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Market alternatives for Treasure Valley cull onions

A. E. Levi, J. K. Fellman, J. F. Guenthner, L. D. Makus, and M. K. Thornton

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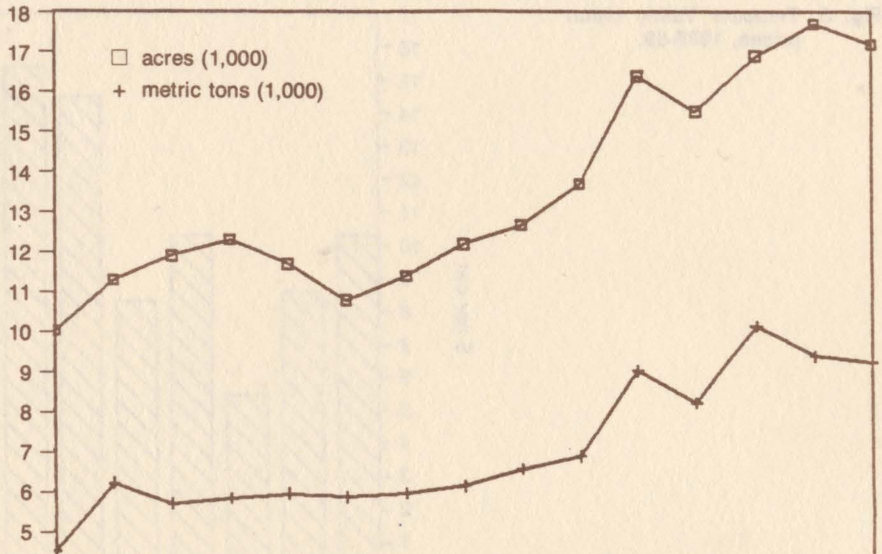
Introduction

The Treasure Valley of southwestern Idaho and Malheur County, Oregon, supports a large, growing onion industry (Fig. 1). The region's onion production accounts for about one-third of the total annual U.S. storage onion crop. Total onion production in the region has more than doubled in 15 years. The 1989 farm value of the crop was more than $90 million, triple its 1982 value (Fig. 2). Ninety percent of the onions grown in the Treasure Valley are of the sweet Spanish variety.

Treasure Valley onions can be stored up to 6 months. Harvest begins in August and lasts through the end of October. Shipments start with harvest and last through the beginning of April. During the harvest and storage season, Treasure Valley onions have at least a 50 percent share of the total U.S. fresh onion market (Figueroa 1989).

Onion prices are quite volatile (Fig. 3). Average farm-level onion prices in the Treasure Valley have ranged from $5.50 per hundredweight (cwt) in 1977 to $16.30 per cwt in 1983. Small changes in onion supplies have caused large changes in onion prices. For example, the 1982 average onion price was 60 percent lower than the 1983 price, while the 1983 price was more than double the average price in the following year. The Treasure Valley onion industry has made progressive marketing efforts to expand demand and decrease price volatility.

Fig. 1. Treasure Valley onion acreage and production, 1975-89.



Source: U.S. Department of Agriculture. Agricultural Marketing Service. Fruit and Vegetable Division. Market News Branch. 1975-89. Marketing Arizona-Colorado-Idaho-New Mexico-Oregon-Washington onions. Federal-State Market News Service, Idaho Falls, Idaho.

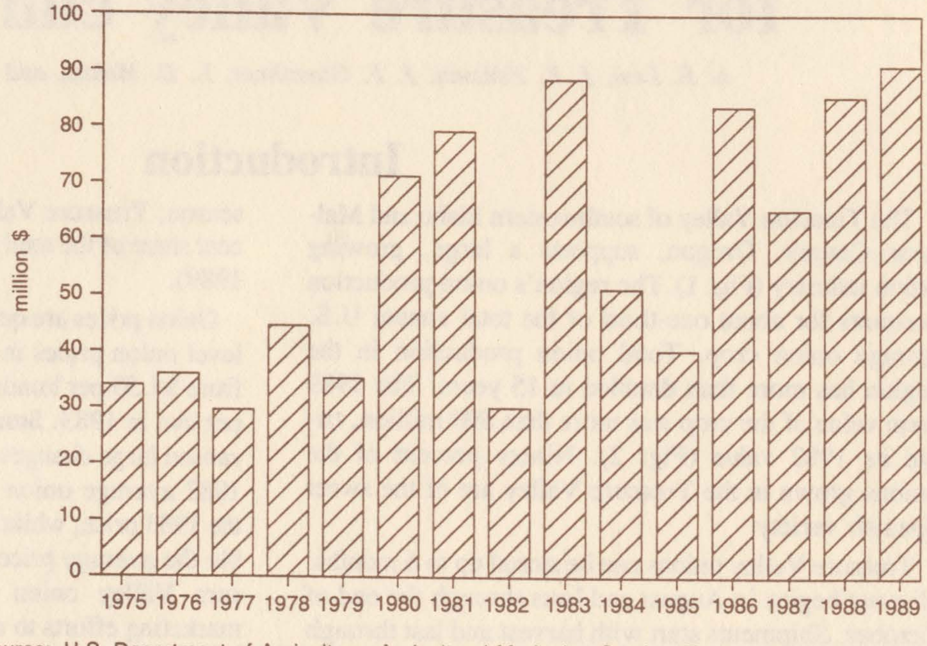
The marketing order and cullage

The Idaho potato and onion industries' successful marketing programs began about the same time. In 1939 the Idaho Legislature established the Idaho Advertising Commission and charged it with enhancing the marketing of Idaho onions and potatoes. A marketing order was one of the tools used to improve market returns for Treasure Valley onions. Mandatory inspection and stringent quality standards enforced through the marketing order have helped the Treasure Valley develop a reputation for high quality onions.

