

**Department of Agriculture, Trade and Consumer Protection  
Division of Agricultural Development  
Agricultural Development & Diversification Program (ADD)**

**Grant Project Final Report**

Contract Number: 19041

Grant Project Title: Marketing Potential of Overlooked Fruit Crops

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## ***ORIGINAL INTENT OF THE GRANT***

Intent of the grant was to evaluate market acceptance of new, unusual and overlooked fruit crops from around the world. This was a continuation of on-farm research that has been evaluating the horticultural adaptability of over 40 fruit types. The ultimate goal was to determine feasibility and establish guidelines for the production and marketing of new food products that would add value and diversity. A broader complement of Wisconsin agricultural food products could justify investment in a local-regional infra-structure and distribution system needed to meet consumer demand for local-regionally produced foods.

The intent was to demonstrate how profitability and investment in Wisconsin agriculture could be accomplished by diversification and expanded marketing opportunities based on a wider range of consumer ready food items. Public information and outreach has been a significant part of this project. This long-term continuing project was initiated to support and expand a sustainable regional food systems approach. The demand for more locally produced food items has the potential to benefit Wisconsin agriculture by diversifying risk, increasing profitability and creating new agriculturally related job opportunities in our rural areas. In fact, the take home messages from this project will go a long way toward achieving DATCP's objectives in the Buy Local, Buy Wisconsin initiative.

## ***STEPS TAKEN TO ACHIEVE PROJECT GOALS***

Steps taken to achieve project goals were as diverse as the project goals themselves. In order to address risk management, horticultural screening was an on-going process. In order to assess potential return on investment, product development and consumer acceptance was a major component. Public information and outreach efforts were required to bridge the gap between potential producers and potential consumers.

All three components (horticultural screening, testing consumer acceptance and information outreach) were highly successful because of networking and a team approach. There were of course, challenges. Time and financial resources limited detailed documentation on horticultural screening, but much anecdotal information was collected. Limited amounts of product and the inefficiencies of hand harvesting and preparation, along with arranging taste-

testing sessions with a diverse group of potential consumers was very time consuming. We were very fortunate to have the consultive services of the Center for Integrated Agricultural Systems of UW-Madison for public information and outreach. Information on our team approach and a listing of some key team members who contributed to the success of this project is provided in the original grant proposal.

In retrospect, we probably would not have done anything differently because all information gathered has value. We could have reduced the workload by concentrating on the fruit types that initially stood out, but there was a risk of overlooking potential that was not immediately apparent.

## ***ACCOMPLISHMENTS***

### **Horticultural Screening**

Horticultural screening of uncommon and little known fruit crops from around the world has identified at least 15 fruit species that adapt well to regional growing conditions. This is an on-going evaluation. Un-adapted types are being removed and replaced by a wider range of specific cultivars of adaptable types. Other potential fruit crops will be screened for horticultural adaptability as they become available.

The results of this phase of our research are summarized in two fact sheets published by the CIAS at UW-Madison. See the public information and outreach section of this report.

We have determined that Aronia, Elderberry, European Black Currants and Sea Berry are adaptable and can be sustainably grown in Wisconsin. These also show great marketing potential and should be researched for commercial production protocol with an emphasis on regional marketing. Because of their vast value added potential beyond the farm gate, regional processing and distribution could add significant investment and job opportunities for agriculturally related industry in rural areas of Wisconsin.

We have also found that Aronia/Mountain Ash cross, Gooseberry, Red Currant, Russian Quince and Saskatoon show potential, but require further testing. Other fruits that show promise include a variety of stone fruits, especially plums, along with Cornelian Cherry, Honeyberry, Highbush Cranberry and Mulberry.

