

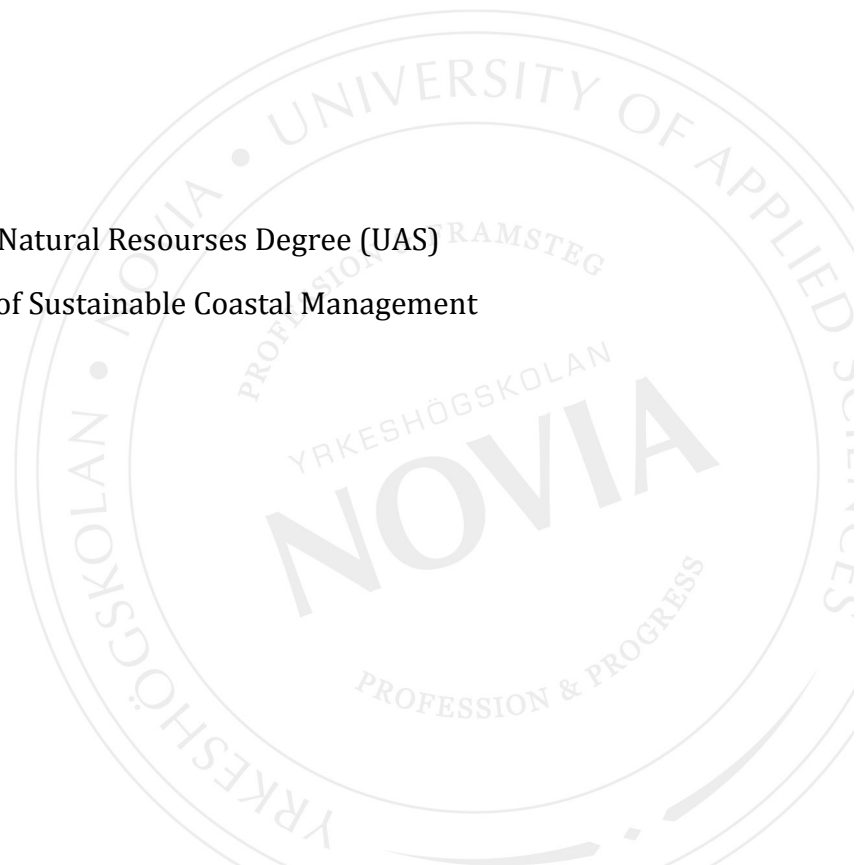
# **Call for an oilseeds crop diversification in Finland**

Olga Angove

Thesis for a Bachelor of Natural Resources Degree (UAS)

The Degree Programme of Sustainable Coastal Management

Raseborg, Finland 2021



## **BACHELOR'S THESIS**

Author: Olga Angove

Degree Programme: Sustainable Coastal Management

Specialization: Natural Resources

Supervisor(s): Veronika Bäckman

Title:

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Date May 20      Number of pages 21      Appendices 4

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### **Abstract**

Promoting crop diversification in agriculture is one of the key measures that could help with the mitigation of existing and evolving environmental problems. Crop diversity strengthens crop quality and productivity, as well as soil health, resilience to pests and diseases among other benefits.

This work is focusing on oilseed crops in Finland. Nowadays the main oilseed crop in Finland is rapeseed. However, there is a great potential for the production of hemp, flax, camelina and other oilseed crops as well on a larger scale.

The main benefits of these crops are related to great environmental adaptability, resistance to pests and diseases, low-soil and water requirements, as well as uses in food, feed, cosmetics, textile, and other spheres.

The following question was central in the research: can hemp, flax, and camelina oils be sustainable local supplements to the oil market in Finland?

The study aimed to discover the attitude of Finnish people towards vegetable oils and their today's preferences as well as their interest in new varieties.

I conducted an online survey and in total 240 people answered the questions. According to respondents' answers, the three most popular oils in Finland are olive oil, rapeseed oil, and coconut oil. Respondents showed high interest in other oils, made from local crops in Finland as well. Vegetable oils extracted from hemp, flax, and camelina seeds could be healthy addition to a diet if they become more available and affordable in Finland.

However, further studies could also investigate the potential to scale up the production of camelina, hemp, and flax from a promising oilseed to a commonly cultivated crop in Finland. I think farmers and end-users have to discover the real potential of this interesting species as well as the health benefits of cold-pressed fresh oils.

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Language: English    Key words: flax, hemp, camelina, vegetable oils

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## Table of contents

1	Introduction .....	1
1.1	Vegetable oils .....	2
1.2	Global Vegetable Oil Market .....	3
2	Theoretical Framework about oil crops .....	5
2.1	Flaxseed ( <i>Linum usitatissimum</i> ) .....	6
2.2	Hempseed ( <i>Cannabis sativa</i> L.) .....	7
2.3	Camelina ( <i>Camelina sativa</i> ) .....	9
3	Growing conditions for flax, hemp and camelina in Finland .....	10
3.1	Other oil cultures for Finnish climate.....	11
4	Methods.....	11
4.1	Survey.....	11
5	Survey results.....	12
5.1	Discussion.....	17
6	Conclusion.....	18
7	References.....	20

## 1 Introduction

There is an increasing demand of food globally. The world's population is expected to grow to almost 10 billion by 2050, boosting agricultural demand by some scenarios up to 50 percent requiring commensurate shifts in output and adding pressure on natural resources. At the same time, diets around the world are changing and becoming more similar, this phenomenon is called "a globalized diet" (Khoury, 2014).

Nevertheless, already today we clearly see how different environmental problems evolve. The environmental impact of agriculture is hard to underestimate. It has the greatest influence on the air, water, soil, and biodiversity when compared to other sources. Agriculture contributes to environmental degradation like deforestation, biodiversity loss, water pollution, and climate change (Figure 1).

One of the key pillars for agroecological transition and for lowering pressure on existing natural resources is promoting crop diversification. Diversifying crops generally enhances crop productivity, quality, soil health and fertility, and resilience to pests and diseases and reduces environmental stress. (Zanetti, 2021).

What are the environmental impacts of food and agriculture?