The Treasure Valley's fresh onion quality standards have created a by-product — cull onions. Onions that do not meet the size, shape, and appearance standards of the marketing order are not allowed to enter fresh market channels and must be culled. Cullage rates vary among growers, growing seasons, and time of year (Table 1).

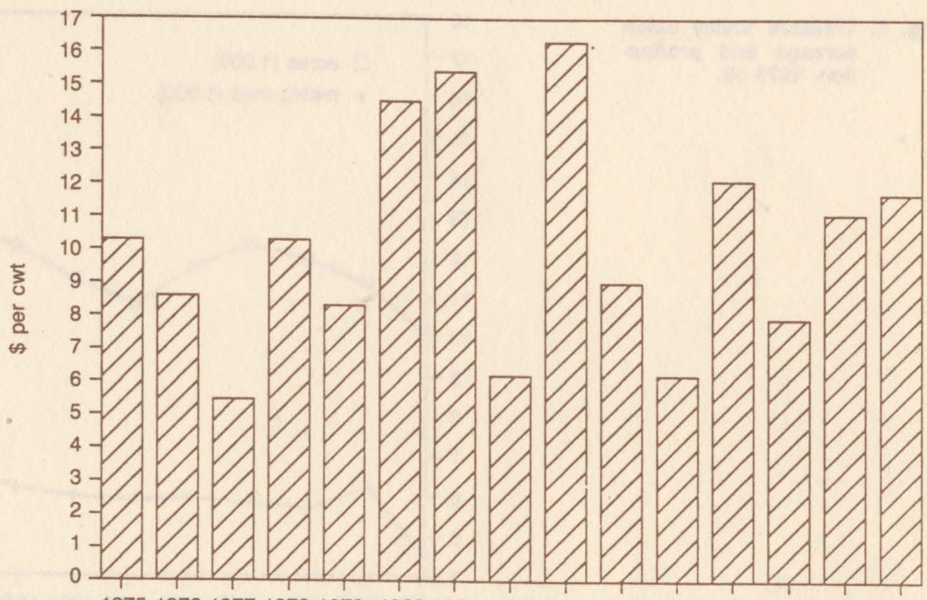
Cullage rates are lowest during the harvest season. Most of the harvest-time cullage reflects size and shape problems rather than decay. During the storage season cullage rates increase. The highest cullage rate is often

Fig. 2. Farm value of Treasure Valley onions, 1975-89.



Source: U.S. Department of Agriculture. Agricultural Marketing Service. Fruit and Vegetable Division. Market News Branch. 1975-89. Marketing Arizona-Colorado-Idaho-New Mexico-Oregon-Washington onions. Federal-State Market News Service, Idaho Falls, Idaho.

Fig. 3. Treasure Valley onion prices, 1975-89.



Source: U.S. Department of Agriculture. Agricultural Marketing Service. Fruit and Vegetable Division. Market News Branch. 1975-89. Marketing Arizona-Colorado-Idaho-New Mexico-Oregon-Washington onions. Federal-State Market News Service, Idaho Falls, Idaho.

Table 1. Typical seasonal cullage rates for storage onions, Malheur County, Oregon.

Time period	Cullage rate
	(%)
August 15 through September 30	5
October	10
November	25
December	20
January	20
February	20
March	20

Source: Unpublished document, Malheur County Economic Development Office, 1990.

in November, when problem storage lots become apparent and are marketed rather than allowed to deteriorate.

Management practices as well as factors beyond grower control affect cullage rates. Proper fertility, irrigation, pest management, harvest, and storage practices can help reduce cullage. A growing-season hailstorm or a rainy harvest period can increase cullage in spite of best management practices.

In recent years, between 75,000 and 100,000 tons of Treasure Valley onions have been culled annually (Fig. 4). Although average cullage rates have been below the 15-year average of 21 percent since 1986, the total volume of culls from an expanding onion industry continues to be a problem.

Other onion producing regions also have cull onion disposal problems, but most of them do not have marketing orders. Cullage rates in these areas are lower because they ship some lower quality onions to the fresh market. Other areas ship only at harvest and do not suffer storage-related decay.

Present uses of cull onions

Treasure Valley cull onions have had little market value as a food product but are sometimes fed to sheep. A decline in the number of sheep gives little hope for expansion of the feed market. The beef feedlot sector has had little interest in cull onions for two reasons. First, cull onions are 90 percent water with a low nutritional value relative to their size. Second, the volatiles in onions are suspected of flavoring the milk and meat of the animals (Kirk and Bulgin 1979). Cull onions have sometimes been frozen or dehydrated, but no processing plants use cull onions exclusively.