### **Product Development and Testing**

All four of the most adaptable fruit types (Aronia, Elderberry, European Black Currant and Sea Berry) are producer friendly and have very high dietary value. All have high vitamin and mineral content and contain vast amounts of anti-oxidants, essential oils and other nutraceutical components. None have universal fresh market appeal and will require some degree of processing to achieve marketing potential based on their high nutritional value. While this may be a disadvantage in a direct marketing system, it is actually an advantage in a regional marketing system. Freezing, drying and preserving add value and will make those food items available year around which greatly increases consumption and sales volume. Other locally and regionally produced agricultural products could benefit from a value-added regional infrastructure. Capacity to accommodate other agricultural products would increase investment and job opportunities in rural areas.

To evaluate marketing potential, several approaches were used with very encouraging results. One approach was to work with a group of graduate students at UW-Madison, Department of Food Science. This group, which has won past awards in national competition for innovative product development, accepted the challenge of finding unique value added uses for the most unusual and sustainable test fruits (Aronia and Sea Berry). One product they perfected was flavored teas made from the skins of these fruits. Their other emphasis was to develop fruit chips using the juice. The result was a vibrantly colored series of chips that were visually attractive and eye catching (Sea Berry-bright yellow; Aronia –deep purple; Combination-violet), highly nutritious and flavorful. Test quantities were very limited, but the 15 or so people who had the opportunity to sample them were extremely impressed.

The Product Research Report prepared by Rachel Prosocki, Research Assistant, Department of Food Science (UW-Madison) is attached as an appendix to this final report. The report, titled

“Exotic Aronia and Sea Buckthorn Chips”, does not include specific formulation and recipe information. This information can be provided on a discretionary basis.

Another approach to product development was to blend pure juice from these unusual fruits with plain yogurt. The resulting yogurt drinks (very similar to Kefirs), exhibited the flavors of the unusual fruits. We soon teamed up with Sugar River Dairy who provided the yogurt and experimented with a blended yogurt and a fruit on the bottom version. These later attempts resulted in a very flavorful product, but will require more research to perfect consistency. The preliminary collaborative work with Sugar River Dairy, has shown an exciting potential for new product development that could further support both our dairy and commercial fruit industries. These unusual flavors could be used in ice cream, milk and cheeses, as well as yogurt products.

A third approach to product development was to experiment with a series of jams, jellies, sauces and syrups. Smaller amounts of fruit were required, so we could expand our efforts to include other unusual fruits including: Gooseberry, Gumi, Medlar, Quince, and Saskatoon. For taste testing and educational outreach, we developed rating sheets for public comment on both jams and jellies and the fruit/yogurt drinks previously mentioned. These are included in the appendix section of this final report.

In a series of seven taste testing events (often in conjunction with other public outreach opportunities) we were able to get feedback from nearly 150 people. This does not include feedback from events not hosted by Carandale Farm, such as the Dane County Dairy Breakfast, where yogurt drink products were hosted by Sugar River Dairy and the Family Farmed.org EXPO in Chicago, where CIAS staff shared unusual jellies and yogurt drinks with participants.

Results of these taste-testing events were very positive. Of those who filled out the rating sheets, 77 percent rated the Sea Berry yogurt drink as very good or excellent. Seventy-five percent rated the Black Currant and 60 percent the Aronia in this category (very good or excellent).

It should be noted that about half of the total participants filled out rating sheets. A couple of events took place before rating sheets were used, and at some events it was difficult to make the rating sheets readily accessible to participants. With the number of events and diversity of participants, we feel that the final results are quite representative of the general public.

We did not attempt to analyze the jam and jelly rating sheets because we did not have a full contingency of products available at every tasting event. Anecdotally, the top four (Aronia, Black Currant, Elderberry, and Sea Berry) got high ratings, but, Gooseberry, Quince, and Saskatoon, were not far behind.

### **Public Information and Outreach**

A significant amount of time and effort has gone into education and outreach regarding this project. We have had receptive audiences ranging from consumer groups, producers, prospective producers, service organizations, food security advocates and government employees. From December 6, 2006 through August 17, 2007, we attended and/or organized 16 events where we provided information, made presentations and conducted consumer product sampling. A listing of the outreach effort is included in the appendix section of this report.