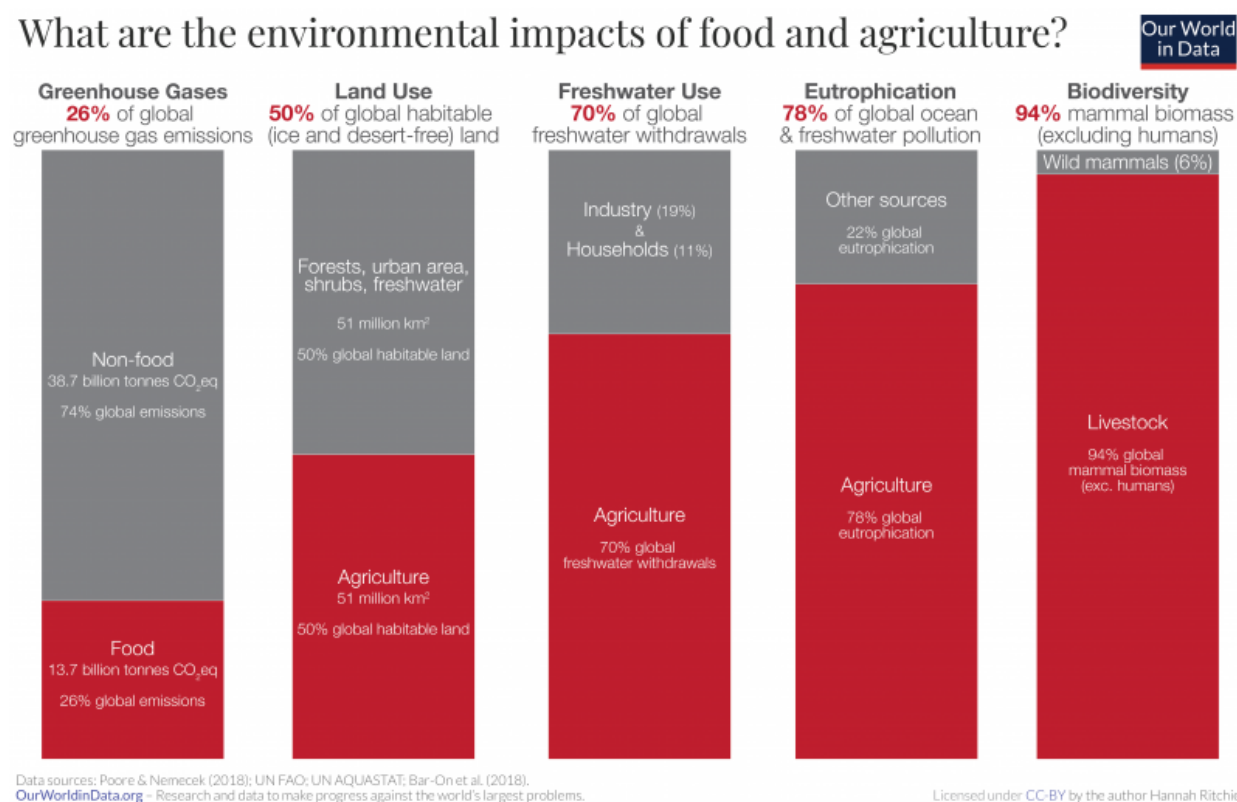


Figure 1. Environmental impact of food and agriculture (Ritchie, 2020)

At the same time, the UN Food and Agriculture Organization (FAO) claimed that "the diversity of cultivated crops declined by 75% during the 20th Century and a third of today's diversity could disappear by 2050". An expansion in the diversity of main food source crops is needed for improving the adaptability of the global food system to future changes and improving countries' food security (Khoury, 2014).

In this work the focus is on vegetable oils and oilseed crops as a food source.

Vegetable oils are widely used from food to household. The most common oilseed crop in Finland today is rapeseed (Luke 2021). Renard & Tilman (2019) in their research writes: "increasing national effective crop diversity may be an additional way to year-to-year stability of the total national harvest of all crops combined". Therefore, it might be interesting to investigate possibilities for growing other varieties of oilseed crops in Finland. At the same time, new oil varieties could be beneficial for the consumers as a healthy local oil source in addition to the current oil dietary choice. For example in my home country, Russia, we have about 5-7 different fresh-pressed local oils available in almost any city, and personally, I miss the opportunity to buy fresh-pressed oils here, in Finland. That's why I am interested in this topic.

Therefore, in this research project, I studied if oil crops such as hemp, flax, and camelina are suitable crops for growing in Finland. The main research question was: can hemp, flax, and camelina oils be sustainable local supplements to the oil market in Finland? The aim was to describe the attitude of Finnish consumers towards vegetable oils and their current preferences as well as their interest in new varieties. This was done by conducting an online survey.

## **1.1 Vegetable oils**

Vegetable oils are fats that have been extracted from different oilseeds crops. The extraction of oils has been a common practice in several cultures since early times. Most likely, the first oils were olive and palm oils, since oil could be easily extracted just by hand squeezing ripe fruits. For example, according to archaeological research, people started to make olive oil already almost 8000 years ago in the Middle East. However, the other vegetable oils extraction from different oil crops was discovered later in the 1600s, when people created oil presses (Namdar, 2015).

Oilseeds crops include plants, which seeds and fruits contain fat, usually from 20 to 60%, that can be used for obtaining vegetable oil. However, some oil crop species like Candlenut (*Aleurites moluccanus*), Sesame (*Sesamum indicum*), Oiticica (*Licania rigida*) and Ucuhuba (*Virola surinamensis*) contain up to 76% oil in their seeds (Murphy, 1996). Therefore, there is a potential to increase oil content in other oil crops through breeding and genetic engineering. For example, currently oil content of rapeseed is around 42% in China and Australia, 45–48% in Canada, but the number that some research show that it can even reach up to 65% (Shen, 2007; Seberry 2008; Wang, 2010).

Vegetable oils have great nutritional and technical value. The fruits and seeds of oilseeds contain proteins, which include many essential amino acids like lysine, tryptophan, cystine, arginine, etc., for humans and animals (Marchik, 2006).

Vegetable oils can be eaten raw, used in bakery, confectionery and other food production. They are also raw materials for other industries, like cosmetic (especially soap), paint, varnish production, medicine, biodiesel etc. Moreover, all parts of plants could be useful. Oilseed cakes and meals are the residues remaining after the removal of the greater part of the oil from oilseeds. They are rich in protein and mostly used as feed for livestock.

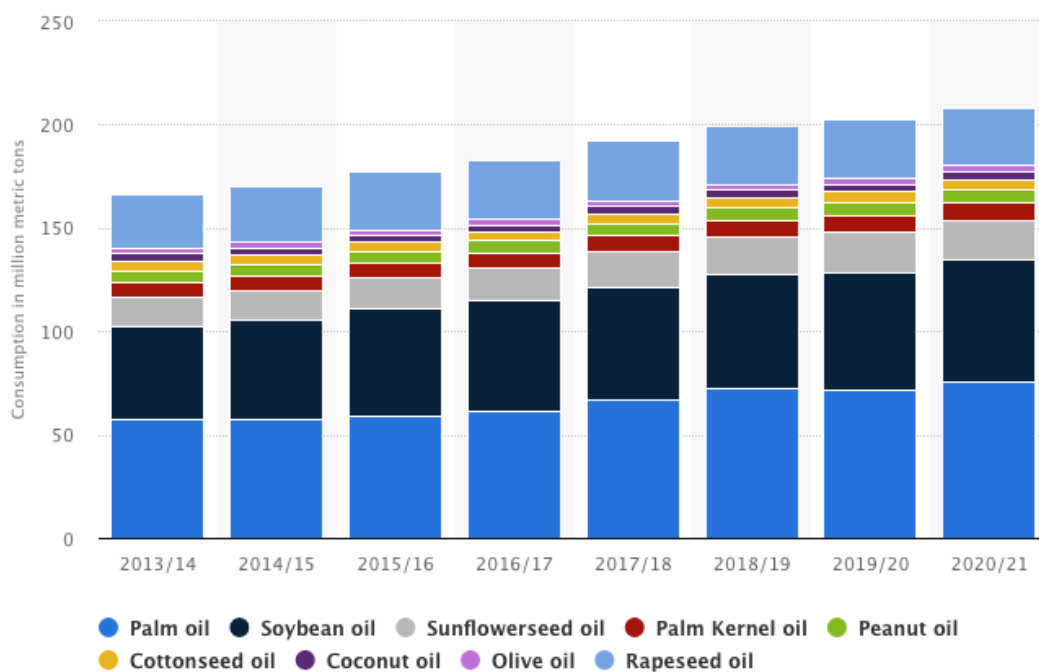
The amount and quality of fat in seeds and fruits of various crops depends on the type and variety of plants, as well as on the conditions of their growth, in particular, on the soil, climate, agricultural technology. Many of the oil plants are also good honey plants (Shen , 2007).

