

SECTOR STUDY PROCESSED MANGO



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Funded by
the European Union

This document is part of the mango sector study. This study explores the technical and economic feasibility of different processing and waste valorisation activities. The other chapters are available here: resources.colead.co.uk/

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1. What is mango vinegar?

Vinegar is produced by fermenting sugary items such as fruit or wine. It is used as a flavouring agent in condiments or as a preservative in pickling. Vinegar adds a slightly acid flavour to meals, both in fragrance and flavour. It also “cooks” meals by dissolving their structures and softening their textures.

Cheaper vinegars can also be used as cleaning products, weedkiller (herbicide), etc. Such products are about 45% concentrated vinegar. Food grade vinegar is far less concentrated (4–5%).

Mango vinegar, which is a niche, speciality product is mostly used as a food grade dressing vinegar. As a result, it is used to flavour salads or as a marinade. Dressing vinegar comes in a variety of flavours including lemon, apple, raspberry, garlic and cherry. The mango vinegar on the market is typically a table or balsamic vinegar that has added mango purée for flavour. However, a 100% mango vinegar can be produced using standard vinegar processes, technology and ingredients.



2. Demand

The vinegar market is large and growing. Nearly €890 million worth was exported in 2021. Most vinegar in this year was imported by the USA, Germany, France, the UK, Canada and the Netherlands. Collectively they import 52% of global vinegar by value.¹

Within vinegars and condiments, the demand for premium dressing vinegar has been growing², a trend that is expected to continue.

Mango vinegar is thus a small part of a very large market. Shoppers have many options available to them when it comes to dressing vinegar. They can use other fruit vinegars such as strawberry, they can opt for premium balsamic vinegars (original or flavoured), or they can opt for home-made or premium salad dressings. The mango vinegar segment is thus very small when compared with the very many vinegars that make up the vinegar market. In fact, it is almost invisible in most retail stores.



Image Source:
www.amazon.com

2.1 Relative pricing

2.1.1 Food grade vinegars

Premium fruit vinegars are significantly more expensive than table vinegar, but they are not the most expensive vinegars on the market. In France, in one of the most developed vinegar markets, fruit vinegars are far more expensive (by volume) than table vinegar, but they are cheap when compared to artisanal speciality Italian balsamic vinegars. A raspberry or mango pulp vinegar in Carrefour France costs €23.96 per litre,³ nearly half the price of an aged balsamic vinegar from Italy (see Table 1).⁴

Table 1. Comparative costs of white, fruit and balsamic vinegars, France

Product	White vinegar	Raspberry pulp vinegar	Mango pulp vinegar	Artisanal balsamic vinegar	Balsamic vinegar crème	Honey, garlic and thyme garlic	Traditional aged balsamic vinegar (12-year min. age)
Brand name	None	Elise Et Felicie	Elise Et Felicie	Elise Et Felicie	De Modène Bio Bionaturae	Le Rucher De Macameli – Bouteille	De Modene Aop
Price per litre	€0.40	€23.96	€23.96	€26.00	€34.33	€69.96	€226

Source: Prices from www.carrefour.fr (August 2022).

¹ ITC Trade Map

² www.coherentmarketinsights.com/market-insight/dressing-vinegar-and-condiments-market-3353

³ All price data are for August 2022.

⁴ The development of this market means that there were a variety of products and prices available for comparison.

The consumer price of mango vinegar does not seem to have a direct relation to the mango purée content of the vinegar. But seems to be set rather by the bottler, especially considering that the biggest share of most vinegar blends is white wine vinegar which is relatively cheap (see Table 2).

Table 2. Comparison of prices of mango vinegar across countries

Product	Mango infused vinegar	Mango pulp vinegar	Mango flavoured vinegar	Mango flavoured vinegar	Cameroon mango vinegar	Mango flavoured vinegar
Webstore	Our finest	Carrefour France	Oil vinegar online – Netherlands	The Artisan Food Company – UK	Piccantino World of Spices – Austria	Oil and Vinegar – USA
Price per litre	€10	€23.96	€39.80	€47.68	€52.45	€70
Mango purée content	Unknown, blend	Unknown, blend	32% mango purée blend	Unknown, blend	40% mango purée blend	35% mango purée blend

Source: Prices from online webstores indicated in the table (August 2022).