Most notably, in addition to educating the general public, we have created interest with producers about the commercial potential of some of these new fruit crops. As a direct result of a presentation made to the Agri-ventures group (a group of prominent farmers and others interested in agricultural issues), one family farm operation has planted 2500 Aronia plants and plan to plant another 2500 plants as early as the fall of 2007 for a seven acre commitment.

An IPM Field Day was held at Carandale Farm on August 17, 2007 and featured a tour of the test plot. The field day was sponsored by the Wisconsin Berry Growers Association (WBGA) with financial support from CIAS. The attendees, (who are growers of conventional fruit crops), expressed a great deal of interest in the sustainability and grower friendliness of some these unusual fruit crops.

Public information and outreach activities have had support from both the Dane County Extension Service and the Center for Agricultural Systems (CIAS) of UW-Madison. CIAS has provided a significant amount of consultive services for publication, review and promotion including sponsoring a taste-testing event at the Family Farmed. org. EXPO, held in Chicago on March 23-24, 2007. The Center's Eco-fruit project underwrote the August 17 Field Day by \$500 through a USDA Special Projects grant.

The most visible service provided by CIAS is the publication of two fact sheets. "Uncommon Fruit Crops with Sustainability Potential" was prepared for producers and highlights the economic and marketing potential of eight unusual and little known fruit crops. This was the primary handout for the August Field Day and will be used extensively when talking to potential producers.

The second fact sheet, "Uncommon Fruits at Carandale Farm", provided by CIAS, is primarily an education tool and highlights the four most promising unusual fruits (Aronia, Elderberry, European Black Currant, and Sea Berry). It is consumer and marketing oriented with more information about nutritional value and culinary use. It also provides background information about Carandale Farm and the fruit trial. This will be used for public outreach and made available to consumer groups through community service organizations and other venues such as the Food for Thought Festival and the Dane County Food Council.

Both fact sheets are included in the appendices section of this final report and can be downloaded individually from the CIAS website at [www.cias.wisc.edu](http://www.cias.wisc.edu)

## ***CONCLUSIONS***

The introduction of unusual fruit crops that contribute to the health, welfare and well being of consumers, and can be profitably grown in an environmentally sustainable way, will become the cutting edge for developing a regional marketing system. Diversity is the strength of Wisconsin agriculture. Results of this project demonstrate that we can add to that strength. With political will and entrepreneurial leadership, Wisconsin can be the leader and model in

the local foods movement. For more details about the regional marketing concept, see “Why a Regional Marketing System” in the appendix section of this report.

### ***FUTURE PLANS***

As time and resources allow, we will continue to research commercial production protocol, gather sustainability data from the test plot, and share our acquired knowledge with perspective growers. We may establish a demonstration planting and experiment with an agri-forestry concept to take advantage of symbiotic relationships among plant species that enhance sustainability. This is a retirement project and we do not intend to make large commercial plantings ourselves. Our objectives are threefold: 1) to acquire and share knowledge so other growers can minimize risk and maximize profitability; 2) to contribute toward the feasibility of establishing infra-structure for a system that can make locally-regionally produced foods more readily available; and 3) promote a sustainable future for humanity.

### ***ENTERPRISE DEVELOPMENT***

This project has brought a visionary concept to the threshold of practical implementation. Crossing the threshold will open up new opportunities for Wisconsin agriculture and help define a national trend toward a more responsible approach toward food delivery systems. The basic knowledge and physical resources exist, but the first tenuous steps across this threshold will require political will, entrepreneurial vision, leadership and risk tolerance.

Our observations are that the consuming public are anxious for the agricultural community to cross the threshold and that “Ag in the middle” producers will welcome alternative cash flow opportunities. The biggest obstacles appear to be policy geared toward corporate interests, bureaucratic inflexibility and resistance to change.

