

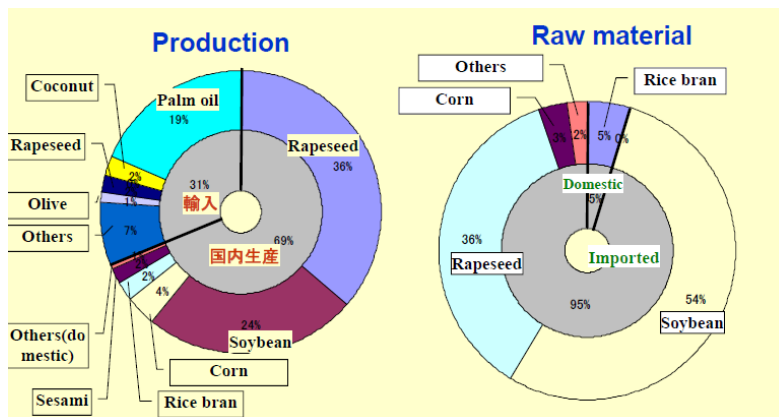
Jiabura oil extraction

(Final report)

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Introduction: Vegetable Oil demands in Japan/Jiabura

Vegetable Oil has become an essential ingredient for cooking in Japan, whether it be in households or restaurants. The overall demand has risen significantly since the 1970s, with a 2.5 fold increase from 1970-2005. Ever since 2005, the demand has remained relatively constant. Three major methods of generating vegetable oils exist in Japan today. (1) The original produce (i.e. rapeseed, soybeans) is either harvested in Japan or shipped from a foreign country, crude oil is extracted and its impurities are removed to create the finalized product. (2) Crude oil is imported from foreign countries, and the impurities are removed within Japan to create the finalized product. (3) The finalized, purified product is directly imported from foreign countries. It must be noted that Japan's vegetable oil production is heavily dependent on the overseas market. Out of all raw materials used as resources of vegetable oils, only rice bran, which makes up for 5% of the produce is grown within Japan. 69% of the vegetable oil production process is done within the country, while 31% (including palm oil, coconut, olive, etc) are directly imported. 97% out of the 2.6 million tons of oil production in Japan is reliant on overseas, in some form or the other.



Pie Chart of the breakdown for Japan's oil production- as you can see, only 5% of the raw material is domestic and the rest are imported from overseas.

Conventional vegetable oil goes through a lengthy process of extraction. For example, plants rich in oils such as rapeseed must go through an initial oil extraction via compression, which separates the plant into oil cake/meal and the actual oil product. Further oil extraction via the use of solvents such as hexane is administered to get the initial crude oil. Once the crude oil is obtained, it is purified by removing impurities, bleaching, and removing the odor. While large companies widely use this conventional extraction method, some small-medium sized enterprises have found alternatives. Known as the cold-press oil extraction method, this process uses a cold-press to physically extract the crude oil instead of chemicals such as hexane. The vegetable oil produced as a result is known as Jiabura(地油) in Japan. Jiabura has been known to contain more nutrients, including vitamin E and carotene compared to its conventionally extracted partner. As a result both the oil product as well as the oil cake can be sold at a higher price. Furthermore, Jiabura garners a high reputation from its users, who state that this type of oil retains its original flavor, and brings out the best taste in many different types of cooking methods.

Although hexane has been classified as not directly carcinogenic to humans by the United States Environmental Protection Agency (EPA), concerns have arisen from certain groups over its use in vegetable oil extraction. Short-term exposure to the chemical has been known to cause dizziness, nausea, headaches, and other central nervous system effects. While very small amounts of hexane may be present in processed vegetable oils, it is generally said that this amount is far too low to have any sort of significant effect on human health. The 1960s and early 1970s saw several documented cases of health risks caused by n-hexane, in shoe workers who used glues and solvents containing n-hexane in countries such as Japan and Italy. The employees who had breathed in high concentrations of n-hexane reported symptoms such as numbness in hands, feet, and muscle weaknesses. For those who are still skeptical in hexane use for oil production, Jiabura would be a good alternative to your conventional, inexpensive solvent used vegetable oils.

Reference: <http://www.atsdr.cdc.gov/phs/phs.asp?id=391&tid=68>

Our group visited Naka City as well as a small-medium scale farm called Club Core, located in Namegata City of Ibaraki prefecture to get a first-hand experience of Jiabura production. Naka City grows sunflowers with the aid of Club Core. When harvest season arrives, Club Core takes the sunflowers and extracts the oil, producing sunflower Jiabura. The Jiabura is then returned to Naka City, where they are commercialized and sold to households as well as restaurants and factories within the city. The goal of our group was to understand how Jiabura is made, identify its issues, and provide potential solutions, both in terms of quantitative Jiabura production and marketing to the outside society.