2.1.2 Industrial vinegar

Industrial vinegar is considerably cheaper than food grade vinegar. Industrial vinegar on Amazon retails at €5.70 per litre. This product is pure vinegar (100%), but diluted to 45%. As a result, the actual pure vinegar costs €12.54 per litre (see Table 3).

2.1.3 Competitive analysis

Mango vinegar in France costs €23 per litre for the finished, blended product. But it only contains 70% vinegar and is 30% mango purée. If we calculate the cost of pure vinegar, it €64.40/l at 100% concentration. By selling vinegar as mango vinegar, the product achieves a very high price. It appears that swapping out the generic vinegar with vinegar made from mango waste enables companies to achieve this high retail price.

Table vinegar in comparison is very cheap. It costs €0.40 per litre. This is typically at 5% concentration. So, if it was sold as pure vinegar the table vinegar would be €8 per litre. This is about an eighth of the price of the vinegar in mango vinegar (i.e. mango purée with vinegar).

Table 3. Comparative pricing on 100% pure vinegar

	Mango vinegar	Industrial vinegar	Table vinegar
Retail price per litre	€23	€5.70	€0.40
Pure vinegar content in the product recipe	70%	100%	100%
Vinegar concentration	5%	45%	5%
Price of 100% pure concentrated vinegar per litre	€64.40	€12.54	€8

There are a few conclusions we can draw from this analysis.

1. Food manufacturers are using the addition of purée to increase the perceived value of the white wine vinegar. This allows for higher prices of and better profits from a product that is usually very cheap. It essentially allows vinegar companies to sell white wine vinegar, made from just about any feedstock, for exceptionally high prices (in this case equivalent to €64.40 per litre at 100% concentration).
2. From an economic perspective it would be theoretically feasible to manufacture a 100% mango purée vinegar, i.e. without added white wine vinegar, which it could be very profitable. However, the very low price of white wine vinegar explains why so many food companies blend mango purée with white wine vinegar instead of making 100% mango vinegar – if they used the cheapest white wine vinegar available, the raw material would cost €8 per litre, then they could sell it for €64.40. It is very unlikely that they are in fact using the cheapest white wine vinegar available, but it does suggest that a vinegar made entirely from mango would have to be quite cheap to be able to compete. In this scenario, a competitive price would be between €8 and €12 for a processor to consider selling food grade pure (100%) mango vinegar to a bottler. But, the bottler would need to be convinced to spend considerably more than the current price they are paying for vinegar.
3. In all likelihood, a processor is better off producing industrial grade vinegar rather than cheap table vinegar. By concentrating the product and selling it for other uses, it achieves significantly higher retail prices than white wine vinegar, leaving better margins for all actors along the value chain.
4. There are major overlaps in the process used to produce vinegar and purée. Both processors would have to rely on sourcing third-grade fruit, which is in short supply in most African countries. For many processors it would be necessary to choose whether to use the fruit for juice or vinegar production.

Purée itself sells for €800 per tonne on the global market. This is not even the retail price, yet it is as expensive as cheap table vinegar to a retailer in Europe. Industrial grade vinegar fetches higher prices. At the retail level, however, this is only 25% more than the global price of mango purée. The opportunity cost of producing 100% pure mango vinegar instead of purée from damaged fruit could therefore be too high.

2.1.4 Local variety production

It might be possible to use local mango varieties for vinegar production. These tend not to be a part of an organised collection system, which would therefore need to be developed. A second challenge is that many local varieties bruise easily, or they are very fibrous. Both issues could result in high losses. First, bruised fruit is more likely to rot so would need to be sorted out at the first stage of production. Second, fibrous fruit yields less fruit pulp. As a result, vinegar processors would face many similar costs to purée processors. For example, logistics costs, processing costs, packaging costs and labour costs would all be similar. Processors would need to be certain that a lower cost of fruit justifies the higher losses from bruising and higher fibre content.

It is more likely that vinegar processors would have a better business case for using purée as a raw material rather than collecting their own local varieties of fruit. But this would need to be confirmed through a more thorough economic analysis.

2.2 Buying criteria

2.2.1 Acidity

The acidity of food grade vinegar is carefully monitored. If it is too acidic, it is unpleasant. But vinegar that lacks acidity has a shorter shelf life. Vinegar should have an acidity of between 3.5% and 7%.

