scenario involves producing large volumes of avocado per day over a lengthy production season. Year-round production is ideal. However, if this is not possible the company should aim to develop several products that can be frozen and brought to market outside the avocado season, such as mango, pineapple or even vegetables.

Operations and sourcing excellence

Running a successful IQF plant requires careful attention to ongoing sourcing. The company should invest in developing strong sourcing and operations capability.

Marketing excellence

The scale of production required for IQF product requires that investors gear up to be able to sell this product. This needs a good understanding of the market and an ability to be flexible. When dices are flooding the market, companies need to know this and be able to hold back and produce slices and halves. In some cases, companies might need to be prepared to hold back product altogether for a few months until prices rise, or they may need the ability to target new markets where existing companies are not active.

This need for market intelligence suggests that most suppliers from Africa would benefit from working together, or from working with agents in importing countries. This would provide the best visibility and allow them to respond quickly.

6.3 Conclusion

Producing IQF avocado would give an investor access to a growing market that has great potential in the future. The scale of the operation would, however, need careful management of sourcing, operations and marketing. Without access to capital and the skills needed to run year-round operation, companies are likely to struggle. However, if these ingredients are in place, then the opportunity could be very interesting.

3 | AVOCADO PULP

This chapter has been developed by the Fit For Market +, implemented by COLEAD within the framework of the Development Cooperation between the Organisation of African, Caribbean and Pacific States (OACPS) and the European Union (EU).

This chapter has also been developed by the New Export Trade Kenya programme, implemented by COLEAD, funded by the European Union (EU) and established in collaboration with the EU Delegation in Nairobi and Kenyan stakeholders.

This chapter has been produced with the financial support of the EU and the OACPS. Its contents are the sole responsibility of COLEAD and can under no circumstances be regarded as reflecting the position of the EU or the OACPS. (more information).

Funded by
the European Union

Contents

1. Avocado pulp

1.1 What is avocado pulp?

Avocado pulp, which is sometimes called avocado puree, is the mashed flesh of avocadoes. This is typically made by destoning (removing the pit) the avocadoes, scooping out the flesh and then pressing the avocadoes into a creamy paste.

Avocado pulp is used largely as a replacement for fresh avocado in packaged guacamole. There are a number of brands that offer guacamole that needs to be refrigerated, as well as non-chilled product. Some brands in the European Union include Old El Paso, Sabra and Holy Moly Guacamole. However, a growing number of local, international and retailer brands are available inn stores in developed economies. The category is also becoming more innovative, with many variants of guacamole and other dips that contain avocado pulp becoming more widely available each year (Figure 1). These might include avocado with chickpeas, for example, or other herbs and spices.

Avocado pulp is also used in preparing packaged foods. It has a smooth texture that makes it better suited to applications that themselves have less texture. Baby foods, guacamole chips, vegetable juices and smoothies are examples of products that contain avocado pulp.

Avocado pulp is increasingly used in the food services sector (i.e. hotels, restaurants, caterers, delis, etc.) These businesses use avocado pulp in foods such as open sandwiches, toast or hamburgers; to prepare their own guacamole and dips; and to add flavour, colour and visual appeal to popular new dishes such as sushi bowls.

Figure 1. Illustration of uses of avocado pulp

Avocado guacamole and dips	Packaged foods ingredient	Food services – fresh avocado replacement
		 

Source: Brand images sourced from brand websites (from left to right) Holy Moly, Once Upon a Farm, AH. Food services images sourced from www.canva.com

1.2 Avocado pulp's competitors

When avocado pulp is used in a guacamole recipe, it usually replaces fresh avocadoes or even individually quick-frozen (IQF) avocado. IQF avocado dices and pulp can be blended together to create a chunky guacamole that has a more authentic, home-made feel. Chunky avocado pulp is becoming more readily available. This enables the food services sector to avoid buying and storing two different processed avocado products. It also allows them to reduce the risk of waste, which is a concern when using any avocado products.