### ***RELEVANCE FOR THE AGRICULTURAL INDUSTRY***

The agricultural industry should embrace the opportunity for more diversity. The industry should support a local/regional marketing concept that puts greater emphasis on community development and keeps wealth at the community level. They should advocate for policy changes that allow flexibility and greater decision-making authority at the local/regional level.

They should also promote product development and marketing research appropriate for a regional sales approach.

## ***APPENDIX***

Numerous papers and reports were written as separate stand-alone documents during the course of this grant. To keep the final report concise, the most relevant documents are mentioned by reference in the report narrative and are included in their entirety in this section of the report.

### **Contents:**

*Exotic Aronia and Sea Buckthorn Chips* by Rachel Prosocki, Research, Assistant, Department of Food Science, UW-Madison

*Uncommon Fruit Crops with Sustainability Potential* by Dale Secher, Carandale Farm, and the UW-Madison Center for Integrated Agricultural Systems

*Uncommon Fruits at Carandale Farm* by Dale Secher, Carandale Farm and UW-Madison Center for Integrated Agricultural Systems

*Why a Regional Marketing System* by Dale Secher

*Rating Sheets* (for taste testing of unusual fruit products) by Cindy Secher, Carandale Farm

*A listing of Outreach Activities from December 6, 2006 through August 17, 2007*

# *Exotic Aronia and Sea Buckthorn Chips*

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**PRODUCT RESEARCH CONDUCTED  
FOR CARANDALE FARM**

*Financial support provided by the Wisconsin Department of Agriculture  
ADD Grant No. 19041*



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*By Rachel Prosocki*

## **INTRODUCTION**

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Consumers crave exotic and distinct flavors that open the window of innovation to marry new, gourmet seasoning combinations in chips. *Seaberry* and *Aronia* chips flavored with spices (*Seaberry* barbeque/honey mustard and *Aronia* black peppercorn/red wine/vinaigrette) have a unique mouth-watering taste and crunchy texture consumers look for in a great snack. These fruit chips combine the natural taste and vibrant colors of an exotic juicy fruit with the health benefits associated with aronia's high antioxidant capacity and seaberry's high vitamin C content.

### **Why Aronia and Seaberry?**

Consumers are increasingly becoming more aware of how important their diet is to their health and are looking for new ways to incorporate foods with added nutritional benefits to their diets, including vitamin and antioxidant rich foods. Aronia and sea berries offer tremendous nutritional and health benefits.

The Aronia berry, also known as chokeberry, has all of the healthy attributes of the cranberry, and in addition contains five to ten times the amount of anthocyanins and polyphenols of a cranberry. Anthocyanins are known for their link to a multitude of health benefits including antioxidant, anti-inflammatory, antiviral, antibacterial and anticarcinogenic activity. They also have the highest concentrations of antioxidants out of all berries (Zheng and Wang, 2003).

Seaberry, also known as sea buckthorn, is valued for its golden-orange fruits which provide vitamin C, vitamin E, flavonoids, oils rich in essential fatty acids and other healthful components. Sea buckthorn has been shown to have a potent antioxidant activity, mainly attributed to its flavonoids and vitamin C.

## **MARKET TRENDS AND POTENTIAL**

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The snacking industry overall is a \$40 billion annual market (Mintel International Group Ltd., 2003). Driven by innovation and changes in consumers' eating habits, more Americans revert to snacking as a daily means of eating as opposed to an occasional activity. American consumers eat four or more snacks a day and consume more than 6.5 billion pounds of snack food annually

(International Group Ltd., 2006). Salty snacks account for slightly over half the total snack sales and are consequently a large part of the American diet. The overall salty snack category was up 2% in 2004 (IRI, 2006). As consumer's desire for new flavors, textures, tastes, convenience and nutrition grow, the chip category will continue to drive growth in the total snacks category.