Entrance to Club Core



Namegata City, Ibaraki Prefecture

Background Information: Club Core

Club Core is a small-medium sized farm located in Namegata City, Ibaraki Prefecture. Currently, they produce 30 different varieties of organic vegetables, as well as processed foods including vegetable chiffon cakes. Instead of focusing on solely the production aspects, Club Core attempts to widen the capacity of agriculture as an industry. Specifically, they have put in significant efforts for “experience/tourism agriculture” where they provide a farm guide, harvest experience, lunch with ingredients made in the farm for their clients. Initially these agricultural tours were only held 4-5 times a year, but since then it has grown to 20 in 2013. Club Core does an amazing job linking agriculture with “tourism” and “personal experience”.

Introduction: Naka City

Members of group 6 travelled to Naka City of Ibaraki prefecture, where sunflowers were being grown for both tourism and jiabura purposes in association with Club Core. Located in the northern region of Ibaraki, the modern Naka City was established in January of 2005 through the merging of previous Naka as well as Urizura town. Currently, the city is home to approximately 55,797 residents.



Naka City, Ibaraki Prefecture

As the city's symbol flower is the sunflower, Naka has been growing sunflowers for revitalization of the city and for attracting tourists. A sunflower festival held every year in late August has become one of the largest and most successful events of Naka City. Until seven or eight years ago, the sunflowers had been grown solely for the purpose of tourism and were simply incorporated back into the soil after the flowering season. However, Naka City Shoukougai (商工会- Commercial and Industrial Association) felt that flowers were being put to waste, and proposed to extract sunflower oils and commercialize them with Club Core's help. Group 6 had the opportunity of directly speaking with members of the Shoukougai to obtain information on how this sunflower project was currently being managed.

Background Information: 商工会/Shoukougai

The Naka City Shoukougai, or Commercial and Industrial Association we visited is a strictly non-profit organization funded by Naka City. Their primary purpose is promoting the revitalization of Naka City and aiding local business. The Shoukougai is in charge of planning the sunflower festival mentioned in the above, where local shops also put up outside vendors and sell foods and goods to tourists.

Harvesting

Head loss

After the Sunflower Festival at the end of August, the sunflowers will be harvested for jiabura oil extraction. The tasks of both harvesting and oil extraction are carried out by the staff of Clubcore and the supervisor is Takatsuka san.

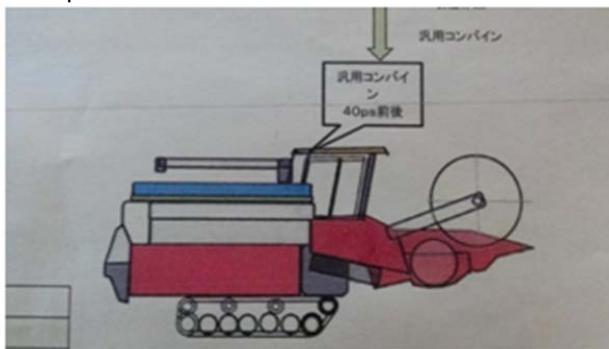


Figure 1. General combine

The machine used to harvest sunflower is a general combine (汎用コンバイン). Takatsuka san has also modified the combine adding pointed tooth protruding from the head part of the machine (header) in order to minimize the head loss. Head loss refers to the harvesting loss occurred when the head of combine fails to cut and gather the crop into the machine. In the case of sunflower, head loss commonly occurs because the sunflower head would frequently be in a falling position facing the ground, and this would be more difficult for the combine to cut and collect the sunflower head.



Figure 2. Dropping sunflower head

http://commons.wikimedia.org/wiki/File:Sunflower_head_2011_G1.jpg

The protruding pointed teeth function to support the sunflower head in a way that the head will sit on top of space in between the tooth, giving the header of the combine a higher chance to cut and grab the sunflower head. According to Takatsuka san, the head loss has been minimised effectively from around 30% to around 10-20% with this modification of the header.

Threshing loss

After the sunflower head is collected into the combine, it will undergo a process known as threshing where the seeds are extracted.

Firstly, the sunflower head will be introduced into a rotating threshing drum known as the cylinder (component 6 in figure 3) where the seeds, chaff and smaller debris will be separated from the head through mechanical action. All the extracted material will then be introduced into an air flow generated by fan (component 10). The air flow functions to separate the seeds from the chaff in a way that the seeds would fall and enter through the sieves (components 11 and 12) and chaff would be blown out of the machine. The seeds which enter through the sieves would be collected at the grain auger (component 15) and get transferred to the grain tank (component 16).