When avocado pulp is used in packaged food ingredients it tends to replace fruits and vegetables, or even some oils. However, many of the alternatives are more affordable and easier to handle and store than avocado pulp, so manufacturers tend to use as little avocado pulp as possible in recipes. Some recipes that are clearly labelled as containing avocado actually use relatively small amounts in the recipe.

The health perceptions of avocado mean that it is used as a signal of freshness, taste and health in many dishes in fast food outlets (Figure 2), restaurants, cafes and delis. It has also become a popular ingredient in sandwiches, on toast and in dishes such as nachos.

Avocado pulp is a very practical alternative to fresh avocadoes at it is always available, ready for eating, lasts longer when "open", can be frozen for longer and offers easier storage. However, the biggest competitor to fresh avocadoes is IQF slices. These give a more visible avocado appearance than pulp and so are in greater demand in the food services sector.

Figure 2. McDonalds France advertising for burgers with avocado pulp

Source: McDonalds France Facebook Page

2. Demand forecast

Several market trends suggest that demand for avocado pulp will increase in the coming years. Currently, the market is relatively small. Some estimates suggest that €480 million of avocado pulp was sold globally in 2021.[1] This is marginally more than the €395 million of fresh avocado imported into Germany in that year.[2]

Nevertheless, current predictions suggest that demand for avocado pulp will grow. Some market analysts predict that the category will be one and half times larger by 2031 (4% compound annual growth rate).[3]

2.1 Market trends

Vegan foods and healthy fats

The vegan way of eating is a significant food trend that has created greater interest in new product innovations that can replace popular food ingredients containing animal products, such as mayonnaise and other sauces containing eggs (Figure 3). The interest in plant-based eating has also increased interest in healthy fats. These promise to improve heart health, reduce inflammation, which is associated with seed oils, and generally improve vitality.

Figure 3. Innovative vegan, healthy fat sauces and dressings

Source: Brand websites. From left to right: Mayoneur, Hellmans, Chop

1 Raju, K & Roshan D. (2022) Avocado Puree Market Research, 2031, Allied market research forecast 2021–2031, Allied Market Research, https://www.alliedmarketresearch.com/avocado-puree-market-A16925

2 Source: ITC Trade Map

3 Raju, K & Roshan D. (2022) Avocado Puree Market Research, 2031.

Exotic flavours

Guacamole is available in many retailers, especially in urban centres. To keep guacamole relevant manufacturers have been introducing new flavours such as chilli, garlic and other herbs and spices (Figure 4).

Figure 4. Example of flavoured guacamole

Source: Retailer website, Tesco

Vegan spreads and dips

Sandwich toppings include a wide range of products. Recent food trends such as an interest in middle eastern cuisine and plant-based eating have led hummus to become more mainstream. More recently, avocado has been added to these dips and spreads to create new flavours, or even specialised bread spreads. This is allowing avocado to become more mainstream and convenient.

Figure 5. Examples of hummus with avocado

Source: Brand websites (from left to right): Deli Genuss, Carrefour, Allos

2.2 Importing countries

Data on avocado pulp trade and consumption is not readily available. However, the consumption of fresh avocado is a good indication of how much interest there could be in purchasing avocado pulp.

The Netherlands and Spain are the largest importers of avocado in the EU. However, both countries are also large exporters of fresh avocado. When exports are taken into account, Dutch consumption (0.6 kg per capita) is relatively low compared to other EU countries.

Scandinavia and France enjoy the largest consumption per capita in the EU, while+ consumption in large markets such as Germany, France and the UK lags behind. The gap between consumption in Scandinavia and these countries suggests that there is potential for increasing consumption in these larger markets. There is a considerable marketing effort from the avocado industry to increase consumption of avocadoes and to make this a more regular eating habit. There are some signs that this is paying off as countries such as Italy have seen rapid growth in consumption,[4] while innovation in the UK and Germany has become more visible.