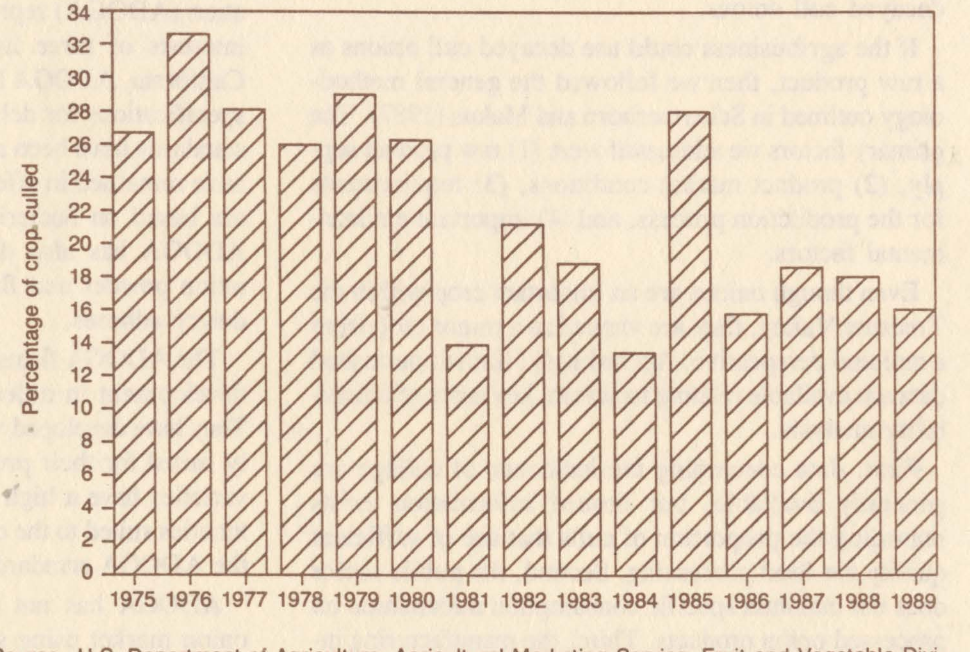
Cull onions as waste product

Due to limited feed and food markets, cull onions have been treated as a waste product. Disposal methods have included burial in trenches and broadcasting on farm fields. However, environmental and pest control problems are associated with these disposal methods.

Idaho and Oregon state governments regulate cull onion disposal. Burial and landfill restrictions are imposed because cull onions are a potential source of nitrate contamination in groundwater. Furthermore, since cull onions are a potential source of onion maggots and diseases, onion pest concerns influence burial and feeding regulations.

Although limited soil fertility benefits might be gained from spreading cull onions on fields, disposal costs usually mean that cull onions have a negative price. Packers in the Treasure Valley area said they would pay $5 per ton to have their cull onions hauled away. Currently, growers in the region are paying shippers

Fig. 4. Average annual onion cullage rates for the Treasure Valley, 1975-89.



Source: U.S. Department of Agriculture. Agricultural Marketing Service. Fruit and Vegetable Division. Market News Branch. 1975-89. Marketing Arizona-Colorado-Idaho-New Mexico-Oregon-Washington onions. Federal-State Market News Service, Idaho Falls, Idaho.

about 1 cent per hundredweight to dispose of the culls (the total real cost per hundredweight is unknown). As disposal options become more restrictive, growers and packers may be required to pay a higher price to dispose of their cull onions.

Objectives

The large volume of raw culled onions available at a low or even negative price has generated interest from the onion industry in the feasibility of a processing facility that would run on cull onions. Interest in alternative market solutions to the cull onion problem also led to the Idaho State Board of Education's funding the University of Idaho research described in this report. Treasure Valley onion industry representatives provided some research guidelines.

The major objective of this study is to identify alternative uses for cull onions. We were interested particularly in the feasibility of a processing facility that could run on decayed cull onions. A separate publication identifies practices that could reduce the incidence of cull onions.

Methods

We examined four types of cull onion utilization opportunities: (1) dehydration, (2) freezing, (3) oil extraction, and (4) nonfood options. For the three food processing options, we conducted an industry overview with regard to the use of sweet Spanish onions (90 percent of the Treasure Valley onion acreage). We then determined whether each processing option could use decayed cull onions.

If the agribusiness could use decayed cull onions as a raw product, then we followed the general methodology outlined in Schermerhorn and Makus (1987). The primary factors we addressed were (1) raw product supply, (2) product market conditions, (3) requirements for the production process, and (4) important environmental factors.

Even though onions are an important crop within the Treasure Valley, they are viewed as a minor crop from a national perspective. Accordingly, limited published data are available relating to several key areas of a feasibility analysis.

First, data concerning the incidence of cullage are generally available, but limited information exists regarding the proportion of culls that are of sufficient quality for food processing. Second, the public sector does not maintain specific consumption information on processed onion products. Third, the manufacturing industry for onion products comprises only a few firms and is a relatively small component of food manufacturing. Published research on manufacturing costs does not exist for this industry.

As a result of these data limitations, much of the information we used is from individuals familiar with the industry. We used in-person contacts and telephone interviews conducted during 1990 as the primary information sources. Names and telephone numbers of all contacts and information providers are listed in the appendix.

Dehydrated onions

Industry overview

Dehydrated onions appear to have a growing market, but there may be a trend to substitute frozen onions for certain dehydrated onion products. The demand for dehydrated powders is growing rapidly relative to the demand for dehydrated flakes and whole onions. The demand growth relates to the use of powders for batter, fries, bagels, and other baked products. Dehydrated products are mainly sold to wholesalers and food processors who use them in soups, sauces, and batters. A small percentage is sold in retail stores (Luh and Woodruff 1975).

In general, the demand from food processing firms seems to be moving toward higher quality. This is particularly true of the pet food industry, which demands dehydrated onion products meeting stringent quality control standards. Exports also account for a good-sized portion of demand, and the international market is expanding.

The American Dehydrated Onion and Garlic Association (ADOGA) represents the political and economic interests of three large onion dehydrating firms in California. ADOGA has published standards and quality specifications for dehydrated onions and garlic. These standards have been adopted by the whole industry and have remained in effect for many years. The standards are based on bacteria levels, color, and bulk index. ADOGA has also developed grades for dehydrated onion powder and flakes to which the rest of the industry adheres.

The ADOGA firms have done extensive research and development in order to maintain their market share. They have developed white onion varieties that are ideally suited for their production operations. These onion varieties have a high level of solids and other characteristics suited to the dehydration process. Furthermore, the ADOGA standards are well suited to their onions.

ADOGA has not established a dehydrated yellow onion market using sweet Spanish onions. According to ADOGA standards of pungency and color, the yellow onion would produce a marginal product. ADOGA has little incentive to change the standards to include yellow onion products. In spite of this, one firm is developing a dehydrated yellow onion market and plans to expand capacity. The dehydrated product from sweet Spanish onions has a promising market because of its flavor; however, market development efforts will need to be aggressive.