*Seaberry* and *Aronia* chips will be well received by consumers since they follow several global food trends (Food Technology, 2005):

1. Quick, small fix
2. Inherently healthy foods
3. Layered flavors, especially containing exotic fruits

**Trend #1:** Convenience continues to be a major purchasing factor for snacks. It is not only influenced by the packaging, but the shapes of the snacks as well. *Seaberry* and *Aronia* chips are cut in oval shapes and will be available in single and multiple serving packages. The expansion of new portion controlled snacks and mini sizes are becoming increasingly popular. (IRI, 2006). Some of the snack segments posting real gains were reduced sugar, natural, premium specialty products, unique forms and products addressing gourmet nutrition—smaller but satisfying portions of high quality snacks.

**Trend #2:** Consumers are opting for natural goodness and increasing their consumption of products they consider healthy. In terms of health, interests in salty snack products that are organic or all natural, low-calorie, low-fat, low-sodium or offer health-promoting benefits such as the elimination of trans fat are in greater demand by consumers. *Seaberry* and *Aronia* chips utilize fruit juice that is grown organically and offer low-fat, low sodium, cholesterol free and trans fat free nutritional claims. Health oriented, brightly colored chips containing real fruit juice for kids will surely be an attention getter. “Baked not fried” will also attract consumers who don't like the greasy hands and high fat content associated with traditional potato chips.

**Trend #3:** Although consumers are interested in healthier snack products, they are not willing to sacrifice flavor. Intense and full-flavor snacks remain an important trend in the salty snack market. The layered *Aronia*-black peppercorn chips provide a unique sweet berry flavor uniquely balanced with a touch of spice. The barbeque-*Seaberry* chips combine a sweet orange-like fruit with a sweet and spicy barbeque flavor.

## COST ANALYSIS

The total ingredient and variable costs associated with the fruit chips are estimated to be \$0.66 per retail canister (Table 1). The chips will be sold to distributors at \$1.40 per carton. The suggested retail price of the product will be \$2.30 per canister containing three servings (~84 g).

**Table 1.** Variable costs per container of fruit chips.

Variable Costs	Cost/canister (US\$)
Ingredients	0.23
Packaging	0.10
Waste	0.03
Labor	0.15
Utilities	0.07
Distribution	0.08
<b>Total</b>	<b>0.66</b>

## NUTRITION

One serving of sea berry chips will help meet consumer's dietary needs by providing more than 10% of the daily value for vitamins A, E and C. The nutrition information for each type of chip can be seen below. It is important to note that the nutritional analysis for the aronia juice in the aronia chips was estimated using values for unsweetened cranberry juice. Similarly, the nutritional analysis for the sea berry juice was estimated using the values for raw orange juice. These alternative juice values were used due to the lack of nutrition information available for sea berry and aronia juice. Orange juice was selected on the basis of having a similar citrus taste, consistency and pH to sea berry juice. Orange juice is also high in vitamin C like reported values seen in sea berry juice. Cranberry juice was selected to estimate aronia juice due to its high antioxidant capacity, tart and astringent taste and similar pH.

<b>Nutrition Facts</b>	Amount/Serving	% Daily Value*	Amount/Serving	% Daily Value*
	<b>Total Fat</b> 1g		2%	<b>Total Carbohydrate</b> 17g
Saturated Fat 0g		0%	Dietary Fiber 0.5g	1%
<b>Cholesterol</b> 0mg		0%	Sugars 8g	
<b>Sodium</b> 160mg		7%	<b>Protein</b> 1g	
• Vitamin A 15% • Vitamin C 3% • Vitamin E 4% • Calcium 10% • Iron 2%				

Serving Size: 28 g (1 oz)  
Serving Per Container 3  
Calories 80  
Calories From Fat 10  
\*Percent Daily values are based on a 2,000-calorie diet.