Table 1. Consumption figures for leading fresh avocado importers in the EU

Country	Imports (tonnes)	Consumption (tonnes)	Consumption per capita (kg per person)
The Netherlands	378,761	10,503	0.60
Spain	214,202	189,777	4.00
France	181,609	149,282	2.21
Germany	120,986	104,873	1.26
United Kingdom	114,273	107,662	1.60
Scandinavia (Sweden, Denmark, Norway, Finland)	65,041	64,775	2.39
Italy	41,655	39,711	0.67

Notes: Imports and export volumes are from ITC Trade Map, consumption calculated from imports, exports and production. Spanish consumption figures include production number sourced from World Bank statistics.
Source: Population figures used for consumption calculations for the EU are sourced from EuroStat, UK population data is sourced from World Bank.

4 Fruitrop, Edition 283; 28 Sept 2022

In 2021, Spain produced 115,000 tonnes of fresh avocadoes and imported almost twice as much as it produced (Table 2). This allowed the country to export more than it produced, while also retaining a large amount of avocado in the country. In 2021, more than 189,000 tonnes of avocado were available to consume, which make Spain the largest consumer of avocadoes in the EU. If this is correct, the average person in Spain would have consumed 4 kg of avocadoes over that year.

Table 2. Spanish trade figures and consumption data

	Production	Imports	Exports	Consumption (tonnes)	Population Size (millions)	Consumption per capita (kg)
Spain (estimate)	115,500	214,202	139,925	189,777	47.4	4.00

However, from the perspective of what people eat rather than what they grow, avocadoes are still relatively new and considered an "exotic" food ingredient in Spain. Most studies agree that it is not likely that the Spanish consumer enjoys anywhere near 4 kg per year of avocadoes. If this is the case, what is happening to the rest of the fruit?

Spain has a large processing sector (Table 3) and is well known for supplying processed avocado, especially guacamole and avocado pulp. It is far more likely that Spanish consumption of avocadoes is similar to that of Italy (0.6 kg per capita). At that rate, 161,337 tonnes of avocado would be available for processing, or nearly 85% of the avocadoes remaining after export. Once converted into a final product, they could produce as much as 80,669 tonnes of avocado pulp, guacamole and IQF each year. As Spain is well known for pulp and guacamole most of this volume is likely used for these purposes rather than for IQF avocado.

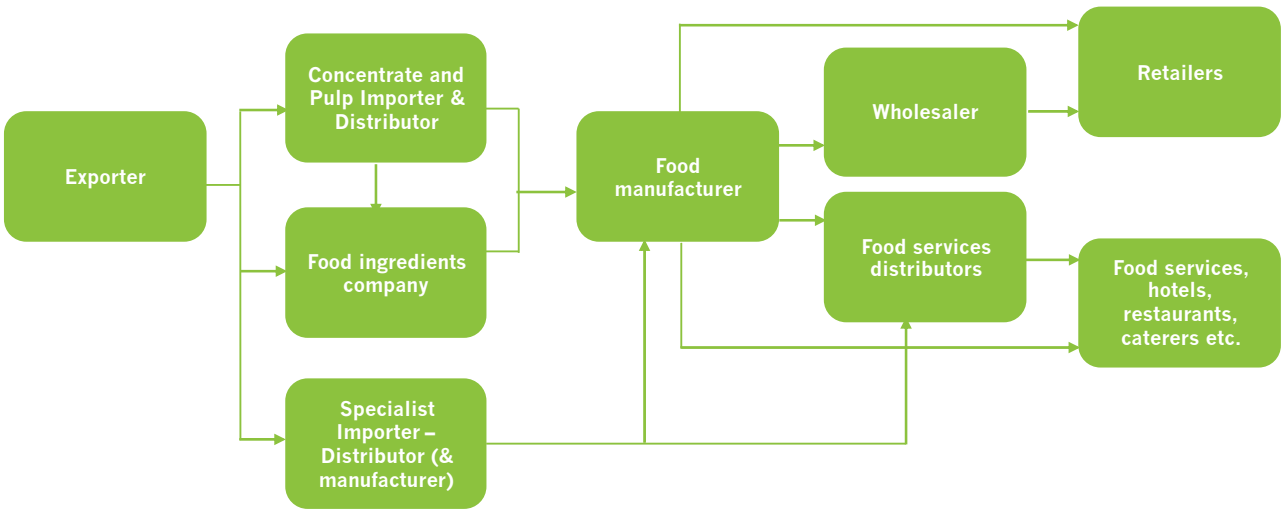
Table 3. Estimates of Spanish processing volumes.