## **1.2 Global Vegetable Oil Market**

If we look globally, then it is clear that palm oil is the leading vegetable oil, followed by soybean oil in terms of consumption and production. The third-place belongs to rapeseed oil (Figure 2). However, in this thesis, I want to focus on private sector vegetable oils, not oils for commercial use, where for example palm oil mostly used in.

One of the most widely used vegetable oils for cooking is canola and rapeseed. They both belong to the *Brassicaceae* family (also called cabbage or mustard family). However, they are different plants. In the 1970s canola was created by plant cross-breeding in Canada. The scientist wanted to remove two undesirable components of

rapeseed: glucosinolates and erucic acid because it was believed to be inedible or toxic in high doses. The new plant was named “canola,” as a combination of “Canada” and “oil” (or ola).



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Figure 2. Vegetable oils: global consumption by oil type 2013/14 to 2020/2021 (Statista Research Department, 2021)

Rapeseed (*Brassica napus ssp. oleifera*) is also grown in Finland. According to statistics from LUKE in 2018, Finland’s total production of turnip rape and rapeseed (*Brassica rapa ssp. oleifera* and *Brassica napus ssp. oleifera*) was 71 million kilograms. Spring turnip rape and/or rapeseed is produced only in Nordic and Baltic countries, elsewhere in the EU almost the entire production is made up by winter turnip rape and/or rapeseed. *Brassica napus ssp. oleifera* usually has a higher yield than *Brassica rapa ssp. oleifera* but requires a longer growth period. Finland’s short growth season has traditionally favored turnip rape (Luke, 2021).

In this work I’m mostly interested in camelina (*Camelina sativa*), common flax or linseed (*Linum usitatissimum*), hemp (*Cannabis sativa*) as oil crops that could be grown in Finland in large scale, but currently not as common as rapeseed.

## 2 Theoretical Framework about oil crops

Oil crops include both annual (usually called oilseeds) and perennial plants whose seeds, nuts, and fruits could be consumed directly as food or pressed to obtain the oil. Some of the crops included are also fiber crops in that both the seeds and the fibers are harvested from the same plant like linseed, hempseed coconuts and cotton (FAO, 2021).

Oil crops are a large group of plants (more than 20 species), consisting of representatives of various families. The common property of these plants is the high content (over 20%) of vegetable (fatty) oil in the seeds or fruits. The seeds (fruits) of these plants are raw materials for obtaining vegetable oil. The list of the main field oil plants is presented in the table (Table 1).

Table 1. Some of a common field oilseeds

<b>English name</b>	<b>Latin name</b>
Common sunflower	<i>Helianthus annuus</i>
Safflower	<i>Carthamus tinctorius</i>
Peanut	<i>Arachis hypogaea</i>
Colza	<i>Brassica rapa L. var. silvestris Briggs</i>
Rapeseed	<i>Brassica napus L. ssp. oleifera</i>
Brown mustard	<i>Brassica juncea</i>
White mustard	<i>Sinapis alba</i>
Camelina, False flax	<i>Camelina sativa</i>
Castor bean	<i>Ricinus</i>
Sesame	<i>Sesamum indicum</i>
Breadseed poppy	<i>Papaver somniferum</i>
Dragon's head	<i>Lallemantia iberica</i>
Perilla or Korean perilla	<i>Perilla ocymoides</i>
Common flax or linseed	<i>Linum usitatissimum</i>
Hemp	<i>Cannabis sativa</i>
Soybean	<i>Glicine hispida</i>



## 2.1 Flaxseed (*Linum usitatissimum*)

”Everything new is forgotten old”

Russian proverb

Flaxseed is one of the oldest crops, which have been cultivated since the beginning of civilization. The Latin name of the flaxseed is *Linum usitatissimum*, which could be translated as “very useful”. Flaxseed produce food, feed, and fiber. Every single part of the flaxseed plant is used directly or after processing. Flaxseed stems are used for fiber production to make linen fabric and paper. Seed are used to produce oil, for human consumption as well as technical purposes too, e.g. in the production of oil colors, floor oils, and by-products are used in animal feed formulation. There are little differences in names, flaxseed, and linseed. Usually, the flaxseed term is used when we talk about seeds as human food, and linseed is used when flax is used in the industry or for animal feed (Goyal, 2014).

Recently flaxseed has been in focus because of it’s health benefits. A flaxseed containing 35%–45% of oil. Flaxseed oil is very unique because it’s the richest plant source of the omega-3 fatty acid i.e.  $\alpha$ -linolenic acid (ALA) (Gebauer, 2006). The health benefits also are associated with proteins and an array of antioxidants. It has health imparting benefits in reducing cardiovascular diseases, decreased risk of cancer, particularly of the mammary and prostate gland, anti-inflammatory activity, laxative effect, and alleviation of menopausal symptoms and osteoporosis (Ivanova, 2011; Goyal, 2014).

There are different methods to extract oils: cold-press extraction, solvent extraction, and supercritical CO<sub>2</sub> extraction (Pradhan, 2010). However, the high concentration of ALA in flaxseed oil gets easily oxidized after being extracted and purified (Holstun, 1994). From personal experience very often oil bought in a store in Finland, which has a long shelf-life from half a year and longer, have a very unpleasant smell and taste which is the result of oxidization. The lipid oxidation process is responsible for flavor deterioration, loss of nutrients as well as the formation of toxic compounds (Shahidi, 2010).

## 2.2 Hempseed (*Cannabis sativa* L.)

Hemp was known by humans from their earliest industrial initiatives. One of the oldest references in the Chinese medicine about using hemp has been dated to 2727 before Christ (BC). Different studies suggest that it used to be our planet's largest agricultural crop and one of the most useful raw material in different industries, involving a large variety of products since hemp is a very variable plant and produce food, feed, and fiber.

Archaeological studies found cannabis pollen grains in northern Italy, dating to 3450 BC samples from Germany, Scandinavia, England, and France have dated back between 2900 to 1700 BC. However, these discoveries do not suggest the cultivation of hemp, but its wild growth (Bouloc, 2013).

When global synthetic fiber production started and around the same time in 1937 "Marijuana Tax Act" was introduced, the situation with hemp cultivation changed. One of the key roles in the situation played global power of the USA, starting around 1945 onwards. Hemp has effectively been banned in the USA and later the USA imposed their view on hemp in the other countries as well. As a result, worldwide ban of the plant in China, India, USSR, Eastern Europe, Italy and France, and other places (Figure 3).