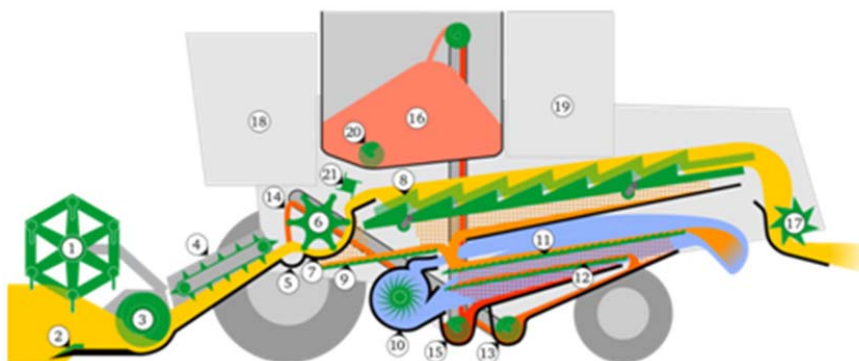


Figure 3. The threshing component inside a combine

http://en.wikipedia.org/wiki/File:Maehdrescher_schema_nummeriert.svg

Threshing loss can happen in this separation process when the seeds are blown out of the machine by the air flow instead of falling through the sieves. This is particularly significant in the case of sunflower seeds because they have a flattened, tear-shape which gives the seed a large surface area susceptible to the wind flow.



Figure 4. Shape of sunflower seed

http://en.wikipedia.org/wiki/File:Sunflower_Seeds_Kaldari.jpg

In the case of Naka city, the amount of sunflower seeds that can be potentially harvested by manual method is estimated to be 4 tons out of 4 hectares of land. But with combine harvesting, only 2.6 tons can be commonly harvested giving a threshing loss of 35%. This represents the most significant loss in the whole production process of sunflower jiabura according to Takatsuka san.

Improvement

Minimizing head loss - although the protruding tooth modification by Takatsuka san has already effectively reduced head loss, it could be further reduced with the use of a picker header. The advantage of a picker header over simple tooth modification is that it can pick up the dropping sunflower head automatically through mechanical action. The downside of using a picker header modification is high purchase price.



Figure 5. General combine modified with a picker header



Figure 6. Sunflower picker header by produced fantini company

<http://www.fantiniworld.com/public/images/4062.jpg>

Minimizing threshing loss -

1. Wind velocity: the speed and direction of air flow is extremely important because excessive wind will blow the seeds out of the combine and inadequate wind flow on the other hand will result in poor separation of seeds from the chaff. The wind velocity must be carefully adjusted such that precise air flow is created to keep the chaff floating for efficient separation from the seeds (National Sunflower Association).
2. Moisture: moisture is a key factor in the threshing process because the seeds and chaff often stick together with high moisture making the separation process more difficult. Unfortunately, Japan has high rainfall in the summer during which sunflower is produced and harvested. This is in direct contrast with other major sunflower producing countries for example the United States which has wet weather in the cold season from around September to May. Therefore the problems of sunflower seed production in these countries are often due to drought or diseases rather than problems in seed separation. Overall, the timing of harvesting should be considered but it is unlikely to reduce the problem because of Japan's wet weather throughout the whole summer.
3. Plant breeding: altering the shape of sunflower seed seems to be most direct solution because the flattened, tear-shape is a significant factor leading to susceptibility to wind flow and hence threshing loss. However, current researches in the Europe on sunflower breeding focus mainly on resistance to diseases, oil quality and drought stress tolerance (Vincort 2014). It appears that altering the shape of sunflower seed is not under major research efforts because there are few countries which experience problems in seed separation as in the case of Japan. Thus, sunflower breeding is a potential solution but it is very important to consider its practicality especially in terms of time and cost.

Conclusion

There are considerable potential improvements in the harvesting stage of sunflower production. As mentioned, if the 35% threshing loss can be completely reduced it will imply that a total of 1.4 tons of seeds can be used to make more jlabura directly contributing to a higher level of oil production. However, drawing such a conclusion is not so straightforward because it has to be emphasized that the