	Available Avocadoes (tonnes)	Population Size (millions)	Consumption per capita (kg)	Consumption (tonnes)	Available Processing Volume (tonnes)	Final Product tonnes @ 50% conversion rate)
Spain *(estimate)*	189,777	47.4	4	189,600	177	89
Spain (mid-tier consumption estimate)	189,777	47.4	1.2	56,880	132,897	66,449
Spain (low consumption estimate)	189,777	47.4	0,6	28,440	161,337	80,669

Source: COLEAD based on World Bank

2.3 Market structure

Figure 6. Avocado pulp market structure



Avocado pulp is typically used in the food services sector and increasingly as an ingredient in manufactured food products such as sauces, and in some innovative new snacks such as guacamole chips and dips. Successfully marketing avocado pulp therefore relies on being able to access food manufacturers and the food services sector.

As the preferred suppliers of avocado pulp for the food services sector, specialist importer-distributors play an important role in this chain. In some cases, these importers are also branching out into food manufacturing, with some offering products such as avocado sauces or spreads.

Many food manufacturers prefer to source products from food ingredients companies, although some companies that manufacture juices or smoothies have stronger, more established relationships with concentrate and pulp importers. This strategy allows manufacturers to have a steady, year-round supply of a similar or near-identical ingredient.

Some food ingredients suppliers also import avocado pulp or source the product from importer-distributors in the EU. Currently, food ingredient companies and juice and concentrate importers play a smaller role than specialist importers. However, if food manufacturers continue to innovate and introduce new avocado-based products, their role in the supply chain is likely to grow.

3. Regulatory and quality requirements

3.1 Product specifications

Table 4. Avocado pulp export product specifications

Item	Specification
Ingredients	Avocado (99.9%), Stabiliser – ascorbic acid, citric acid, salt
Variety	Hass
Appearance	Characteristic shades of green, typical of fresh avocadoes.
Shelf life	18–24 months
Preservatives	Zero, a clean label product is required, natural antioxidants (ascorbic and citric acid) permissible and recommended
Storage conditions	-18°C
Packaging	1 kg, 2 kg, 5 kg and client specified pack sizes, vacuum packed bag, often preformed, typically 6 x 1 kg bag per box

3.2 Food safety and quality management

Avocado pulp is often an end product that does not undergo any further sterilisation or pasteurisation. As it is also a product that is often purchased for its health benefits, food safety is essential to importers, retailers and the food services sector. Food safety concerns mean that related certifications are greatly valued. Companies without certification might find it challenging to market their product as an export-grade product without investing in systems and certification. Some respected and desirable certifications are:

- International Featured Standards (IFS)
- British Retail Consortium (BRC)
- FSSC 22000
- An equivalent standard

3.3 Sustainability and certifications

As avocado pulp is so often an ingredient in a finished manufactured food product, or a dish in a restaurant or deli, sustainability certifications are not necessarily marketed to the manufacturers, or even to buyers in the food services sector. Usually, this would mean that importers do not value these certifications. However, in the case of avocado pulp, sustainability certifications can still assist in marketing efforts, especially when competing as a new supplier.

Rather than the certification being valuable for what it is intended to signify (i.e. a free trade or sustainably produced product), it provides reassurance to importers that the supplier is organised and professional. This in turn signals that quality and food safety is likely well managed. Suppliers therefore have a wide choice in the specific certification to invest in.