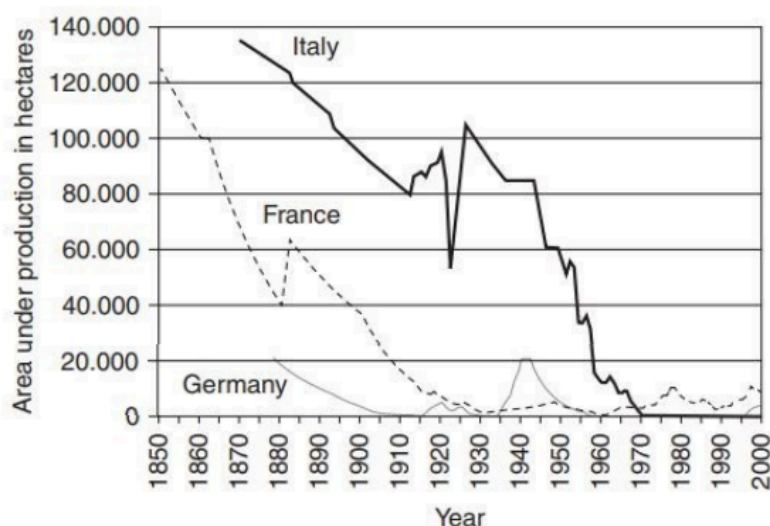


Figure 3 . History and decile of hemp (Bouloc, 2013)

Many EU countries lifted the ban on hemp production in the 1990s and nowadays, the situation slowly changes. Today about 30 countries in Europe, Asia, and America

started hemp cultivation. For example, in The European Union (EU) most of the member nations cultivating hemp (Johnson, 2014) (Table 2).

Table 2. Countries Cultivating hemp in 2004 (Bouloc, 2013)

Countries Cultivating hemp in 2004			
Europe 25 <sup>3</sup>	Area of hemp in 2004 (ha)	Other European countries	Area of hemp in 2004 (ha)
Germany	1730	Romania	2000
Austria	397	Russia	2500
Belgium	0	Serbia	200
Denmark	0	Ukraine	1000
Spain	678	<b>TOTAL</b>	
Estonia	PM	<b>Other European countries</b>	<b>5700</b>
Finland	6	<b>ASIA<sup>4</sup> (estimations)</b>	
France	8 427	China	65000
Great Britain	1 640	North Korea	13000
Holland	27	South Korea	224
Hungary	539	Japan	20
Ireland	22	Turkey	700
Italy	885	<b>TOTAL Asia</b>	<b>78944</b>
Latria	PM	<b>Australia</b>	
Lithuania	PM	Australia	250
Poland	81	<b>North America</b>	
Slavakia	PM	Canada	5500
Sweden	PM	<b>South America</b>	
Czech Republic	500	Chile (FAO)	4300
<b>TOTAL</b>		<b>Africa</b>	
<b>Europe 25</b>	<b>14932</b>	South Africa	PM
		<b>TOTAL WORLD</b>	<b>105756</b>

3. Data from the EU.  
4. Data from FAO and estimations  
\* PM = not recorded

Hemp oil is made from hemp seeds. Hemp seed contains about 30–35% oil by weight. Harvested seeds need to be dried to reduce their moisture content because incorrectly stored seeds can have high moisture content, and the moisture will tie up the oil within the seeds during pressing. Too low moisture levels are problematic because it could increase pressing temperature and exceed the cold pressing temperature limit (Pickering, 2019). Hemp oil is considered to be a relatively unstable product, so that's why oil extracted mostly by cold-pressing methods (Jace, 2018). Usually, seeds are put into the machine, crushed and pressed, then the oil separated from the pulp, and as a result: pure and unprocessed oil is ready. Cold-pressed, unrefined hemp oil is green, with a fresh nutty flavor. Carotenoids and Chlorophyll were found in hemp seeds, which make oil dark green color. Refined hemp oil is clear and has almost no flavor.

## 2.3 Camelina (*Camelina sativa*)

Camelina is an annual dicot species belonging to the Brassicaceae family, as well as a rapeseed. Its origin comes from Asia, but is found in other places like Japan, China, Korea, America, and Europe. Camelina is known by many names: gold-of-pleasure, false flax, wild flax, and others. It has been cultivated as far back as the Bronze Age. Usually, it used to be associated as a weed plant, but later people discovered its beneficial properties and began cultivation. Today, Camelina is cultivated for the production of valuable oil in many countries. Camelina attracts attention in many countries due to tolerance for dry soils and low rainfall, unpretentiousness and early maturity, high and stable yield. Also, it ripens early, which is important for the Nordic climate conditions. Camelina can grow to maturity before frost in regions with a short growing season, for example maturing 21 days earlier than flax (Shukla, 2002). Camelina can survive early-season water deficits and minor frosts in spring (Terramax, 2008). Camelina and Rapeseed seeds comparison shown at the figure 4.

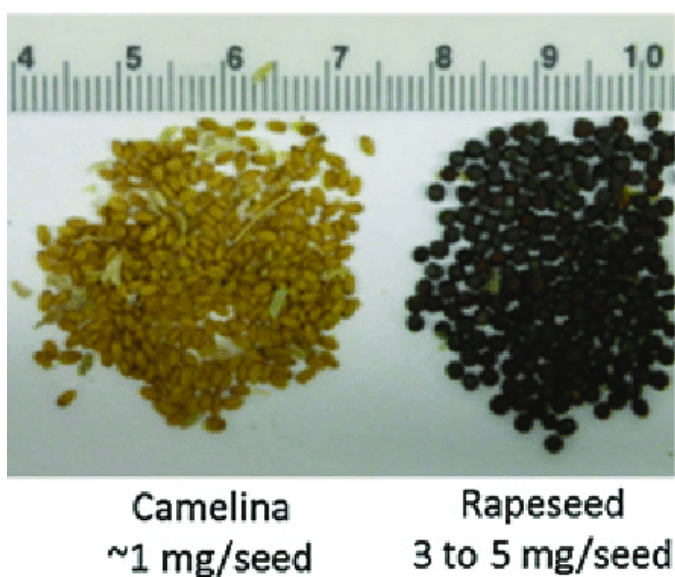


Figure 4. Camelina and Rapeseed seeds (Iskandarov, 2014)

Another interest in camelina is due to the high productivity of seeds. According to different statistical information, the yields may vary from 1 to 2.1 t / ha and more. Seeds contain 35-45% of multi-purpose oil. For example, a tone of Camelina will contain 350 kg of oil, of which the press will extract 250 kg. Cold pressing (40C) is required because high temperatures will damage the antioxidants (Iskandarov, 2014).

### **3 Growing conditions for flax, hemp and camelina in Finland**

According to the Finnish Cereal Committee (VYR), the Agricultural area in Finland that is in use nowadays is about 2.3 million hectares. Cereal crops are cultivated annually, in an area of about one million hectares. Due to Finland's northerly location, the growing conditions have their own pros and cons. For example, shorter growing season and the yield level (t/ha) is lower than in the rest of Europe.

Oilseed flax is currently cultivated in Finland but as a minor oil crop. Oilseed flax is cultivated about 1000-2000 ha yearly with an average yield of about 1 t/ha. However, the potential of modern flaxseed crops is 2.5-3 t/ha. Interestingly to compare, that the average yield numbers in Russia are similar to Finnish, around 1 t/h. The low productivity has the following reasons as a violation of agricultural technology and weeds, due to the low competitiveness of flax to them. However, In temperate climates, conventional farmers can harvest more than 2 tons of seed per ha, with oil contents ranging from 35 to 44 %.