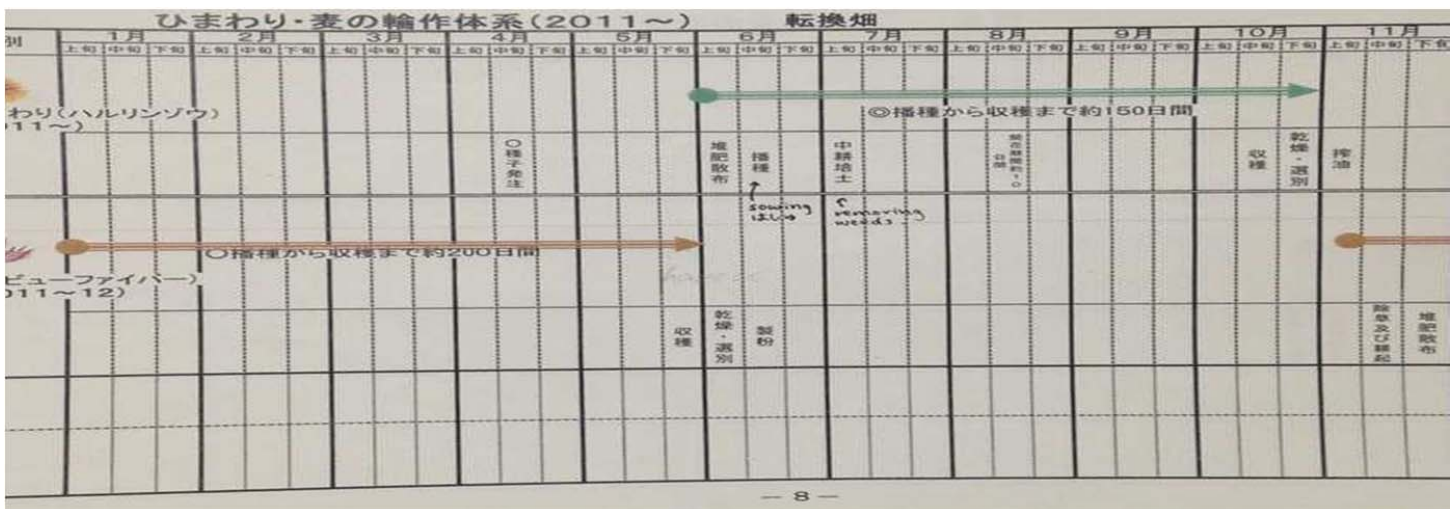
whole sunflower project in Naka city is not a simple business/profit-making project, but rather a complex government project involving various stakeholders. There are a number of ways to reduce the harvesting loss for example purchasing an efficient picker header and changing the shape of sunflower seeds through plant breeding, however all these suggestions would require considerable expenses in the form of government funding. Furthermore, increasing the scale of the whole project would require the participation of more stakeholders, local farmers and staff, and their willingness to join the project must also be carefully considered. Lastly, although the supply of sunflower jlabura appears to be the limiting factor at the moment (please refer to the sales section), the whole demand and supply situation may not be in equilibrium with a higher quantity of supply considering the relatively high price of jlabura. Overall, increasing the production level of sunflower seeds and jlabura to improve the project is not a simple "yes" answer.

References

Vincort, P. 2014 "Research fields, challenges and opportunities in European oilseed crops breeding", Open Source Biology, vol. 21, no. 6.

National Sunflower Association, <http://www.sunflowernsa.com/growers/harvesting-storage/Default.asp?printable=1>, accessed 6 January 2015.

Sowing Schedule



Sunflower planting season is from June to October. As we can see in this figure, at start of June, they spread fertilizer in the farm and then sow sunflower in the middle of June. At the start of July, they try to optimize the soil condition, like removing weeds. In the later part of August, sunflower harvest around 10 days and attract lots tourists to Naka city, which is sunflower festival. The sunflower sowing area is 4 hector and they leave around 5% of area for rotation with wheat. The rotation schedule is from November to May in next year.

Weed Cost

They are using Harurinzu (spring-haru, rinzu-shape of sunflower) 63 and 82 these two varieties of seed.

They have to buy seeds every year, the cost of the seeds is 3750yen/kg, use 5kg/ha seeds, spend about 15000yen/ha just for seeds. For fertilizer they use oil cake, but mix it with other compounds. Oil cake is a kind of nitrogen fertilizer, contains high calories and can increase other compounds' temperature very quickly. If we apply chemical fertilizer, it would be effective, but it is rapid to reduce nutrient from soil. So they prefer to use oil cake which also can release organic nitrogen in more continuous way.

Issue:

1 Typhoon

For Naka city, the final amount of sunflower seed is 2.6 tons /hectare before drying. Sunflower harvesting fluctuate year by year. Sometimes farmers can get higher yield, but sometime not. The main problem is typhoon that dramatically affect sunflower yield.

2 Continuous planting

Naka city continues to grow sunflower year by year, they leave a small part of land for sunflower rotation with wheat. Although sunflower yield can be improved by rotation, they are not interested in rotation method because they do not want to plant large amounts of wheat which is time and energy consuming. They cannot get significant benefits from rotation. So continuous planting is one impact on sunflower production.

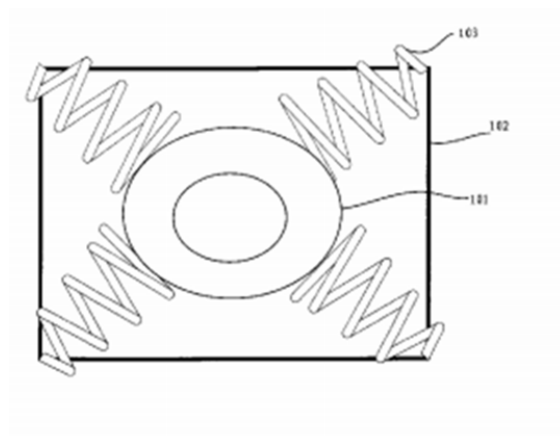
3 Plant disease

Plant disease also influence sunflower yield. Some sunflower disease usually caused by various fungi, bacteria and viruses. Various leaf spot diseases may cause surface spots or yellow patches. Rust, verticillium wilt, and powdery mildew can also affect sunflower plants on occasion. Sunflowers can be affected by these disease problems, but this issue is rarely as these plants are typically quite hardy.