The California onion and garlic dehydrating companies represented by ADOGA have had a near monopoly for some time. Only one other U.S. firm dehydrates onions and garlic. This has influenced the amount of market information released to the public. Market shares among the ADOGA firms have not been challenged until recently, and competition has come mainly from abroad.

Raw product requirements

Dehydrated onions, flakes, and powders are about 8 to 10 times stronger in flavor than fresh onions. Southport White Globes and Blanco Duro are the preferred onion varieties for dehydration because they are more pungent and have a high solids content. Southport White Globes have 20 to 25 percent solids. In comparison, the yellow sweet Spanish onions have 8 to 10 percent solids. This difference in solids affects the rate of conversion from raw onions to a dehydrated product. Typically, yellow onions yield half the product of white onions, pound for pound.

It also takes more energy to dehydrate sweet Spanish onions than the higher-solid white varieties. This is due to the industry's requirement that water content be between 4 and 5 percent. Higher energy use for a smaller volume of output creates a cost disadvantage.

The bacteria count needs to be low for processing dehydrated onions. Disinfecting treatments such as ultraviolet (UV) radiation are necessary to maintain bacterial populations at acceptable levels. ADOGA has bacteria count guidelines for onion powder as well as the other dehydrated products.

According to an ADOGA representative, the primary market trend has been a growing demand for higher quality dehydrated onions. Buyers watch for bacteria, mold formation, color, and defects. Sales volume could be very limited for a substandard dehydrated onion. Using a cull-grade onion for dehydration would be going against the market trend for a higher quality dehydrated onion.

Additionally, the lack of market recognition for dehydrated yellow onions suggests some obstacles to successful market penetration. Even though the yellow onion makes a more palatable product and has a higher sugar content than the white onion, its market is not well established.

While the sweet Spanish onion may have a potential dehydration market, decayed onions do not have the desirable raw product characteristics that the dehydration industry requires. Most decay in Treasure Valley cull onions is due to fungal pathogens, not bacteria. However, the existence of any form of decay suggests that the dehydration option for culled onions is not promising. Dehydrated products from decayed onions have a reduced shelf life, do not meet current industry standards, and go against the industry trend toward a higher quality product. Furthermore, the Food and Drug Administration (FDA) may not designate the product as generally regarded as safe (GRAS).

Frozen onions

Industry overview

Growth in the frozen onion market during the 1980s was relatively stable compared with the rapid growth of the 1970s (Table 2). Growth in the '70s was mainly due to increased demand for prepared foods. In recent years, many of the market shares gained by the frozen onion industry have been at the expense of the dehydrated onion sector. According to Howard Weatherspoon of the American Frozen Foods Institute, the greater convenience of using frozen onions is the primary reason for the shift in market share (Pers. comm. 1990).

The frozen onion industry is an important part of the onion sector and is well established in the Treasure Valley. Several firms are located in Idaho and Oregon, and the Treasure Valley has two processors. The average

Table 2. Frozen onion production in the United States (1,000 pounds).

Year	Midwestern states	Western states	Total U.S.	Percentage change
1970	na	na	52,205	na
1971	na	na	75,882	+18.5
1972	na	na	110,672	+18.6
1973	na	na	114,679	+ 1.8
1974	na	na	111,228	− 1.5
1975	na	na	121,101	+ 4.2
1976	na	na	148,963	+10.3
1977	na	na	152,718	+ 1.2
1978	na	na	154,080	+ 0.4
1979	34,857	132,382	167,239	+ 4.1
1980	39,718	116,363	156,081	− 3.5
1981	40,088	119,786	159,874	+ 1.2
1982	46,822	135,522	182,344	+ 6.6
1983	35,208	107,429	142,637	−12.2
1984	39,106	117,376	156,482	+ 4.6
1985	50,113	91,895	142,008	− 4.8
1986	57,866	127,592	185,458	+13.3
1987	48,399	139,622	188,021	+ 0.7
1988	51,683	105,529	157,212	− 8.9

Source: The almanac of the canning, freezing, preserving industries. 1989. Edward E. Judge & Sons, Inc., Maryland.

Note: na = not available.

annual percentage of the Treasure Valley sweet Spanish onion crop used for frozen product is about 20 percent.

Some frozen onion processors contract with growers and arrange to buy the types of onions suitable for their operations. The processors often store some onions, which helps stabilize the industry-wide input price.

Onion waste is also a concern of the frozen onion industry. Methods to improve processing efficiency and raw product utilization are being developed to increase output and decrease disposal costs and waste handling. Waste water is the primary by-product in the frozen onion sector and is likely to be more of an issue in the future. Only 50 to 60 percent of the raw product goes into the final output. Thus, freezing would reduce but not eliminate the cull disposal problem.

Raw product requirements

Onions for frozen processing must be in good and sound condition, but they do not have to meet the same appearance standards as fresh market onions. Frozen onion processors prefer a flavorful onion and one that is not too "hot" (like those used in the dehydration sector). The processors can use mechanically damaged onions, misshapen onions, and some grade #2 and seeder onions that are larger than 2 inches. The frozen onion industry uses some fresh onion culls in its production process, but the culls must have no visible signs of decay. Therefore, decayed cull onions are an unacceptable input for the frozen onion industry.

Onion oil

Industry overview

Published information on onion oil and the essential oil industry is not readily available to the public. No detailed data are available that would allow a quantitative analysis of the present market situation. Hence, much of the information in this section has been gathered from experts in the essential oil industry.

Onion oil is a small and specific market. Onion oil is used as a flavoring in meats, sausages, soups, table sauces, and in other foods (Guenther 1952). Raw onion oil is sold to essential oil brokers, compounders (companies that produce finished flavor products), and processors who distribute it to the retail market.