**INGREDIENTS:** ARONIA JUICE, SUCROSE, RICE FLOUR, CAKE FLOUR, WHITE CORN MEAL, CORN STARCH, SAFFLOWER OIL, MODIFIED FOOD STARCH, SALT, VANILLA AND SUCRALOSE.

**NUTRIENT CLAIMS:** LOW FAT, TRANS FAT FREE, CHOLESTEROL FREE, GOOD SOURCE OF VITAMIN A AND CALCIUM

<b>Nutrition Facts</b>	<b>Amount/Serving</b>	<b>% Daily Value*</b>	<b>Amount/Serving</b>	<b>% Daily Value*</b>
		<b>Total Fat</b> 1g	<b>2%</b>	<b>Total Carbohydrate</b> 15g
	Saturated Fat 0g	0%	Dietary Fiber 0.5g	1%
	<b>Cholesterol</b> 0mg	<b>0%</b>	Sugars 5g	
	<b>Sodium</b> 1mg	<b>0%</b>	<b>Protein</b> 1g	
• Vitamin A 75% • Vitamin C 230% • Vitamin E 70% • Calcium 7% • Iron 0%				

Serving Size: 28 g (1 oz)  
 Serving Per Container 3  
**Calories** 75  
 Calories From Fat 10  
 \*Percent Daily values are based on a 2,000-calorie diet.

**INGREDIENTS:** SEABERRY JUICE, RICE FLOUR, SUCROSE, WHITE CORN MEAL, CORN STARCH, SAFFLOWER OIL, MODIFIED FOOD STARCH, VANILLA AND SUCRALOSE.

**NUTRIENT CLAIMS:** LOW FAT, TRANS FAT FREE, CHOLESTEROL FREE, LOW SODIUM, EXCELLENT SOURCE OF VITAMIN A AND VITAMIN C

## MANUFACTURE OF CHIPS

The processing of the fruit chips involves four major steps: 1) batter preparation, 2) baking, 3) cooling and 4) packaging. The manufacturing process is designed to produce the fruit chips in an existing continuous baking facility with no major investments. The “baked” chip is preferred over frying because of health concerns associated with deep fat frying. Baking also enhances the crispy texture and maintains the vibrant fruit color.

**Batter Preparation:** The dry ingredients are weighed and added to the mixing tank through a hopper. At the same time, the vegetable oil is metered in to prevent dusting. Fruit juice and vanilla are then added to liquefy the chip batter. The batter is uniformly spread into a thin layer (~0.5 mm) on a non-stick Teflon® coated belt. The belt speed and the dimensions of hopper are continuously monitored to maintain the uniform thickness of the product.

**Baking:** The topping is sprinkled on the batter and the initial baking step is done at 325°C for 7 minutes. This partial baking step produces a uniform sheet that is pliable for cutting. The partially baked chip batter is cut into oval shapes using rolling knives. Rework from this stage is added back to the batter at a 5% level. Cut pieces are baked for an additional 10 minutes at 325°C for the desired crunchy texture.

**Cooling:** The chips are then air cooled and sprinkled with seasoning prior to packaging.

**Packaging:** The crispy chips are stacked and packed in mini canisters (holding 30 chips) made of a rigid recycled paperboard tub (to provide physical protection) with an aluminum foil and polyethylene liner on the inside to provide an excellent oxygen and moisture barrier which preserves the light and crispy texture. The canister has an outer paper liner, a steel base, a top

foil seal and a polyethylene cap. The packaging material for the chips has been selected to deliver the highest quality in terms of taste and safety.

## **ANTIOXIDANT-PHENOLIC ANALYSIS**

### **Total antioxidant capacity**

The total antioxidant capacity of juice and skin extract from fruits were measured by standard ABTS radical colorimetric assay. The antioxidant capacities were reported in gallic acid equivalent (GAE) as a standard compound. The total antioxidant capacity refers to all compounds in juice and skins that have the capacity of quenching free radicals (in this case the ABTS free radicals). These compounds could include phenolic, flavonoids, vitamin C, vitamin E, and other known or unknown compounds in the materials.