Possible solution:

1 Typhoon resistance management:

Develop a typhoon-resistance plant cultivation device, fixing the sunflower with rope and rod. The typhoon-resistance plant cultivation device effectively solves problem of easy breakage of plants by wind during plant cultivation at wind belts.



2 Disease resistance sunflower

We can use molecular biology techniques and plant improvement methods. By inserting certain genes into plants, we can get the transgenic plants to enhance resistance to diseases and pests.

3 Management:

Construct a management system considering irrigation and fertilizer. Collect basic parameter information, then use some application, like Apsim to make modeling and improve decision-making.

4 Reason for yield increase using rotation

Sunflower rotation with wheat can get higher yield, but what is the reason for yield increase? Is that because the wheat root? If the reason is the wheat root, we can use wheat residue into sunflower soil mixed with fertilizer to get the yield increase.

Conclusion:

For sunflower oil in Naka city, the most problem is the oil price which is 1000 yen/135g. So if we can improve the sunflower yield or decrease the harvest loss, we can decrease the price of himawari oil. For improving the yield part, the problems as we mentioned above are typhoon, continues planting and plant disease. Since typhoon is the major effect of sunflower yield, if we can solve this problem we may increase the yield in large amounts. Typhoon-resistance plant cultivation device does work which introduce in the reference patent paper, but this way is time consuming to fix the sunflower and also labor consuming. Plant disease is not a big effect because sunflower seeds are typically quite hardy that cannot easily be affected by plant disease. Also molecular biology techniques and plant improvement methods take time to verify the sunflower safety. So crop modeling method seems like a better way for them to increase sunflower yield. The sowing date is in rainy season in Japan, but sunflower originated from dry land so if the rainfall is a lot, sunflower roots usually do not grow into deeper to avoid the extra moisture in soil. We can conduct experiments and use crop modeling methods like apsim to support decision making regarding water management. By using crop modeling, we can know how much water plant need to get a highest yield and how much water we need to drain off if it occurs the rainy season. But this method is also labor consuming to measure all the parameters, so for increasing sunflower yield, we still have a long way to go.

References

Typhoon-resistance plant cultivation device

CN 202009589 U

<http://www.google.com/patents/CN202009589U?cl=en>

Vegetable oil extraction

Sunflower oil extraction is the process of separating the oil from the sunflower seeds contents. Common process uses for manufacturing mainly by large oil industries includes cleaning and grinding, pressing,

extracting additional oil from solvent, removing solvent traces, refining the oil, packaging the oil, proceeding of by-products or waste(fig1).

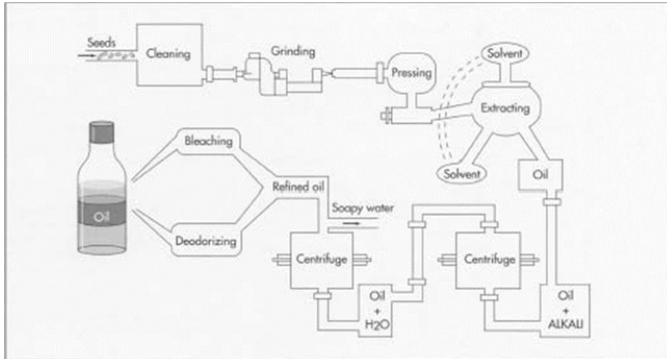


Fig7: manufacturing

Ji-Abura oil extraction

Because of small scale manufacturing of Ji-Abura, its manufacturing process is different from regular vegetable oil manufacturing process. Ji-Abura oil manufacturing is the main step in sunflower oil production in Naga city , which includes seeds drying, seeds separation, oil extraction, filtration, bottling and leftovers(oilcakes) processing, all of those mentioned above have been completing by Clubcorne. In addition, they are searching for the possible low cost and environmental friendly way of biodiesels manufacturing process.

Extraction process

Seed drying

Seed drying is the first step of oil extraction as the moisture contents directly affect oil quality and shelf ages in oil industry, therefore before separation and extraction the drying is key preparation step. The machine used by Clubcore for seeds drying is far infrared dryer (fig2). This type of dryer is very popular in Japan, can dry the most inner part of grains, therefore can avoid the side effects of extra moisture to oil extraction. By to do so the seeds will lost 10 to 20 percent of weight, mostly water content of seeds, but can guarantee high oil quality. However according pure calculation after drying the total net production is 2.2ton, which just equals to about 16percent of weight loss. The average moisture content of sunflower content is 4-22%¹, therefore can get conclusion that by infrared dryer can reduce moisture level into optimum level, or even some oil fraction related organic compounds might also evaporated with water molecular bonded gas stage.