Opportunities exist for the onion oil firm to establish itself in the Pacific Northwest for three reasons. First, the raw product is close by, decreasing raw product acquisition costs. Second, the onion oil would be produced under FDA guidelines. Products that adhere to such guidelines tend to be of higher quality than imports already on the market. Third, a domestic onion oil firm could capture market shares if it is able to reasonably compete in price with onion oil imports.

Several firms located in the United States have already expressed an interest in domestically produced onion oil. Beije Chemical Products, Inc., an essential oil brokerage firm in New York, is interested in promoting a domestic onion oil. Kalsec, Inc., a Michigan firm that has been in the extract, essential oils, and spice business for more than 30 years, is very interested in a quality onion oil. Given a competitive price and quality oil, Kalsec indicated to us that it would buy as much as could be provided.

A range of onion oil prices exists due to the differing attributes of the oil, particularly its quality, color, odor, and taste. According to a Beije representative, the lowest price has been stable for a number of years at around $370 per kilo for Mexican onion oil. According to PENTA Manufacturing Company, a U.S. firm in New Jersey, onion oil sells for $497 per kilo. Assuming that the low end price will remain at $370 per kilo and that there is potential annual production from Treasure Valley cull onions of 15,000 to 60,000 pounds, the value of the onion oil could range from $2.5 million to $10 million.

Raw product requirements

The amount of cull onions disposed of each year would produce a large amount of onion oil. However, it is unknown whether the sweet Spanish onion variety meets the raw product requirements of a quality onion oil. Furthermore, it is unknown whether these onions, when decayed, can be used to process a GRAS onion oil product.

However, we confirmed the quality requirement of the input for one facility. An onion oil firm in Mexico reported using all kinds of onions, including culls and bruised onions, in its process. However, it did not use decayed onions because they produced an oil with a bad odor. The onion shoot is also not used in the manufacture of oil because of the odor it produces.

Current technology may allow the use of decayed onions. Therefore, the use of decayed onions is assumed feasible throughout the remainder of this section.

Raw product supply

The average annual amount of cullage would be adequate to process a large volume of onion oil. For example, cullage levels during the 1980s ranged from about 44,000 tons in 1983 to 108,000 tons in 1985. The average yield of onion oil from raw onions is between 0.01 and 0.03 percent, which converts to a potential 15,000 to 60,000 pounds of Treasure Valley onion oil per year. Yield variability reflects the onion variety processed, method of oil extraction, and sophistication of equipment. The variety of onion also affects the pungency of the oil. Published yield data for onion oil are available but not for recent years (Guenther 1952; Heath 1981).

Market conditions

Market barriers to entry — One of the main barriers to entry in the onion oil industry is its secrecy. Companies have long-established market shares that depend upon flavor formula trade secrets.

Descriptions of exact methods of distillation and/or extraction of onion oil are difficult to find since most procedures have not been submitted for a patent. There is a similar reluctance to submit formulas to patent offices. The examination procedures of the patent office may be subjective, and the firm may reveal trade secrets without protection. Furthermore, protection of a patent in one country does not guarantee protection abroad. A slight variation in a patented methodology may allow a firm to use another firm's formula (Dorlund and Rogers 1977). If a firm's formulas or operating methods were obtained by its competitors, it could be the firm's downfall.

Other barriers exist for the establishment of a flavor company. A flavor firm's good reputation is vital to its existence. To obtain recognition within the industry, sample flavorings must be made available to the food industry. However, food manufacturers usually don't use unsolicited flavorings unless they represent a new technology or a unique flavor (Dorland and Rogers 1977).

Competition from overseas — The United States imports onion oil from various countries. Most onion oil is produced in Mexico, Holland, Egypt, and China. Recently China has tended to set a lower relative price in an attempt to regain market share lost after the 1989 Tiananmen Square conflict and subsequent trade sanctions.

Imported onion oil tends to compete with domestic oil in terms of reliability, quality, and price. Political situations and ease of trade also affect imported oil competition.

Mexican oil has maintained the highest percentage of the U.S. market share by occupying the lower price range. It is not considered to be a quality oil. The higher quality oils are produced in Egypt and central Europe. Dutch onion oil is of high quality but is more expensive due to its lower yield, higher labor cost (relative to Mexico), and higher transportation cost to the United States. According to one buyer, lower quality onion oil that is imported into the United States is often adulterated to increase volume.

Distillation process

Specialized, costly equipment is necessary to distill onion oil. Onion oil can corrode equipment so stainless steel or porcelain machinery is used in onion oil processing.

When onion oil is in the first stage of the distillation process, it has the same specific gravity as water. Hence, it is a problem to distill. In Mexico, salt or hexane is used to separate the oil from the water. The additives must then be removed from the onion oil until they meet U.S. standards of 30 parts per million (ppm) or lower.

It is uncertain whether mycotoxins present in the decayed culled onions are of any consequence in the distillation process.

The capital investment and labor requirements for extracting onion oil depends on the distillation process. Specific figures are not available. Given that labor costs are higher in the United States than in Mexico, Egypt, or Holland, the costs of producing onion oil in the United States may be higher if a labor intensive process is selected. However, a modern domestic facility may operate more efficiently.

Certain working conditions should be considered before hiring the necessary work force for onion oil processing. Working with onion oil can be unpleasant. An Oregon firm's experience with a pilot distillation project exemplifies the problems with manufacturing onion oil:

- Onions were highly corrosive.
- The onion odor permeated the building as well as clothes and skin.
- The onion odor was absorbed into the human bloodstream, and people retained the smell for an extended period.

Distillation may be less than ideal technology to use for the following reasons:

- The process has low energy efficiency, using high pressures and temperatures for long periods.
- It uses hexane, a hazardous solvent, to separate extracted oil from water.
- Associated odors may cause environmental and social concerns.