Cool climatic conditions in temperate regions lead to high shares (>60 %) of omega-3 fatty acids related to the total oil content in organic farming as well as in conventional farming.

Hemp is quite a new crop for Finland. If oilseed flax is cultivated 1-2 t/ ha yearly, then oil hemp even less than that. The seed yield of oil hemp is about 0.7-1 tons per hectare in Finland. Usually, on average global yield varies from 0.6 to 2.4 tons per hectare, depending on a variety of the hemp seed. There is one oil hemp cultivar, "Finola" with low THC content in Finland. "Finola" Cultivated in South-Western Part of Finland. As The Finnish Cereal Committee (VYR) says "Domestic demand for oilseed crops outweighs production".

There are a few big companies that grow *Camelina sativa* in Finland, like Raisio Oyj and Janakkalan Piensiemien Oy/ Suomen Kasviöljyt, (Laurinen, 2007). *Camelina* is cold-resistant, and can be cultivated over a large territory up to the Arctic. It also belongs to long-day plants but differs in an even shorter (65-86 days) growing season.

The spread and industrial cultivation of *Camelina* is restrained by a lower yield compared to other oilseeds crops. However, as a result of the promotion of the crop to regions where the cultivation of crops that are more demanding to the climatic

conditions of growing crops was difficult, as well as due to the development of new varieties of Camelina with increased seed yields, in recent years, the volume of Camelina production could be increased significantly from the average number of about 1t/ha to 7 t/ha. The average yield in Finland is around 1 200 kg/hectare (Laurinen, 2007).

Vegetable oils extracted from hemp, flax, and camelina seeds could be a great healthy addition to a diet if they become more available and affordable in Finland. However, the way that these oils are produced commercially has a great effect on oil taste, quality, shelf life and possible health benefits, which may widely vary depending on oil extraction methods.

### **3.1 Other oil cultures for Finnish climate**

There are prospects for expanding the volume of industrial cultivation for oilseeds, which are still uncommon in Finland, such as white mustard (*Sinapis alba*), black mustard (*Brassica nigra*), sarepta mustard (*Brassica juncea*), oilseed radish (*Raphanus sativus L.*), crambe (*Abyssinian crambe*), Wintercrosses (*Barbárea*) and other.

## **4 Methods**

### **4.1 Survey**

To be able to answer the research question an online survey was conducted. The questionnaire was designed in April 2021 in Google Forms. In total, the survey included 9 questions and in general, it took around 1 minute for the respondents to answer all questions. The survey was sent online to Novia's student email database. I asked people via my private Facebook page to answer questions. The survey was open for answers only during 3 days, which I mentioned for participants, hoping that it will motivate them to answer the questions quickly.

## 5 Survey results

In total, 240 persons participated in the survey and the results were collected anonymously.

In the first few questions, respondents were asked to provide basic demographic information such as gender, age, and region of origin.

From figure 1 it can be seen that the majority of the respondents were between 18-34 years old, followed by 14.6 % of people between 35-49 years old. People in the age group 50+ were only around 4 % of all responses.

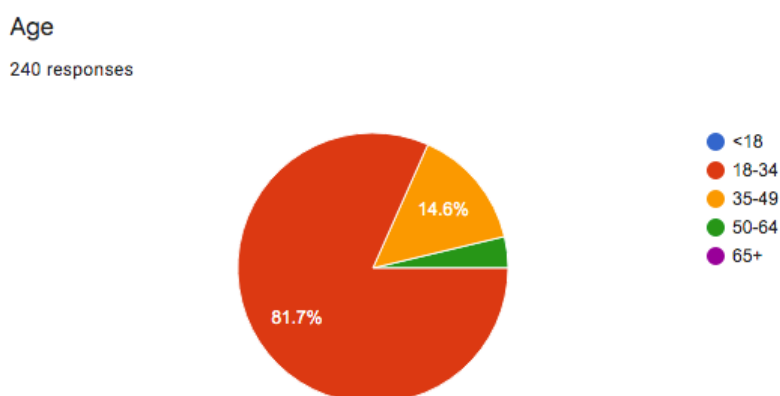


Figure 1. Age of the respondents

Figure 2 shows gender division. It could be clearly seen, that among 240 respondents 37,9% are males and 60% are females, while 2.1% decided not to say their gender.

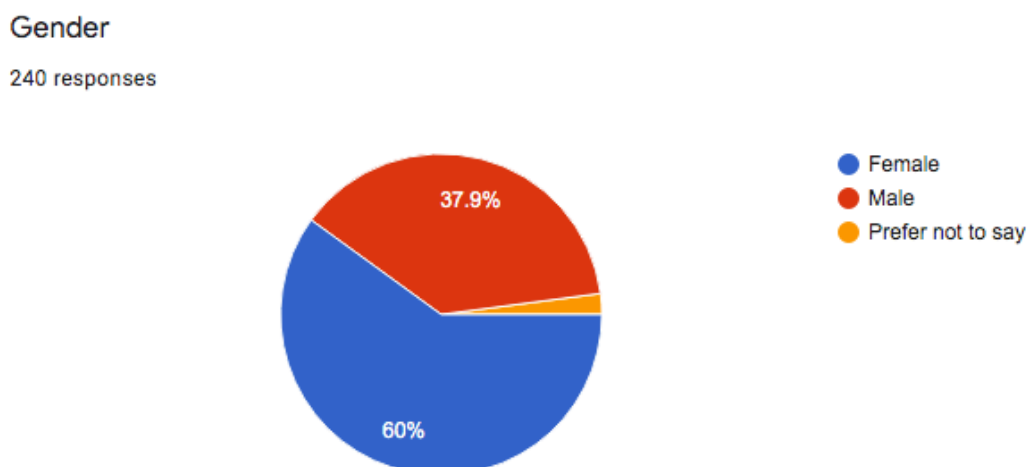


Figure 2. Gender of the respondents

Location of the respondents can be seen at the figure 3. Almost 90% of the respondents were from Finland, while a little bit more than 5% came from other

European countries, and the rest of the respondents came from other parts of the world.

#### Location. Where are you from?

240 responses

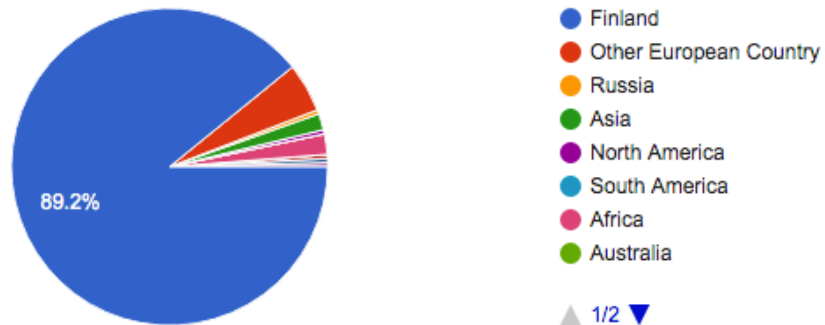


Figure 3. Location of the respondents

In the following question (Figure 4), respondents were asked for what purposes do they use vegetable oils. The most popular answer (90,4%) was for cooking (217 respondents chose this answer). At the same time, 141 respondents answered that they use oils for frying (58,8%), followed by 51 responses who use oils as a cosmetic (21,3%). Only 23 respondents use oils raw, for health benefits (9,6%) and less than 1% have other uses or don't use it at all.