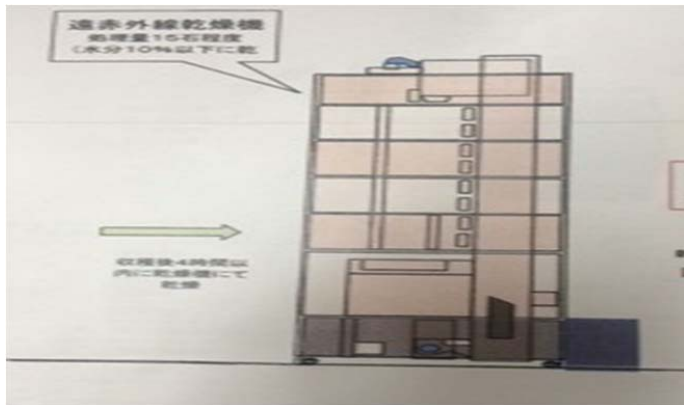


Fig2: far infrared dryer structure outline

Separation

Even after combine threshing there is still mixed chaffs in dried seeds, so separation is required. The rough separation machine (fig3) separate sunflower seeds from fine seeds based on gravity and seed size, so the speed of wind during the process is important to get less contaminated seeds. However there is less difference between chaffs, underqualified seeds and fine seeds thus cause great amount of seed loss during the process.

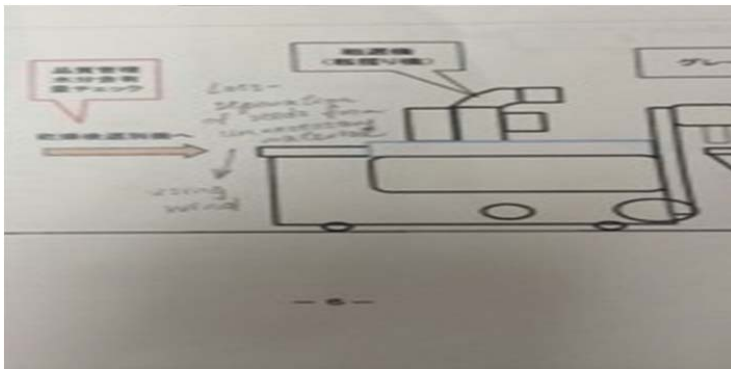


Fig3: structure of separation machine

Oil extraction

For the oil extraction, the method has been applied is cold press oil extraction instead of chemical extraction, aims to keep high level of vitamin E ,carotene and original flavor in the oil. The cold press is a kind of physical extraction method, through combination of grinding and low heat, extract oil form sunflower seeds. Introduction of heat into oil extraction process leads to degradation of oil flavor and loss of nutrition by evaporation. Therefore by using cold press crude oil extraction method with combination of advanced extraction machine, oil producers can sell their oil in higher price due to its healthier processing method. The machine used for extraction is 搾油機(fig4), has all typical part of classical oil mill, additionally it has extra moisture meter and temperature meter, therefore if temperature or moisture exceed the standard level then it end extraction process automatically to ensure lower temperature in whole extraction. Besides, operation of this machine is simple and not

labor intensive, so considered as the most promising machine for small scale oil industry.



Fig4: oil extraction machine

Filtering or refining

Filtering is the important tool to purifying crude oil. In Clubcore this step is done by conventional method, which is that collect oil in one big container and left it as it is for two or three weeks, let contaminated oil sink to the bottom of tank due to the sedimentation then pure oil can be absorbed by suction pump. (fig4) The filtering process leads to little yield loss and time consuming, but for the oil production, and let crude oil arrive to standard level, it is necessary.

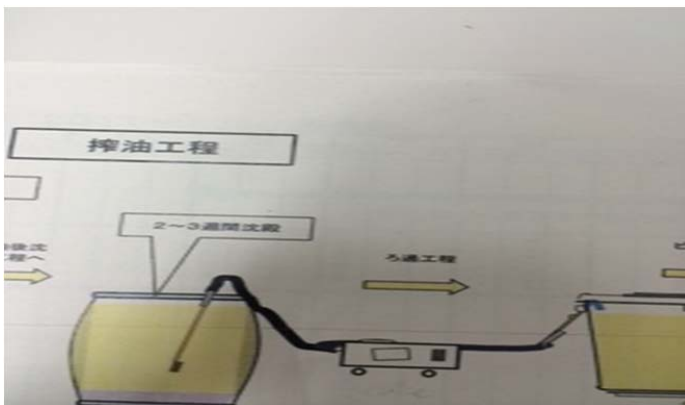


Fig3: Ji-Abura oil filtering principle

Bottling

Bottling is the last step before transporting oil to the local market (which is currently just limited by small scale retailing shops and restaurants and individual consumers in Nagoya city). For Ji-Abura oil, the bottling also has been done by manually (fig4 & fig5). The bottles used for the Ji-Abura oil packaging are transparent glass bottles in order to magnify customer's appetites and reduce packaging material cost.