Supercritical fluid extraction (SFE)

Market determination — The supercritical fluid extraction (SFE) method is a relatively new extraction process that has potential to segment the onion oil market. The long-run demand for products manufactured with the SFE method seems promising because the method does not use toxic chemicals.

At the present time, only two food processes in the United States use the SFE method: hops oil extraction and coffee bean decaffeination (Rizvi et al. 1986). Many SFE extractions are still in the experimental stage, including one for onion oil. Onion oil manufactured with the SFE technique has been analyzed and found to be relatively pure. Companies that are manufacturing hops oil using the SFE method are getting a higher price than firms producing chemically extracted hops oil. An interest does exist for chemical-free inputs, which suggests that onion oil extracted with the SFE process may have the potential for building a clientele.

Production process — The SFE method is a leaching process in which carbon dioxide (CO_2) is the supercritical fluid used to separate the oil from the raw product's residual liquid. The rate at which it extracts the oil is slow relative to the distillation method.

Preparing a product for the SFE process can be fairly complex and time consuming. For example, hops must first be pelletized and then reground in order to achieve a higher density. Similarly, onions may have to be chopped and dried somewhat. Users of the SFE method presumed that drying the onions would make the SFE method more effective. Test trials would need to be run to determine the appropriate type of raw onion preparation.

The SFE machinery can take up to 4,000 pounds of pressure and is constructed with steel at least 6 inches thick. Some SFE systems occupy a relatively small space (about 100 feet square) and cost approximately $500,000 for every 9 cubic yards of input batch capacity.

The SFE unit performs fully automated density stepped extractions. The sample is first extracted with CO_2, a low density supercritical fluid. Solvent power increases as the density of CO_2 is increased by regulating pressure. At a density of 0.25 gram per cubic centimeter, it behaves like hexane (Miles and Quimby 1990).

Samples of extracts using SFE with alternative CO_2 densities can be collected and inspected. Hence, one could determine the best CO_2 density for onion oil production. The system can simultaneously measure levels of carbon, sulfur, and nitrogen. Such information is essential for the analysis of oils and extracts in the flavor industry.

Costs of operation — The SFE method has specific requirements for each raw product. If it were deemed a feasible option for onion oil made from sweet Spanish onions, an operation would be custom designed. The cost of an SFE operation for onion oil is unknown. However, future SFE operations have the potential to become multiproduct assuming the engineering expertise for different products is available.

Environmental conditions

Adequacy and availability of site — Population density should be considered in the choice of site because the odor from processing decayed onions may be overpowering. International Food and Flavor (IFF) had an onion oil distillation processing plant in Portland, Oregon, about 10 to 15 years ago. The firm processed Danver yellow onion culls within the city limits and near a residential area. The Oregon State Department of Environmental Quality (DEQ) closed the plant because it did not have proper permits and many residents complained about the plant's emissions.

IFF moved to Woodburn, Oregon, and tried to get a permit to reestablish its onion oil distillation processing plant there. The DEQ turned down IFF because the proposed site was too close to a population center. Part of the problem stemmed from IFF's practices of stockpiling onions and improperly disposing of onion waste from the extraction process. Both stockpiled onions and onion waste smelled as they began to rot. Given the age of the case, the DEQ did not have information on file. Information from the IFF case either had been archived or eliminated from DEQ records. Our information came from a source who wished to remain anonymous.

Another firm, Mt. Jefferson Farms, set up an onion oil distillation pilot project about 10 years ago that met Oregon DEQ preliminary approval. The site's location away from populated areas and the small size of the operation helped in obtaining DEQ approval. Because the Treasure Valley already has air quality problems, an onion oil facility might be unacceptable.

Government policies — The Oregon DEQ had no record of its action against IFF. The Idaho and Oregon state control orders focusing on the disposal of onion culls would likely need to be updated to include waste from the manufacture of onion oil. Because the type of waste product onion oil processing produces is unknown at this time, government regulation may play an important role in the exact specifications of waste disposal in the future.

Transportation — Once onion oil is produced, it is no longer considered an agricultural product and becomes a volatile chemical (essential oil). Transporting the oil can be a problem. As onion oil warms up, its pungency and volatility increase. Onion oil is about 4,000 times stronger than fresh onions. Hence, care must be taken in its transportation.

Depending on the oil's volatility, it may need to be refrigerated in transit. Lowering the oil's perishability and increasing its stability while in transit will be an issue of the highest priority.

Disposal of waste by-products — Producing onion oil is a seasonal operation with a substantial solid and liquid waste problem. Depending on the process used, air emissions and waste water containing some waste solids will be produced. When designing a pilot project for onion oil, the problem of solid and liquid waste disposal from the process must be addressed.

Returning the liquid to the soil is possible except that the fumes may be considered an undesirable emission. Additionally, this option would not be available during the winter months.

Furthermore, traditional distillation processes employ toxic solvents. The storage and residual waste products of these toxic chemicals must also be addressed.

Nonfood options

Livestock feed

Cull onions have been used as feed for both cattle and sheep. The nutritional value of cull onions, in terms of dry weight, is near that of barley. However, the raw onions are approximately 90 percent water by weight. Because cull onions contain a high level of water, they must be mixed with other supplemental feed grains in order to meet the livestock's minimum nutritional requirements.

A decline in the number of sheep provides little hope for expansion of the sheep feed market. Furthermore, the beef feedlot sector has had little interest in cull onions for two reasons. First, cull onions are 90 percent water with a low nutritional value relative to their size. Second, the volatiles in onions are suspected of flavoring the milk, breath, and flesh of the animals (Kirk and Bulgin 1979).

Cattle are known as the meat animal most susceptible to anemia when consuming cull onions over a short period of time. Sheep and goats are more resistant (Kirk and Bulgin 1979).

Two studies have been conducted with the primary objective of determining the effects of cull onions on livestock. Both the investigations were done in the Treasure Valley under local conditions and using culls of the sweet Spanish variety. The culls used in the trials were only slightly decomposed, if at all; hence the potential side effects of decayed onions are unknown.