Organic certification is less important than in the fresh market and is not strictly essential. Nevertheless, there is growing interest in organic product in the EU. This could provide a useful entry point to start a relationship with new buyers, or in new markets.

4. Supply

4.1 Supplying markets

Due to the high demand for fresh avocado and because avocado processing requires complex methods and technology to prevent browning, relatively few countries have specialised in pulp production. Mexico is arguably the largest supplier of avocado pulp, alongside South Africa and Spain.

Mexico

Mexico is the largest supplier of avocadoes to the USA, which imports about 30% of all traded avocadoes worldwide. The local market for guacamole is also very strong. From a production perspective, quality export-grade avocadoes are available year-round and in large volumes. This steady and sizeable demand and continuous supply of the raw material has enabled processors to make the business case for investing in advanced technology to prevent browning of the avocado pulp, which has allowed Mexico to become the largest supplier of avocado pulp globally.

Spain

Avocado is still an unfamiliar, exotic fruit in Spain, so demand is low. However, local production and imports of about 214,000 tonnes each year[5] have created an opportunity to develop a processing industry for avocadoes. Processing has the added benefit that fruit damaged during shipping and ripening can be used to create a valuable product, rather than becoming waste. The processing sector imports some local and exotic varieties from Peru and Colombia, which are suitable for processing and can be blended with Hass avocadoes to create a more affordable avocado pulp.

The combination of local production, damaged fruit and imports of lower cost exotic varieties enables processors to enjoy a longer processing season. And thereby to afford the high-pressure pasteurisation equipment that is needed to produce and market quality avocado pulp.

South Africa

Avocadoes are a well-known and widely enjoyed product in South Africa, where shoppers have access to quality avocado products. There are several growing regions for avocadoes in South Africa, which allows processors to access a relatively reliable supply of avocadoes year-round. This means they can export pulp for most of the year and establish a business that supplies avocado pulp and guacamole to the local market. There are several companies that have been able to invest in the necessary technology for pulp production and packaging and are able to export avocado pulp from South Africa.

Peru

Peru is the second largest exporter of fresh avocadoes globally. Most avocado production happens at altitude, which creates an avocado that is relatively low in fat compared to the

5 Sourced from ITC Trade Map.

avocadoes supplied by Mexican or African exporters. Typically, avocadoes that are lower in fat (i.e. less than 10% fat) are better suited to making IQF products. This is the case in Peru, so pulp production in the country is relatively low, particularly relative to the scale at which avocados are produced and exported.

Kenya

Kenya is well established as a supplier of fresh vegetables to the EU and is a relatively new exporter of avocado pulp. Even though avocado pulp is typically sold as a frozen product with a long shelf life, buyers still appreciate that the product will be "fresher" due to shorter travel distances. As carbon footprints become more visible and important in the supply chain, the shorter travel distance may also be advantageous for being able to market pulp from this origin.

4.2 Pricing

Avocado pulp is approximately €6.66 per kg at free-on-board (FOB) price.[6] Organic avocadoes are able to achieve a higher price – typically between €7.99 and €9.32 per kg – than conventional avocado pulp (Table 5). As with fresh avocadoes, this price premium is about 20–40%.

Table 5. Avocado pulp export pricing (FOB)

	Conventional avocado pulp	Organic avocado pulp
EU	€6.66 per kg	€7.99–€9.32 per kg
USA	€8 per kg	€9.60–€11.20 per kg

Source: Pricing sourced from interviews with exporters and importers.

4.3 Seasonality

Pulp production relies on the supply of fresh fruit, particularly if it is being used as a way to create value out of waste. Typically, peak production follows the export season for fresh fruit. Buying during or at the end of the export season is preferred, as the market values freshness and this allows buyers in the EU the longest shelf life.

4.4 Variety

It is possible to produce avocado pulp from many varieties of avocado. However, the market has become accustomed to the Hass variety –the intense flavour, creaminess and fresh green colour of the Hass variety is what most buyers of avocado expect.