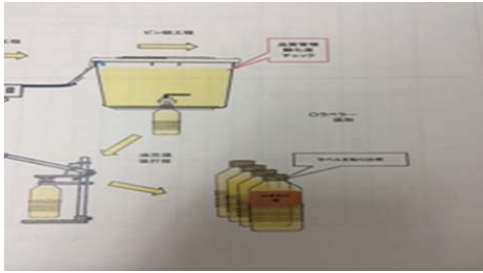


Fig4: bottling principle



Fig5: bottling

Typical features of Ji-Abura oil

The most distinguish difference between commonly used vegetable oil and Ji-Abura oil is that Ji-Abura production process didn't involve in any step which related to harmful chemical substance like Hexane. And comparatively low temperatures during the extraction endowed great taste, nutrition and flavor to the oil. Therefore the unique features of oil extraction should be highlighted in Ji-Abura oil marketing, and sustainable future plan for Ji-Abura oil business.

Issues during extraction process

Drying loss

The total production for drying is the 2.6 ton, got 2.2 ton after drying. The loss for drying is moisture content and which is necessary for elongations of oil shelf life.

Separation loss

The total production for separation is the 2.2 ton, got 2.1 ton after drying. Comparing with seed content of the original materials, can be indicated that great amount of seeds blew away with chaffs.

Reason: less difference between kernels and seeds on the gravity & size aspect

Extraction and filtering loss

- a) 10% weight reduction of Oil-bearing crops by extraction

Different type of oil's net production reduced about 10 percent from actual oil capacity rate by extraction, possible reason for this phenomena and improving ways such as detaching small oil related molecular from water bounded mixture should be considered. The solution will be added to the final report if there is any.

- b) Actually extraction process and bottling, filtering loss for Ji-Abula oil

The oil extractable rate of sunflower seeds is 25~30 percent, according to total amount of raw material after separation, the expected crude oil should be 525~630kg. However after bottling, the total pure oil for selling is 372kg, more than 35percent of crude oil decreased, comparing with decreasing ratio of oil industry during the same process, it is quite considerable loss.

Conclusion for the loss of the section: Extraction is unique character of Ji-Abula, couldn't have much improvement towards the process, so possible improvement can be given to filtering and bottling step.

Possible suggestion to the issues:

Possible suggestion to the separation loss.

- a) Idea1: changing sunflower seed size through genetic modification of sunflower or breeding, so that the separation machine can separate seeds efficiently. Through inner breeding or via cross-species breeding through Niger plant² (*Guizotia abyssinica*), get more distinguishable shaped seed size. (<http://www.agriinfo.in/default.aspx?page=topic&superid=3&topicid=2168>)

Or through genetic modification to get more easy-breeding sunflower cultivars.

- b) Idea2: the sunflower seeds contain high amount of oil than kernels, so the calorimeter based selection machine (if invented) would be possible to reduce the separation loss.

To filtering loss:

1. Better equipment, such as centrifugation machine.
2. Dark-colored bottles
3. Make use of highly contaminated crude oil.

Conclusion:

Ji-Abura oil extraction includes seeds drying, seeds separation, oil extraction, filtration, bottling steps, constructed the main idea of Ji-Abura oil this concept, its unique processing methods and highly estimated environmental effect can be the mark to ongoing the business, however through systematical analysis of each step (including mathematical pure calculation, economical practicable analysis), better equipment and advanced waste-turning techniques should be introduced. And the more people should be involved for the better idea and future ongoing of the business.

Further improvement

Should have further cost-benefit analysis and have better strategies for better equipment introducing and price adjusting.

References:

<http://www.sunflowernsa.com>

<http://www.fao.org/docrep/v4700e/v4700e0a.htm>

[1] Gupta R K, Das S K. Physical properties of sunflower seeds [J]. Journal of Agricultural Engineering Research, 1997, 66(1): 1-8.

[2] Singh A B, Srivastava S K. Status and control strategy of peanut bud necrosis disease in Uttar Pradesh[C]//Recent studies on Peanut bud necrosis disease: Proceedings of a meeting. March, 1995, 20(1995): 65-68.

Sales& Marketing

After the harvest of the sunflowers and the extraction of the oil, it comes to the critical stage which tremendously determines the profits that the farmers can make after a year of hard work- how to put the sunflower oil on market.

Shoukoukai is a non-profit organization which plays a vital role in connecting the production end with the consumption end. Funded by the government of Japan, the organization aims to help facilitate the sale of the sunflower oil produced by the farmers, with an objective to promote sunflowers in Naka city and make it as a city renowned for sunflowers in Japan.