Cattle — The most recent study was a collaboration between the University of Idaho and Oregon State University. The trials were conducted on beef cattle to determine the hematological effects and feedlot performance of feeding different levels of cull onions (Howell et al. 1990). The onions were crushed or chopped and mixed with the other feeds to guarantee intake of the specified ration of onions. Otherwise, the cattle tended to eat onions only.

The research showed that onions may be safely fed to feeder weight beef cattle at rates of up to 25 percent of the diet. The effects of onions on performance and carcass residue is not known.

Sheep — Another study was a trial conducted on ewes fed onions freely. The onions were scattered on the ground in piles, and the sheep fed on the onions for a 130-day trial.

Some sheep developed anemia. The investigators concluded that, given information from previous research on using cull onions as feed, the degree of anemia seemed to be proportional to the amount of onions in the diet. The anemia was reversible if the animals had not become moribund. Hence, the investigators recommended that if symptoms become evident, onion feeding should be discontinued temporarily (Kirk and Bulgin 1979).

Presently, Treasure Valley cull onions are being fed to sheep, but the sheep population there is slowly declining. Fifteen onion producers in Malheur County, Oregon, are transporting culls to places with sheep herds. About 8,000 to 10,000 pounds of culls are fed to the sheep each year. One ewe can consume about 35 to 50 pounds of cull onions per day.

Other UI trials with onion silage production are using the "Ag Bag" approach. This approach uses different mixtures of onions and alfalfa or onions and grain straw to feed sheep. One of the objectives of the trials is to determine the most effective mix for drying the cull onions to an acceptable level for feed. The water in the onions is either pressed out or the onions are mixed with dry matter to decrease total water content.

Cull onion feed regulation — The cull onions used as feed are regulated in western Idaho. Onions disposed of (left on the fields) as livestock feed must be buried and/or plowed under after March 15 so that no onion residue is evident. This is done to prevent the onion maggot from spreading from exposed cull onions to onion fields.

Composting

Another alternative is to use the decaying onions in an aerobic thermophillic compost mixture. Aerobic means the compost will be without an offensive odor. Thermophilic means the compost reaches a high temperature (170°F) that pasteurizes it, killing onion maggot populations.

A pilot project that would attempt to determine the appropriate composting method has been proposed to the Idaho-Eastern Oregon Onion Committee. The project would determine which types of matter would be necessary to convert the decaying onions into a pasteurized compost. The compost would then be used for fertilizer. The project would be conducted under local conditions with local materials.

Onion composting is the only alternative that could potentially use the cull onions year-round. The decayed onions could be processed after the March 15 control order deadline for exposed cull onions in fields or landfills.

Ethanol production

J. R. Simplot, Inc., operates an ethanol processing facility that has used Treasure Valley cull onions. According to Dave Kueneman, manager of the facility (pers. comm. 1990), cull onions do not work well. Problems encountered include the high water content of cull onions, rocks and other trash in the delivered cull onion loads, and rot organisms in the decayed onions. Simplot may use small amounts of cull onions in the future, but it would not be feasible for the firm to purchase culls for ethanol production.

Conclusions

The cull onion problem in the Treasure Valley is a by-product of the Idaho-eastern Oregon onion marketing order. The same marketing tool that has promoted the growth of the local fresh onion industry has produced a cull onion volume of 75,000 to 100,000 tons each year. This represents about 20 percent of the onions grown in the Treasure Valley.

Due to a lack of market alternatives, cull onions are a waste product. Disposal has not been costly, but environmental and pest control concerns may increasingly limit burial and other disposal methods. Growers and shippers may face increased disposal costs and are anxious to find alternative channels for their cull onions.

We analyzed alternative market solutions to the cull onion problem with particular focus on decayed cull onions. The research was funded by the Idaho State Board of Education with input from Treasure Valley onion industry representatives. The main conclusions of the research are briefly summarized below.

- Dehydrated onion processing using decayed cull onions as the primary source of raw product is not a feasible option.
- Frozen onion processing using decayed cull onions as the primary source of raw product in not a feasible option.
- Processing onion oil from cull onions by the super critical fluid extraction (SFE) method may be feasible. Additional research is required.
- Livestock feeding, composting, and ethanol production may provide minor market outlets for cull onions.
- Pre-sorting cull onions would allow existing onion processors to use more of the nondecayed cull onions.
- The best short-run solution is to adopt production, harvest, handling, and storage practices that reduce cullage rates. We will address those issues in a separate College of Agriculture publication.

References

Dorland, W., and J. Rogers, Jr. 1977. The fragrance and flavor industry. Wayne Dorland Company, New Jersey.

Figueroa, E. E. 1989. The competitiveness of New York state onions during 1987-88 marketing year. AE-Ext. 89-1. Cornell University, Ithaca, New York.

Guenther, E. 1952. The essential oils. Vol. VI. D. Van Nostrand Company, Inc., New York.

Heath, H. B. 1981. Source book of flavors. AVI Publishing Company, Inc., Westport, Conn.

Howell, M., J. J. Combs, S. D. Lincoln, and D. Hinman. 1990. Effects of feeding cull onions to feedlot steers. Progress Report no. 276. Caldwell Research and Extension Center, University of Idaho.

Kirk, J. H, and M. S. Bulgin. 1979. Effects of feeding cull onions (*Allium cepa*) to sheep. American Journal of Veterinary Research 40(3):397-399.

Luh, B. S., and J. G. Woodroof. 1975. Commercial vegetable processing. AVI Publishing Company, Inc., Westport, Conn.

Miles, W. S., and B. D. Quimby. 1990. Characterization of sulfur compounds in spices using SFE-GC-AED. American Laboratory 22(11):28F-31F.