### **Total Phenolic Content**

The total phenolic contents in juice and skins were also measured, specifically using phenolic colorimetric assay. This assay only measures the amount of phenolic compounds in the materials but did not measure the antioxidant capacity of these phenolic compounds. Freshly squeezed orange juice was used to compare the total phenolic compounds in it to those in seaberry and elderberry juice. The total phenolic compound content was reported in gallic acid equivalent (GAE) as a standard phenolic compound.

In summary, the ABTS assay gives more qualitative measure of antioxidant power of fruit materials while phenolic assay gives more quantitative measure of total phenolic compounds only in these materials. In other words the value from ABTS assay is somewhat independent of the value from phenolic assay for a particular fruit material.

### **Sample Preparation**

The juice was diluted in appropriate buffer prior to use in a colorimetric assay. Skins of aronia and seaberry were dried and extracted in 80% methanol containing 1% HCl for 2 h at room temperature (Velioglu et. al., 1998). The supernatant was collected after centrifugation. The total antioxidant activity of the juice and skins was determined by the ABTS radical cation decolorization assay (Pellegrini et al., 1999). Samples were analyzed in duplicate and the average results were reported (Tables 2 and 3).

**Table 2.** Contribution of phenolic and antioxidant activity in aronia and sea buckthorn juice.

<b>Fruit Juice</b>	<b>Total Antioxidant (<math>\mu\text{g GAE}</math>)/g of juice</b>	<b>Total Phenolic (<math>\mu\text{g}</math> GAE)/ g juice</b>
Seaberry	1.59	668
Elderberry	3.9	978
Aronia	11.7	N/D
Orange Juice	N/D	274

**Table 3.** Contribution of total antioxidant activity in aronia and sea buckthorn skins.

<b>Dry Skins Extract</b>	<b>Total Antioxidant (<math>\mu\text{g GAE}</math>)/g dry skins</b>	<b>Total Phenolic (<math>\mu\text{g}</math> GAE)/ g dry skins</b>
Aronia	97	N/D
Seaberry	36.4	N/D

N/D- Not Determined

### **TANNIN REMOVAL IN ARONIA JUICE**

Aronia berry juice contains insoluble matter imparting a haze and high astringency to the juice. These undesirable constituents can be removed to achieve a better tasting juice with higher clarity by a process referred to as fining. To achieve higher clarity, two fining agents, bentonite (earth-based) and gelatin (protein) were added in different concentrations individually and together to the aronia juice. The fining agents work by carrying an electrical charge that is the opposite of the particles in suspension. The opposite charges attract and bind to each other resulting in neutralization and absorption. After addition of the bentonite and/or gelatin, a filtering aid (diatomaceous earth) is added to ease the removal of the bound proteins. The juice was then filtered and tasted against a control to observe any differences in astringency of the juice. The concentration of bentonite (500 ppm) and gelatin (100 ppm) with 2% diatomaceous earth had a slight reduction in astringency. The effectiveness of fining is dependent upon the concentration of the fining agent, method of preparation, pH, temperature and juice constituents. Analyses of different concentrations, processing conditions and methods needs to be further explored

### **SUMMARY**

*Seaberry* and *Aronia* chips are the perfect choice for a nutritious and delicious snack at any time of the day for kids and adults. They are conveniently packaged for any busy consumer to grab n' go!

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# Uncommon fruit crops with sustainability potential

Dale Secher, Carandale Farm, and University of Wisconsin-Madison Center for Integrated Agricultural Systems

Carandale Farm has been evaluating 42 unusual fruits since 2003 for environmental, social and economic sustainability. The goal is to find fruits that can be grown easily, without a lot of labor or chemicals. The fruit should be nutrient rich and appealing to consumers. The fruits must provide economic viability for the farm, which can lead to local job opportunities and feed into a cycle of regional development. Carandale owners Dale and Cindy Secher are developing a “short list” of unusual fruits that farmers can grow to develop local markets and local food systems. The Sechers score each fruit on several attributes, shown below starting with the highest ranking fruit. So far, eight fruit crops have rated high in the trials.