Two different volumes of bottles of sunflower oil are produced every year. 1-liter size bottles are sold at 2000 yens to restaurants in the city while around 2,000 140-gram bottles are produced and sold at 600 yens to 20 to 25 shops in the city, and the shops then sell them at 1,000 yens to consumers. For the sake of avoiding the emergence of monopoly of sunflower oil by big grocery stores and creating a better business environment for the sustainability of small shops in the city, the selling price of each bottle of sunflower oil is fixed in accordance to the results of discussion among Shoukoukai, sunflower oil farmers

and the retailers. With the support of Shoukoukai and all the concerned retailers, all bottles of sunflower oil are usually sold out in around 6 months, which proves that it is sought after by the local citizens in Naka city and indicates that there is a potential for further development of and business opportunities for the sunflower oil in the city.



A Poster shows the 135g of sunflower oil bottles are sold at 1,000 yens in Naka city.

Before actually putting the sunflower oil on the market in Naka City, Shoukoukai has to make sure that a white seal is put on each bottle of sunflower oil for authentication.



In a bid to publicize the sunflower oil in the city, a one-day Sunflower Festival is held every year in summer to impress the visitors with the blooming of sunflower. Without the need to pay for the entry fee to participate in the festival, around 40,000 visitors, both local and those from the neighboring cities, are attracted on the particular day each year to appreciate the blooming of sunflower. Booths selling food and drinks made by locally grown raw materials are set up in cooperation of Shoukoukai and around 100 shops, which eventually can be able to make a sales record at around 20 million to 30 million yens on the day of festival. Not only could the shops participating in the festival share the fruits of the success of the festival, the total economic effects brought out by the festival could be up to around 40 million to 60 million yens, which are greater than the amount of investment for the entire sunflower project carried out by Shoukoukai.

Waste oil produced by the users from restaurants is collected for recycling and conversion into biodiesel fuel carried out by Biodiesel Fuel Processor. It is capable of processing 300L of waste oil per day with a cost of 54 yens per liter. The biodiesel fuel produced will be used for the transportation of biodiesel fuel and the operation of harvesting machines. It is said that oil crop cultivation at 5ha can produce biodiesel fuel required for the operation of harvesting machines for 113 ha.

After learning about the operation of Shoukoukai on the sunflower oil project and its strategies on advertising the sunflower oil, we have come up with several recommendations which are possible for the enhancement of the entire promotion campaign of sunflower oil.

Being one of the events able to bring about a deal of economic benefits to the city, Sunflower Festival is the main focus of the enhancement project. Since the festival can successfully attract a number of visitors to purchase in the city, the duration of festival can be lengthened from a day to a week to increase the business opportunities for the sale of the products, including but not limiting to sunflower oil, and the chance for the visitors to purchase. Other unique cultural activities and elements for the city could be incorporated into the festival for the enrichment of the event, for instance, parades and performances by local citizens can help tourists experience the historical background of the city and can help build the sense of belonging to the community of the local citizens. In spite of the possible benefits that the above mentioned suggestions could bring about, the elongation of the festival period may

require the efforts to settle down the problems raised by a higher number of tourists visiting the city, such as the need to spare more land and spaces for accommodations, restaurants and tourist information centers.

A one-time large scale promotion campaign is not enough for the sustainable development of sunflower oil in Naka city since the provision of a long-term stable income for sunflower farmers should be taken into consideration. Advertisement should be put in a variety of mass media. Newspaper, both local newspapers in Naka city and cities around it, like Tokyo, is considered to be one of the effective ways for the promotion of the festival. Leaflets introducing the city and the festival can be made available at main train stations around Naka city, in which recommendations such as the routes for travelling around Naka city, souvenirs available in the city, information about the sunflower oil and festival, and even coupons to boost sales, can be provided to increase The effectiveness of the Internet promotion should not be neglected. Social platforms, ranging from Facebook to Twitter and from Instagram to LINE, are regarded as low-cost, instantly responsive, and long lasting promotion strategies. For instance, in a free-of-charge Facebook fans page, news and information of the city and the festival can be shared such that numerous Facebook users can be able to keep tract of the latest updates with the use of personal electronic devices anytime and anywhere. Most important of all, this kind of low-cost promotion strategy may arouse the interest of the users in the city and festival, and thus may increase the publicity of the festival.



Social platforms available in the Internet nowadays are used for promotion at low costs

Conclusion

First, I really appreciate the efforts, hard work and ideas that the staff in Naka City Shoukougai has demonstrated as well as the enthusiasm shown for the promotion of sunflower and sunflower oil in Naka city where mainly residential areas can be found. Being a non-profitable organization which is fully funded by the Government of Japan, Naka city Shoukougai aims to fulfill the role as a “connector” facilitating the trade between the sunflower farmers and the local consumers in Naka city. Solely making reference to the sales record of sunflower oil and the economic benefits brought out by the sunflower festival every year, it is delighted to learn about that Shoukougai has done and achieved much more than what one could expect—not only the sunflower