Rizvi, S. S. H., J. A. Daniels, A. L. Benado, and J. A. Zollweg. 1986. Supercritical fluid extraction: Operating principles and food applications. Food Technology 40(7):57-64.

Schermerhorn, R. W., and L. D. Makus. 1987. Economics feasibility studies for agribusiness firms. University of Idaho Extension Bulletin 675. University of Idaho College of Agriculture, Moscow.

Appendix
Onion products contacts

(Current as of 1990)

Public sector contacts

ZaDean Auyer, Malheur County Economic Development Coordinator
251 B Street West #7
Vale, OR 97918 503-473-5177

Dianna Barrett, Chemist
Oregon State University
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Greg Pettit, Water Quality
Department of Environmental Quality (DEQ)
Northwest Regional Office
Portland, OR 503-229-5878

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148 Plant Science Building
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John Fellman, Postharvest Physiologist
Department of Plant, Soil and Entomological Sciences
University of Idaho
Moscow, ID 83843 208-885-6618

Joe Guenthner, Agricultural Horticulturist
Department of Agricultural Economics and Rural Sociology
University of Idaho
Moscow, ID 83843 208-885-6056

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Chico, CA 95929-0310 916-898-5844

Larry Makus, Agricultural Economist
Department of Agricultural Economics and Rural Sociology
University of Idaho
Moscow, ID 83843 208-885-6037

Lois Nadolny
Plant Industries Division
Idaho State Department of Agriculture
Box 790
Boise, ID 83701 208-334-2986

Kelly Olson, Marketing Specialist
Idaho State Department of Agriculture
Box 790
Boise, ID 83701 208-334-2227

Clint Shock (Onion storage research)
Superintendent, Malheur Experiment Station
Onion Ave.
Ontario, OR 97914 503-889-2174

Mike Thornton, Extension Crop Management Specialist
Parma Research and Extension Center
29603 U of I Lane
Parma, ID 83660 208-722-6701

Onion oil contacts

Alcosa (Processing plant for onion oil)
Victor Manuel Vasquez
Irapuato Gto., Mexico 011-52-462-62075

American Spice Trade Association
Tom Burns, Executive Director
New Jersey 201-568-2163

Kalsec, Inc. (Company that purchases onion oil)
Walt Bowers
P.O. Box 511
Kalamazoo, MI 49005 616-349-9711

Flavor and Extract Manufacture Association (FEMA)
1620 I Street NW, Suite 925
Washington, DC 20006 202-293-5800

Specialty Seeds of Oregon (Garlic oil manufacturer)
Bob Griffin
P.O. Box 410
Culver, OR 97734 503-456-2801

Sam Haddad (Retired Chemist from OreIda)
Onion oil investigation
Ontario, OR 97914 503-889-9500

Hopstract (Firm using SFE)
Gerald Savory, General Manager
Yakima, WA 509-248-1530

Mt. Jefferson Farms (Onion oil equipment)
Rob Miller (Conducted pilot onion oil project)
Salem, OR 503-363-0467/503-363-0632

Frozen onions contacts

Appleton Produce Company
P.O. Box 110
Weiser, ID 83672 208-549-1102

Dickinson Frozen Foods, Inc.
Dennis Dickinson, President
P.O. Box 1010
Fruitland, ID 83619 208-452-5200

Northwest Food Processors Association
David Pahl, President
2300 SW 1st Avenue
Portland, OR 97201 503-226-2848

Dehydrated onions contacts

American Dehydrated Onion and Garlic Association (ADOGA)
Diane Leahy
650 California Street, Suite 800
San Francisco, CA 94108 415-392-7077

Basic Vegetable Products
P.O. Box 599
Vacaville, CA 95696 707-864-4518
or San Francisco, CA 415-981-5590

Gilroy Foods
1350 Pacheco Pass Highway
Gilroy, CA 95250 408-847-1414

Oregon Dehydration
Mitch McClannahan, General Manager
P.O. Box 1076
Umatilla, OR 97882 503-922-5055

Fresh onion concerns

Idaho-Eastern Oregon Onion Committee (IEOOC)
Larry Link, Executive Director
P.O. Box 307
Parma, ID 83660 208-722-5111

Idaho-Eastern Oregon Onion Committee (IEOOC)
Noble Morinaka, Chairman
P.O. Box 307
Nyssa, OR 97913 503-372-2889

Murakami Produce Company (Onion packing and shipping firm)
Grant Kitamura, General Manager
Box 9
Ontario, OR 97914 503-889-3131

National Onion Association
Wayne Mininger, Executive
Suite 510, Greeley National Bank Plaza
Greeley, CO 80631 303-353-5895

J. C. Watson Co. (Shipper)
John Watson
P.O. Box 300
Parma, ID 83660 208-722-6646

Cull onion feed contacts

Dan Hinman, District Director
(Worked on using onions in silage)
Caldwell Research and Extension Center
16952 South 10th Avenue
Caldwell, ID 83605 208-459-6365

Mike Howell, County Chairperson
(Investigating the use of cull onions as feed)
Oregon State University
710 SW 5th Avenue
Ontario, OR 97914 503-881-1417

Cull onion land disposal and composting

Lynn Jensen, County Extension Agent
(Investigating the disposal of cull onions on land)
Oregon State University
710 SW 5th Avenue
Ontario, OR 97914 503-881-1417

Phoenix Industry, Inc.
Art Krenzel (Proposed compost pilot project)
37612 KGAL Drive
Lebanon, OR 97355 503-258-7008

Darryl Warncke (Worked on cull onion disposal)
Plant and Soil Science Building
Michigan State University
East Lansing, MI 48824 517-335-0210

Ethanol production

J. R. Simplot, Inc.
Dave Kueneman, Ethanol Facility Manager
Caldwell, ID 83605 208-454-4351

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