2.2.2 Fruit pulp

A premium mango vinegar, at least the final finished product, tends to have a purée content of more than 30%, but this can be as low as 10%. This adds colour, flavour and aroma.

Table 4. Characteristics of food grade mango vinegar

Characteristic	Target	Note
Acetic acid	3.75 g / 100 ml	Range 3.75–7%
Total solids	1.5%	
Pulps or fruit content	>10%, but typically 30%	For pulpy fruit vinegar

2.3 Market trends

2.3.1 Natural cleaning products

Cheap fruit vinegars, typically white wine vinegar, are being used to mix natural cleaning products at home. The product is valued for being less toxic than bleach or other, often heavily fragranced, cleaning solutions. If a cheap mango vinegar is made it would compete in this growing, but low-value category.



2.3.2 Whole foods, plant based

The whole foods, plant-based way of eating focuses on introducing lots of fruit and vegetables into one's diet. Those who follow this way of eating enjoy lots of salads. As these people prefer unprocessed foods, they also mix their own salad dressings. Fruit vinegar, especially those with rich fruity flavours and aromas, are valued in this market. This offers opportunities for vinegar bottlers.

2.3.3 Flavour and organic innovation

Shoppers are increasingly interested in enjoying novel flavours in their foods. This extends to flavoured vinegars. Shallots, apple, tomato, fig, garlic, mango and berries are just some flavours that are being introduced or becoming more available in stores (online and physical).





2.3.4 Natural and organic

New products being introduced in the premium vinegar market tend to be preservative-free and make use of natural flavours from fruit purées, herbs, etc. In some premium vinegars, such as coconut and apple cider, organic is becoming an interesting innovation area. This could offer opportunities for producing an organic mango product.

2.3.5 Oil and vinegar boutiques

The interest in natural oils and vinegars has resulted in an increase in specialist shops selling natural, premium vinegars. This is introducing more affluent shoppers to fruit vinegars such as mango vinegar. This could point to further growth in this product.