This does not mean that Hass is the only variety used. Some manufacturers of guacamole, especially in Spain, use other exotic varieties such as Fuerte pulp in their guacamole recipes. However, in this case it is important that the exotic variety resembles Hass in colour, flavour, texture and fat content. To ensure that the final guacamole has these Hass characteristics, most manufacturers add these exotic varieties to Hass avocado pulp. The exact ratio is determined by the manufacturer and the buyer.

6 Pricing sourced from exporter and importer interviews.

5. Production

5.1 Production process

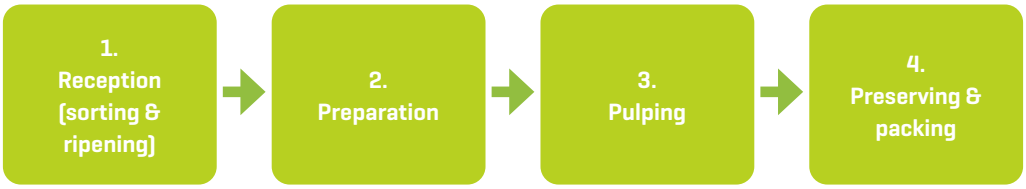
Avocado is a delicate product that requires care to preserve its vibrant green colour and to avoid the pulp becoming bitter. Many possible solutions have been tried. These range from immediately freezing the product, adding preservatives and antioxidants to the pulp and increasingly using high pressure pasteurisation (HPP) to kill microbes and deliver a food-safe product.

Avocado pulp produced using HPP is increasingly preferred by importers and consumers. The high pressure combined with the packaging creates a food-safe product that is free of common food pathogens such as listeria, salmonella and *E. coli.* As the product does not require a preservative it has a clean label. Once opened, it is more stable and provides a longer shelf life.

HPP is a cold pasteurisation method that effectively protects the colour and flavour of the avocado. This enables importers in the EU to market a pulp that very closely resembles fresh avocado. This is especially important to restaurants, hotels and the foods services businesses that are using avocado pulp to replace fresh avocado.

The production process for avocado pulp follows four steps: reception, preparation, pulping, and preserving and packing. As processors are able to market a product that does not use HPP it is important to understand the different options available when making avocado pulp. The biggest difference lies in step 4, preserving and packing.

Figure 7. Production process for avocado pulp



Stage 1: Reception, washing, sorting and ripening

At reception a visual inspection of the fruit is carried out. The fruit is then washed in a water-bath that can be dosed with chlorine or other products, before being sorted, with any infected, overripe or rotten fruit removed.

Stage 2: Preparation

The fruit is typically cut mechanically, the pit is removed and the fruit is scooped out of the skin. This leaves about 60% of the original avocado. In some cases, the pit might be pulped mechanically along with the flesh. However, this is not recommended when trying to enter the export market.

Stage 3: Pulping

The avocado flesh is mechanically squashed to create a paste and then mixed to achieve the correct consistency. This is typically done mechanically.

Stage 4: Preserving and packing

As avocado pulp browns easily when exposed to oxygen, it is important that the final product is stabilised:

Freezing only
The pulp is packed into pouches, which are then sealed and frozen. This method carries the risk of exposing the product to oxygen. As a result, relatively few buyers are willing to buy this type of product.

Added stabilisers and antioxidants
An antioxidant such as citric or ascorbic acid can be added to the pulp along with a stabiliser or additional preservatives. The final product is packed into pouches and can be shipped as a chilled or frozen product. Product with added citric or ascorbic acid is technically clean label. Nevertheless, EU buyers increasingly prefer product without added antioxidants and stabilisers. this will likely change in the future. New investors with an interest in producing pulp should thus consider this a product that will in time be better suited to local or regional markets.

High pressure pasteurisation
High pressure pasteurisation, better known as HPP, is a method of pasteurisation that can be carried out at relatively low temperatures (5–20°C). Placing foods such as avocado pulp under intense pressure destroys pathogens and microbes that might be present. The product then becomes more stable and has an improved shelf life. This treatment allows the flavour and texture of the food to be maintained, which is advantageous in high quality foods that are marketed for their naturalness.