#### For what purposes do you use vegetable oils?

240 responses

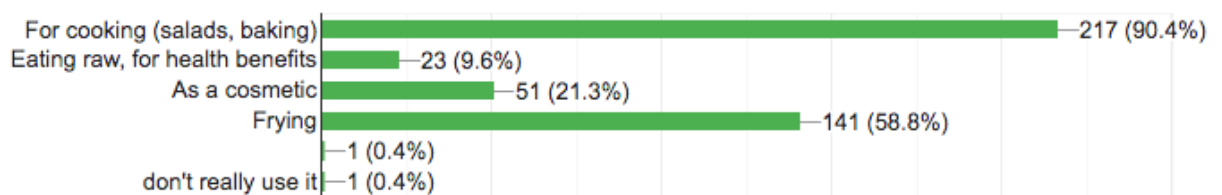


Figure 4. Purposes for using vegetable oils

How familiar respondents are with different oil extraction methods (cold pressed, virgin, refined) were asked next. Figure 5 displays that more than a half (58,8%) of all 240 respondents are not familiar or almost not familiar (88 and 53 responses), followed by people who become more familiar with the difference (49 and 38



responses). The answer “very well familiar” chose only 12 people (5%) of all respondents.

Are you familiar about difference in extraction process between cold pressed, virgin and refined oils?

240 responses

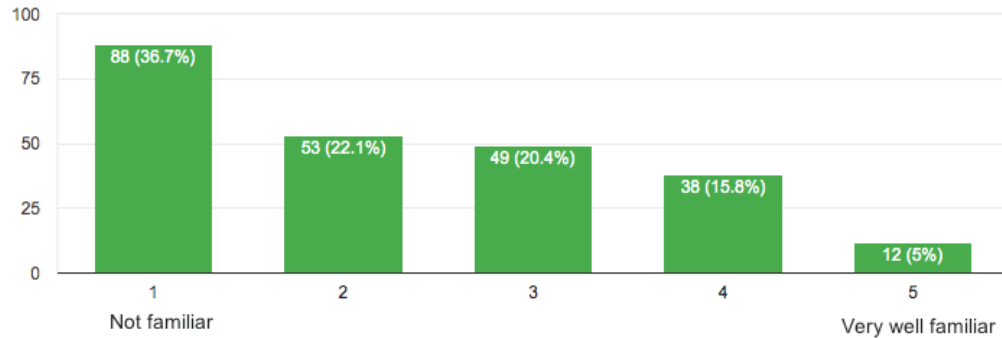


Figure 5. How familiar people are with the difference in extraction oil. Cold pressed, virgin and refined

The following question was about how familiar people are with the process of how refined oils are made (what chemicals are used, temperatures, process, etc.). Figure 6 illustrates, that the significant majority (85%) of participants don't know or almost don't know (151 and 53 replies) about it and only 4 respondents (1.7 %) chose “Yes, I know very well”.

Do you know how refined oils are made? (What chemicals are used, temperatures, process, etc.)

240 responses

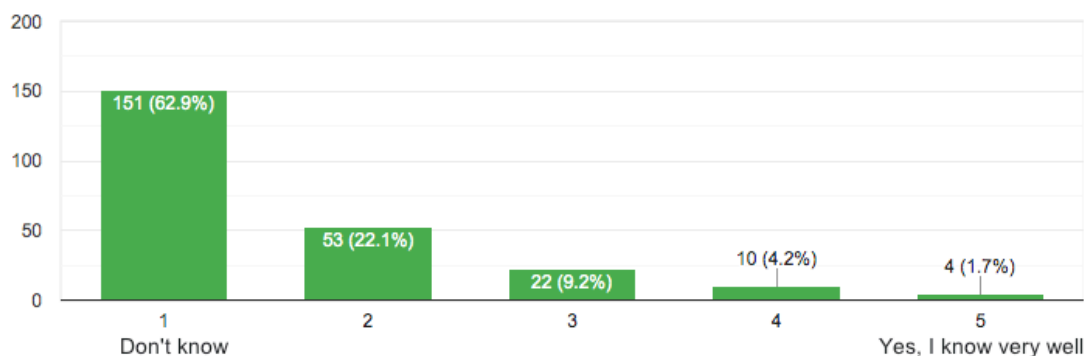


Figure 6. How familiar people are with the process how refined oils are made. (What chemicals are used, temperatures, process, etc.)

The next question was about vegetable oil preferences. In figure 7 it can be clearly seen that olive oil is leading. Of the total 240 respondents 216 answered that they are buying it either on a constant basis every month or few times a year. The second and

third most popular answers were rapeseed (176 answers) and coconut oil (125 answers).

Which of the following oils do you usually buy?

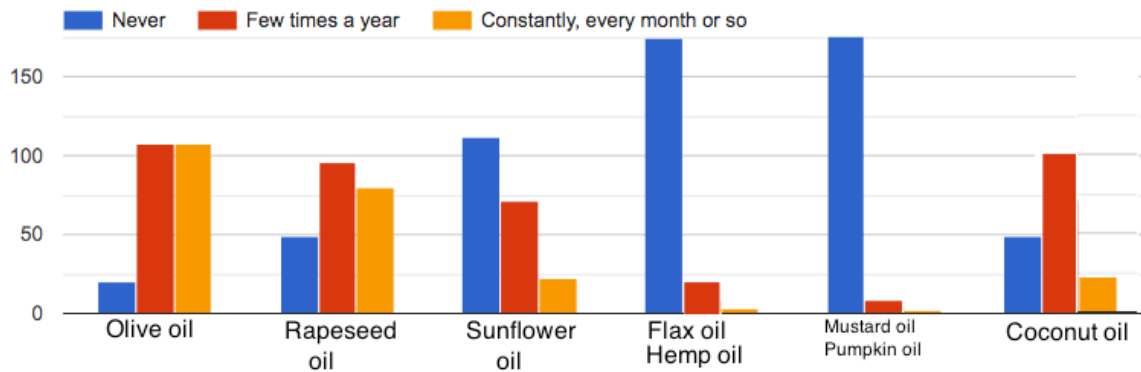


Figure 7. Vegetable oil preferences

Flax and hemp oil were chosen by only 22 respondents out of 240 in total, and the least popular was mustard, pumpkin oils as well as other not common oils, which respondents had a chance to mention in the optional question. None of the respondents mentioned camelina oil. Twenty one of the respondents mentioned sesame seed oil, twelve respondents mentioned avocado oil, two respondents also choose argan and sea buckthorn oil. One respondent mention oregano and castor oil. Few people also mentioned Ghee oil, but since it made out of butter, it has no relevance to this topic.

How important the following characteristic of an oil when you are choosing one in a supermarket?