Images sourced in this chapter are from www.unsplash.com



3. Supply

3.1 How do these products reach the market, what is the value chain structure?

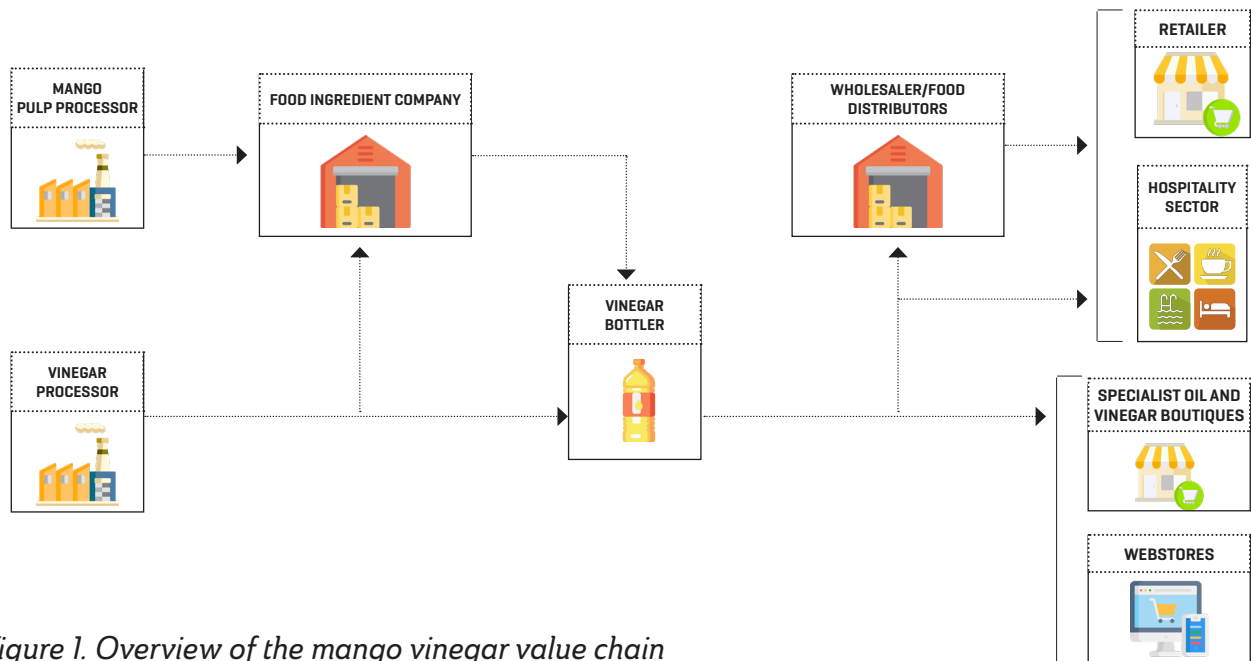


Figure 1. Overview of the mango vinegar value chain

Vinegar bottlers play an important role in the vinegar value chain – especially for premium vinegar sales. These companies blend white wine vinegar with mango purée to create a distinctive flavour. They are also the value chain actors who will determine the amount of mango purée and vinegar will be used in the recipe. Lastly, they determine the quality and hence the price of the cheaper vinegar product and whether this is made from grapes, sugarcane or eventually mango itself.

Food ingredients companies are the most likely suppliers of mango purée to vinegar bottlers in premium markets. This is likely to remain the situation. However, if vinegar bottlers can be convinced to replace generic white vinegar with vinegar made from mango waste, there are opportunities for the vinegar supplier to sell directly to the bottler. Food ingredients companies might also play a role as an intermediary. But the bottler would need to be convinced that this is a viable idea. Using a vinegar made from mango waste needs to be beneficial, for example, having better flavour, health claims, price or some other benefit.

Vinegar bottlers have several options when it comes to selling their product. It can be sold directly to specialist oil and vinegar boutiques, via webstores or to the hospitality sector. Alternatively, they can work through wholesalers or food distribution companies. The premium prices of mango vinegar do mean that many are distributing their product via online stores that specialise in premium food products.

3.2 Technology, processes and techniques

3.2.1 Production process

The process is relatively simple, albeit lengthy. It also requires meticulous attention to bacteria and fermentation control. This is described below (see Figure 2).



Figure 2. Production process for mango vinegar

Stage 1: Reception of raw materials

In this stage the mangoes are cleaned and prepared for processing. The mangoes are washed three times to remove any residual pesticides and dirt. The fruit is then destalked, removing the bitter part of the stem that joins the fruit, and 90% of the peel is removed. This all ensures that the fermentation process is controlled, and that the final product is not bitter. As in purée production, third-grade mangoes can be used for vinegar production. However, at this stage sorting is required to ensure that fruit that is rotting or is still not ripe is removed from the production batch. Both affect the quality and concentration of vinegar that can be produced. Rotting fruit introduces unknown bacteria into the pulp, while unripened fruit is too low in sugar to fully feed the fermentation process.

Stage 2: Pulping

In this stage the fruit is removed from the stone and mango pulp is created. This pulp is called a mash in vinegar production. It is created in a similar fashion to premium mango purée: the mango flesh is removed, and the stone might be scraped to remove remaining flesh. All the mango flesh is placed in containers to soak in 1–4% vinegar water. This prevents browning of the mango, prevents harmful microorganisms from growing and prepares the product for fermentation. Water is then added so that the final product is about 10% water. This is then agitated (stirred) and pressed to release juices and break up the flesh. It is then strained to remove the fibrous part, leaving a concentrated slurry. For a pulpier vinegar, a coarser strainer would be used, allowing more pulp through the strainer and only holding back the fibres.

Stage 3: Pasteurisation

In this stage the liquid is readied for a controlled fermentation process. Sterilisation can take place at this stage.

Stage 4: Double fermentation and ageing

In this stage the liquid is fermented twice. In the first fermentation the sterile slurry is placed in fermentation tanks. Water is added so that it is 20–25% of the mixture, i.e. a ratio of 1:4–1:5. Yeast is added as well as small amounts of salt and sugar. The fermentation tanks' necks are then covered with muslin cloths and aerobic fermentation takes place for 15 days at 30°C (alcoholic fermentation).

After 15 days the yeast on the surface is skimmed off. This helps to keep the vinegar clear. The vinegar is then aged by allowing it to stand aerobically in a sealed state for 15 days (acetic fermentation).