The pulp is pasteurised in its end packaging. Typically, companies use pre-formed bags. These are then vacuum sealed to remove as much air as possible from the packaging. The filled and sealed bags are placed into baskets and inserted into the high pressure chamber of the pasteurisation unit. Water is injected into the chamber, allowing the pressure to rise to 6,000 bar/600 MPa/87,000 psi.

This method is the best way to preserve the colour, texture and flavour of avocado pulp and allows manufacturers to market a product that has no preservatives added. This is a clean label product and is highly prized in the avocado pulp trade. When combined with freezing, which is required by importers in the EU, the product has an even longer shelf life.

5.2 Production technology

Avocado pulp is produced using a blend of manual and mechanical steps. The manual steps assist in protecting the quality of the fruit. Many companies prefer to use manual labour, especially where labour costs are low. Nevertheless, some mechanical equipment is used to reduce processing times. There are described below.

5. Production

Destoner or crusher: A destoner cuts the avocado in half and removes the pit. The fruit is then ready for scooping out, or removal of the flesh from the skin, which tends to be done manually to preserve the quality of the fruit. Companies producing a low-cost, low-quality product sometimes use a crusher, with the pit included in the pulp. This produces a poorer quality pulp that is not in demand for export. It could be tested for the local market.

Mixing group: This equipment allows for mechanical mixing of the avocado into a smooth paste.

Packing equipment: A form-fill and seal machine can be used to form and fill pouches. Some companies prefer to use pre-formed bags. The equipment used at this step would include a vacuum sealing unit to remove as much air from the product as possible. This prevents packaging bursting in the high-pressure pasteurisation unit and preserves the shelf life during distribution.

Pasteurisation: High pressure pasteurisation requires specialised equipment that can withstand the intense pressure applied in the chamber (see Table 6). There relatively few suppliers of this equipment, which is also expensive. The high price and the odd shape of the chamber means that capacity and throughput are important considerations when selecting equipment (see Figure 8 for examples). Capacity is the volume of product that can be contained in the pasteurising chamber and is affected by the shape of the packs being placed in the tube. Throughput refers to the mass of product that can be pasteurised and takes the time taken to pasteurise product into account. This is also affected by the pumps and the pressure that can be created.

Table 6. HPP equipment specifications and costs

Category Descriptor	Details
Capacity/throughput	270 kg, 3 tonnes/h
Dimensions	L: 8 m [26.2 feet] W: 2.8 m [6.8 feet] H: 2.2 m [7.2 feet]
Pressure	600 MPa/87,000 psi
Cost	€700,000 – €3,000,000

Figure 8. HPP packing lines from two international suppliers

Source: www.hiberbaric.com

Source: www.jbt.com

5.3 Production economics

The investment in high pressure pasteurisation technology means that companies need to process a significant volume of fresh avocadoes each month. Should a company invest in the smallest HPP unit (250 kg per hour) and use it for two shifts per day, 6 days per week, that factory would produce approximately 96 tonnes of finished HPP product each month. As a 20-foot container can typically carry 20 tonnes of product, this would mean that the business would be marketing about five containers of finished and packaged product per month (see Table 7). This product can of course be marketed to developed countries as well as locally.

Table 7. Monthly production capacity of 250 kg per hour HPP machine

Capacity (kg per hour)	Production per day (tonnes) (2 x 8 hour shifts)	Production per month (tonnes) (6 days per week, 4 weeks per month)	Number of 20-foot containers (~20 tonnes maximum load)
250	4	96	5

The company would also have a considerable sourcing challenge. Most factories aim to convert 50% of the fresh avocado fruit into finished pulp. Therefore, a company with an HPP unit with a capacity of 250 kg per hour would need to source and process at least 192 tonnes of fresh fruit per month to operate efficiently (Table 8).