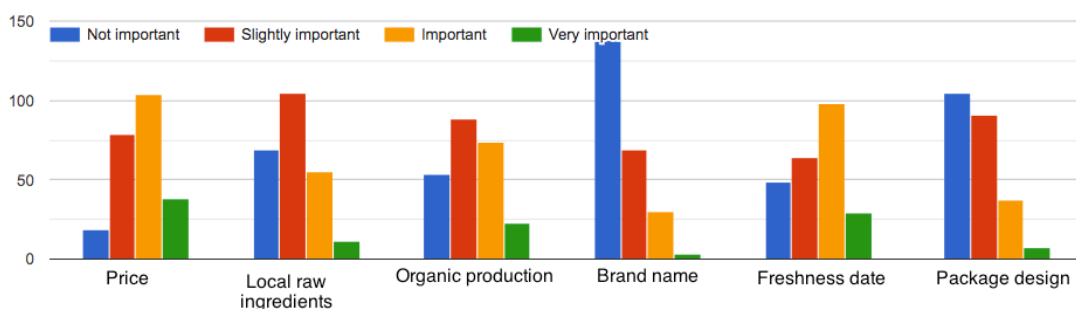


Figure 8. Oil characteristics

At the end I asked about most important oil characteristic for the respondents (Figure 8). Brand name, package design was not important or slightly important (208 and 197 responses). Local raw ingredients for oils also weren't in high priority, it was important for 67 out 240 respondents. Less than 50% (145) of respondent mentioned importance of organic production.

The only characteristics that were important for more than half of all 240 respondents were: price (144 answers) and freshness date (128 answers).

How likely are you to switch from imported oils to locally and sustainably produced ones from not widely spread crops like Camelina, Mustard, Flax, Hemp and other seeds that could grow in Finland?

240 responses

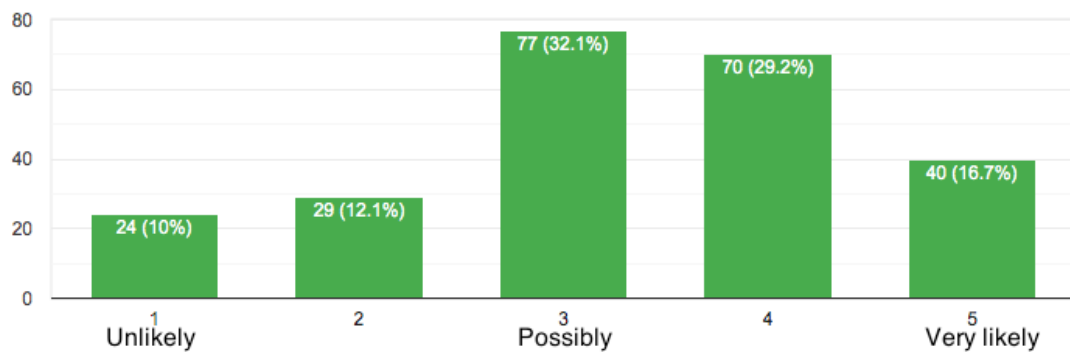


Figure 9. How likely the respondents could switch from imported oils to local ones

The last question was about how likely respondents could switch from imported oils to local ones from not widely spread crop varieties. More than a half, 187 of all 240 respondents showed their interest as can be seen in Figure 9.

Overall the three most popular oils among Finnish people are olive, coconut, and rapeseed. Hemp and flaxseed oils are the least popular, only around 10% of the people that participated in the survey are buying them every now and then. None of the participants ever mentioned Camelina oil. However, almost 50 % of all respondent seems to be interested in local more uncommon oils.

## 5.1 Discussion

This section will contain two main topics. Firstly, a discussion about the result and reasons why I got such results. Secondly, what could have been improved in the study.

The survey was sent online and people were asked to answer questions to help with thesis research about their current vegetable oil preferences. The total amount of respondents was 240. The main age group that answered the survey was 18-34 (81.7%). Thus I can conclude, that there is no big age diversity of the respondents. It would give a more clear and representative picture to have answers from different age groups evenly: The reason for this is that the survey was sent to many students at Novia and most of the students belong to this age group.

The gender division of respondents was not very even, with dominant answers from female respondents (60%), however, it was expected.

However, the respondents who answered the survey followed a pattern. All the questions had few choices and most likely even if the survey had more diversity in respondents' age, the result would likely show a similar pattern, at least at the vegetable oil preferences, as it is shown that they are: olive oil, rapeseed oil, and coconut oil. Simply because it is the most available vegetable oil in Finnish supermarkets.

It is important to mention that in the survey the difference between Canola and Rapeseed oil was not mentioned, however, it's different plants. It would be better to inform people about the difference, especially because it might be confusing for many respondents since in Finland they are named "rypsiöljy" and "rapsiöljy".

Also, the last question about how likely respondents will switch to local oils from imported oils doesn't give much in-depth information. It would be better to formulate it differently and to get more in-depth data, and possible correlations between current choices and future ones, what exactly would be the most important factor for respondents to choose oil made out of new local crops? It would be good to ask what they don't like at their current oils, or what expectations and needs exist.

Further studies could also be done by offering fresh, cold-pressed local oils to a focus group to collect their opinion and learn more about food habits and the way they

affect them, as well as possible changes in local people's dietary choices about oil preferences.

If there would have been more time, I could also have interviewed farmers who are growing different oil crops as well as Finnish companies that produce vegetable oils to get their view on production and consumer interests. I would then have received a better understanding of why camelina, flax, and hemp as well as other oil crops are not widely grown in Finland yet as well as other practical in-depth information. It would be interesting to interview a company like "Nordic Caraway Oy", the company that introduced contract farming practices for growing caraway seeds in Finland. Before them there was no such concept and most of the world's caraway seeds were produced by Eastern European countries. Their experience could be helpful to understand better how to motivate farmers to grow crops that are uncommon in Finland. Today "Nordic Caraway Oy" is the world's largest caraway producer.

## **6 Conclusion**

Based on the research questions, the idea of understanding "can hemp, flax, and camelina oils be sustainable local supplements to the oil market in Finland?" was answered based on book research and the survey. Hemp, flax, and camelina seem to be very promising for growing in the Nordic climate and there is interest for such oils from local consumers.

Possibilities of using the whole plant: for food, oil production, and also for animal feed and fiber are the biggest advantages of hemp and flax. Camelina seems to be very promising in a sense, that the plant belongs to the Brassicaceae crop family as rapeseed, but these family common pests almost do not affect Camelina crops. Generally, the high yield and oil content of seeds, a relatively short growing season, easy post-harvest processing, and rather low demand for soil quality, water, and nutrients availability, make it possible to grow these crops almost anywhere in Finland. Increasing these crop areas will contribute to botanical enrichment and biodiversity generally. At the same time, reducing the amount of pesticides used when growing these crop varieties will reduce the toxic effect on the environment. All these factors make them very promising sustainable oilseed crops that can bring new local oil varieties to an existing market.

However, further studies could also investigate the potential to scale up the production of camelina, hemp, and flax from a promising oilseed to a commonly cultivated crop in Finland. I think farmers and end-users have to discover the real potential of this interesting species as well as the health benefits of cold-pressed fresh oils.