Stage 5: Sterilisation, packaging and shipping

The vinegar is then sterilised by heating it to between 50°C and 60°C for 10–15 minutes. If a final product is being produced, this can be mixed with a mango purée and then bottled. If the product is to be sold in bulk as a low-cost vinegar or an industrial vinegar, then this can be packed into bulk packaging, i.e. double-lined drums.



4. Ingredients for success

4.1 Low-cost mango

To make this model work, the investor needs to be able to access mangoes that are either third grade or are not being used in other applications such as juice or dried fruit. This is challenging in many African countries where mango is expensive and in great demand. Alternatively, local varieties – typically referred to as short- or long-nosed mangoes – might not be suitable for the processing sector. They tend to be damaged more easily, have higher fibre content, or are too small to deliver enough pulp versus the skin and stone – they could have potential as a raw material for vinegar production.

Investors will need to carefully assess the opportunity, keeping in mind that it is technically possible to use mango purée as a raw material for vinegar production. It is also possible to use investment capital to produce mango purée, which is in demand and can be sold at higher prices than mango vinegar.

4.2 A willing buyer

Mango vinegar currently relies on white wine vinegar. So, for a change to be made a processor using 100% mango as a feedstock would need to find a buyer who values a pure, mango fruit vinegar. There are examples of premium balsamic vinegars that have good distribution in French supermarkets and speciality vinegar stores. So, this is challenging, but it could still be possible.

4.3 Local premium niche market

This is crucial to being able to fully assess whether there is indeed an opportunity to produce mango vinegar at all. This could be a niche product in a local or regional market. But this hinges on being able to get distribution of the product via urban supermarkets or local webstores. This is happening in Ghana, but on a very small, artisanal scale.

5. Issues and opportunities summary

Table 5. Issues and opportunities

Opportunities	Issues
<ul style="list-style-type: none">▪ Growing demand for premium dressing vinegars and natural cleaners made from vinegar.▪ Very high prices of mango vinegars, enabling premium prices for the vinegar base.	<ul style="list-style-type: none">▪ Mango vinegar tends to be made of a white wine vinegar, blended with a purée. This is very affordable and profitable for vinegar bottlers.▪ Table vinegar is very cheap.▪ Industrial vinegar uses cheap feedstocks such as sugarcane rather than expensive mangoes.▪ Local varieties are unlikely to be more profitable than using purée as a raw material because of losses to damage and fibre.▪ Small local market for premium dressing vinegar.

6. Conclusion

The opportunity cost of producing vinegar from third-grade mangoes is that processors could be using that mango to process purée – economic analyses suggest that purée fetches higher prices than both table vinegar and industrial grade vinegar on the global market.

Local varieties that are not in demand for juice production could offer an opportunity. But this depends on the fibre content of the varieties. If they are too fibrous, too little juice might be created and too many solids lost to make the product economically viable.

It is economically feasible to manufacture a finished premium mango vinegar for export. However, it is important to ask whether companies that (plan to) do so will be able to compete. Processors in Africa would need to compete with companies bottling a range of vinegars in Europe. These companies use cheap vinegar, blended with purée and face lower shipping costs. If companies in Africa opt to sell premium mango vinegar locally, they will face challenges in marketing an expensive product to a small market and through a limited number of stores. The high price suggests that is likely to remain a niche opportunity, but one that needs effort and investment to generate sales and distribution.

The larger industrial vinegar market does exist. But it asks processors to compete against vinegar products that are made from sugarcane and other feedstocks that are cheap and plentiful. Here too, processors could be using the mango pulp to make purée, which has a higher sale price.

The mango vinegar opportunity is thus unlikely to be truly viable. In nearly every scenario, an investor is better off producing purée instead of vinegar. Ironically, this offers a better opportunity of being able to supply product to premium vinegar dressing bottlers.

SECTOR STUDY: PROCESSED MANGO

1. Fresh cut mango
2. Dried mango
3. Mango puree
4. IQF mango
5. Mango pickle
6. Mango vinegar
7. Mango butter
8. Mango briquettes
9. Mango based compost



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Belgium - Avenue Arnaud Fraiteur 15/23 - B-1050 Brussels
France - Rue de la corderie, 5 - Centra 342 - 94586 Rungis Cedex
Kenya - Laiboni Center, 4th floor, P.O. BOX 100798-00101, Nairobi
network@colead.link | www.colead.link