Table 8. Projected fresh avocado requirements for different throughput rates of HPP equipment

Capacity (kg per hour)	Production per day (tonnes) (2 x 8 hour shifts)	Production per month (tonnes) (6 days per week, 4 weeks per month)	% flesh recovered from fresh avocado	Fresh fruit requirement (tonnes per month)
250	4	96	50%	192
670	11	257	50%	515
1,410	23	541	50%	1,083
2,600	42	998	50%	1,997
3,000	48	1,152	50%	2,304

HPP technology is available at various scales, from 250 kg per hour to 3,000 kg per hour. Some suppliers offer equipment that has been built to specifically process product at a larger scale, while others offer opportunities to scale up by adding more pumps. The larger the capacity, the more expensive the equipment.

The larger scale has implications for the amount of product that needs to be marketed and for the volume of fresh fruit that needs to be sourced. At the largest scale (3,000 kg per hour), HPP equipment needs at least 2,304 tonnes of fresh fruit per month and can produce 1,152 tonnes of avocado pulp. This assumes that the factory operates for two shifts per day. These volumes would increase by a third if three shifts are used.

6. Proposed marketing strategy options

6.1 Key opportunities and challenges

Table 9. Opportunities and challenges

Opportunities	Challenges
▪ Interest from the food services sector ▪ Growing market ▪ Provides tangible benefits: better handling, longer shelf life, improved availability ▪ Many favourable food trends: veganism, plant-based eating, healthy oil, fresh foods ▪ Large markets with potential to increase consumption ▪ Established importers and distributors ▪ Potential to expand business with food ingredients companies and juice and concentrate importers ▪ Certification could be an asset in marketing ▪ Scaling up is possible and can be modular or a replacement of the line.	▪ Quality management is crucial for high value export markets ▪ Food safety must be well managed ▪ Strong established competitors who have access to the required technology and raw materials ▪ Relatively high equipment costs requiring access to finance to enter the market ▪ High costs require business models that allow for rapid recoup of investment ▪ Scaling up requires capability to market larger volumes of avocado pulp and to secure more raw ingredient.

6.2 Ingredients for success

Lengthen the equipment in-use time

The high investment costs for HPP technology requires that companies find models to be able to afford the equipment. In Mexico and South Africa, year-round production is possible thanks to a year-round supply of avocadoes. In countries where this is not currently possible, companies should investigate sourcing avocadoes from further afield. Regional sourcing could be a sensible option.

Where this is not possible, solutions to keep the equipment operational for longer should be considered. HPP technology is very versatile and can be sued to pasteurise many types of fruits and vegetables. This would keep the entire plant operational – the ripening, washing lines, cutting equipment and other machinery can all be repurposed for similar fruits such as mango, passion fruit and pineapple. Vegetable purees can also be pasteurised using HPP technology.

HPP technology can also be used to pasteurise packaged food products such as bottled juices, soups and baby weaning foods. Finally, the company could consider offering toll pasteurisation outside the avocado season.

Quality management systems

Quality is an important aspect of producing avocado pulp, particularly for product for export. This requires careful training of staff and consideration of how to source, process and handle the fruit to protect both the quality of the fruit and the end quality of the pulp. In particular, companies should be clear about where to introduce equipment or manual labour. Where manual labour is used, quality management systems must be well managed and staff need to be particularly well trained.

6.3 Conclusion

The anticipated growth in this market suggests that HPP pasteurised avocado pulp has good potential in the market. Companies that are able to access finance to fund the equipment and who can ensure that a steady stream of product is pasteurised in the HPP unit will have the best chance of succeeding. There are several novel models that can be considered to get the most value from the equipment and to be able to support the investment in the HPP technology. The added complexity requires investors to carefully consider whether they have the capability and appetite to process many types of fruits and vegetables, or to manage a toll pasteurisation business. In addition, the quality requirements to be able to export avocado pulp requires an organised, professional management team.

SECTOR STUDY: PROCESSED AVOCADO

1. Avocado oil
2. Frozen avocado (IQF)
3. Avocado pulp

GROWING PEOPLE