## 7 References

- Bakos, J., Siu, M., Orengo, A., & Kasiri, N. (2020). An analysis of environmental sustainability in small & medium-sized enterprises: Patterns and trends. *Business Strategy and the Environment*. doi:10.1002/bse.2433
- Barbosa, M., Castañeda -Ayarza, J. A., & Lombardo Ferreira, D. H. (2020). Sustainable Strategic Management (GES): Sustainability in small business. *Journal of Cleaner Production*, 120880. doi:10.1016/j.jclepro.2020.120880
- Codex Standard for Edible Fats and Oils not Covered by Individual Standards (CODEX STAN 19-1981, Rev. 2 - 1999) <http://www.fao.org/3/y2774e/y2774e03.htm>
- Devi, V., & Khanam, S. (2018). Comparative study of different extraction processes for hemp (*Cannabis sativa*) seed oil considering physical, chemical and industrial- scale economic aspects. *Journal of Cleaner Production*. doi:10.1016/j.jclepro.2018.10.036
- Dvory Namdar, Alon Amrani, Nimrod Getzov & Ianir Milevski (2015) Olive oil storage during the fifth and sixth millennia BC at Ein Zippori, Northern Israel, *Israel Journal of Plant Sciences*, 62:1-2, 65-74, DOI: [10.1080/07929978.2014.960733](https://doi.org/10.1080/07929978.2014.960733)
- Iskandarov, Umidjon & Kim, Hae Jin & Cahoon, Edgar. (2014). Camelina: An Emerging Oilseed Platform for Advanced Biofuels and Bio-Based Materials. 10.1007/978-1-4614-9329-7\_8.
- Gaca A, Kludská E, Hradecký J, Hajšlová J, Jeleň HH. Changes in Volatile Compound Profiles in Cold-Pressed Oils Obtained from Various Seeds during Accelerated Storage. *Molecules*. 2021 Jan 8;26(2):285. doi: 10.3390/molecules26020285. PMID: 33430033; PMCID: PMC7827483.
- Gatti, R. C., Liang, J., Velichevskaya, A., & Zhou, M. (2018). Sustainable palm oil may not be so sustainable. *Science of The Total Environment*. doi:10.1016/j.scitotenv.2018.10.222
- Goyal A, Sharma V, Upadhyay N, Gill S, Sihag M. Flax and flaxseed oil: an ancient medicine & modern functional food. *J Food Sci Technol*. 2014;51(9):1633-1653. doi:10.1007/s13197-013-1247-9
- Klein, J., Zikeli, S., Claupein, W. *et al.* Linseed (*Linum usitatissimum*) as an oil crop in organic farming: abiotic impacts on seed ingredients and yield. *Org. Agr.* 7, 1–19 (2017). <https://doi.org/10.1007/s13165-016-0146-6>

Kolodziejczyk, P., Ozimek, L., & Kozłowska, J. (2012). The application of flax and hemp seeds in food, animal feed and cosmetics production. *Handbook of Natural Fibres*, 329–366. doi:10.1533/9780857095510.2.329

Leizer, C., Ribnicky, D., Poulev, A., Dushenkov, S., & Raskin, I. (2000). The Composition of Hemp Seed Oil and Its Potential as an Important Source of Nutrition. *Journal of Nutraceuticals, Functional & Medical Foods*, 2(4), 35–53. doi:10.1300/j133v02n04\_04

LUKE, 2021 [https://www.luke.fi/ruokafakta/en/field-crops/rapeseed-production-volumes/#:~:text=In%202018%2C%20Finland's%20total%20production,the%20EU%20\(28%20countries\).&text=The%20largest%20producers%20are%20France,Germany%2C%20with%203.7%20billion%20kilos.](https://www.luke.fi/ruokafakta/en/field-crops/rapeseed-production-volumes/#:~:text=In%202018%2C%20Finland's%20total%20production,the%20EU%20(28%20countries).&text=The%20largest%20producers%20are%20France,Germany%2C%20with%203.7%20billion%20kilos.)

Moore, G., & Spence, L. (2006). Editorial: Responsibility and Small Business. *Journal of Business Ethics*, 67(3), 219–226. doi:10.1007/s10551-006-9180-8

Pojić, M., Mišan, A., Sakač, M., Dapčević Hadnađev, T., Šarić, B., Milovanović, I., & Hadnađev, M. (2014). Characterization of Byproducts Originating from Hemp Oil Processing. *Journal of Agricultural and Food Chemistry*, 62(51), 12436–12442. doi:10.1021/jf5044426

Renard, D., & Tilman, D. (2019). *National food production stabilized by crop diversity. Nature*. doi:10.1038/s41586-019-1316-y

Saastamoinen M, Eurola M, Hietaniemi V. 2016. Oil, Protein, Chlorophyll, Cadmium and Lead Contents of Seeds in Oil and Fiber Flax (*Linum usitatissimum* L.) Cultivars and in Oil Hemp (*Cannabis sativa* L.) Cultivar Finola Cultivated in South-Western Part of Finland. *J. Food Chem Nanotechnol* 2(2): 73-76

Samarappuli, D.; Zanetti, F.; Berzuini, S.; Berti, M.T. Crambe (*Crambe abyssinica* Hochst): A Non-Food Oilseed Crop with Great Potential: A Review. *Agronomy* **2020**, *10*, 1380. <https://doi.org/10.3390/agronomy10091380>

*С.В. Станкевич, Информационное агентство «Светич». Журнал «Нивы России» №4 (170), май 2019*



## Appendices:

### Vegetable oils

All the answers in the survey will remain anonymous

\* Required

1. Age \*

*Mark only one oval.*

- <18
- 18-34
- 35-49
- 50-64
- 65+

2. Gender \*

*Mark only one oval.*

- Female
- Male
- Prefer not to say

3. For what purposes do you use vegetable oils? \*

*Check all that apply.*

- For cooking (salads, baking)
- Eating raw, for health benefits
- As a cosmetic
- Frying

Other:  \_\_\_\_\_

4. Are you familiar about difference in extraction process between cold pressed, virgin and refined oils? \*

Mark only one oval.

	1	2	3	4	5	
Not familiar	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Very well familiar

5. Do you know how refined oils are made? (What chemicals are used, temperatures, process, etc.) \*

Mark only one oval.

	1	2	3	4	5	
Don't know	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Yes, I know very well

6. Which of the following oils do you usually buy?

Check all that apply.

	Never	Few times a year	Constantly, every month or so
Olive oil	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rapeseed oil	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sunflower	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Flax oil	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hemp oil	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pumpkin oil	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mustard oil	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nuts oil	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

7. If you buy other oils, than listed above, could you please specify which ones?

\_\_\_\_\_

8. How important the following characteristic of an oil when you are choosing one in a supermarket? \*

*Mark only one oval per row.*

	Not important	Slightly important	Important	Very important
Price	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Local raw materials	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Organic production	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Brand name	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Freshness date	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The way oil was produced and pressed (cold pressed, virgin, etc)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Package design	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

9. Have you ever tried fresh (same day/week pressed or at least same month) cold-pressed oils? \*

*Mark only one oval.*

- Yes
- No
- Other: \_\_\_\_\_

10. How likely are you to switch from imported oils to locally and sustainably produced ones from not widely spread crops like Camelina, Mustard, Flax, Hemp and other seeds that could grow in Finland? \*

Mark only one oval.

	1	2	3	4	5	
Unlikely	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Most likely

11. Location. Where are you from? \*

Mark only one oval.

- Finland
- Other European Country
- Russia
- Asia
- North America
- South America
- Africa
- Australia
- Other: \_\_\_\_\_