<b>Aronia</b> <i>(Aronia melanocarpa)</i>	<b>Economic potential</b>	
	Input requirements	Low
	First harvest	0-1 yr
	Machine harvest potential	High
	<b>Health characteristics</b>	
	Nutraceutical content	☆☆☆
	Vitamin & mineral content	☆☆☆
	<b>Environmental aspects</b>	
	Adaptability	Best
	Pest resistance	Best
	Invasive potential	Native
	<b>Marketing potential</b>	
	Fresh market	No
	Processing versatility	Yes
<b>Cultural information</b>		
Mature height	6'	Sun/shade ☾ ☀
Hardiness zone	3-4	Cultivars tested: Nero, Viking

Aronia is tops for commercial production potential. It is grower friendly with processing versatility and outstanding health benefits. It has good regional adaptability and very good pest resistance. The fruit is firm and has a long hang time after maturity, allowing for a long harvest season.



<b>European Black Currant</b> <i>(Ribes nigrum)</i>	<b>Economic potential</b>	
	Input requirements	Med
	First harvest	1-2 yrs
	Machine harvest potential	High
	<b>Health characteristics</b>	
	Nutraceutical content	☆☆☆
	Vitamin & mineral content	☆☆☆
	<b>Environmental aspects</b>	
	Adaptability	Good
	Pest resistance	Good
	Invasive potential	Low
	<b>Marketing potential</b>	
	Fresh market	No
	Processing versatility	Yes
<b>Cultural information</b>		
Mature height	6'	Sun/shade ☾ ☀
Hardiness zone	4-5	Cultivars tested: Ben Lomond, Ben Sarek, Titania

This fruit may have the highest overall quantities and balance of minerals, vitamins and phytochemicals of any known fruit. An IPM program with minimal pesticides can control diseases. Research and selection will result in pest resistant cultivars.



<b>Sea Buckthorn</b> <i>(Hippophae rhamnoides)</i>	<b>Economic potential</b>	
	Input requirements	Low
	First harvest	2-3 yrs
	Machine harvest potential	?
	<b>Health characteristics</b>	
	Nutraceutical content	☆☆☆
	Vitamin & mineral content	☆☆☆
	<b>Environmental aspects</b>	
	Adaptability	Best
	Pest resistance	Best
	Invasive potential	?
	<b>Marketing potential</b>	
	Fresh market	No
	Processing versatility	Yes
<b>Cultural information</b>		
Mature height	Varies	Sun/shade ☀
Hardiness zone	3	Cultivars tested: Hergo, Leikora, Titan

Sea Buckthorn is grower friendly. Mechanical harvesting could be a challenge, but is not insurmountable. One non-producing male pollinator is required for each 8 high-yielding female plants. This cold-hardy plant tolerates drought, poor soils and even saline conditions. Sea Buckthorn is a nitrogen-fixing shrub with no significant pest issues. Processing potential and health benefits are its keys to marketability.



<b>American Elderberry</b> <i>(Sambucus canadensis)</i>	<b>Economic potential</b>	
	Input requirements	Low
	First harvest	0-1 yr
	Machine harvest potential	Med
	<b>Health characteristics</b>	
	Nutraceutical content	☆☆☆
	Vitamin & mineral content	☆☆☆
	<b>Environmental aspects</b>	
	Adaptability	Best
	Pest resistance	V Good
	Invasive potential	Native
	<b>Marketing potential</b>	
	Fresh market	No
	Processing versatility	Yes
<b>Cultural information</b>		
Mature height	12'	Sun/shade ☾ ☀
Hardiness zone	3	Cultivars tested: Nova, York

American Elderberry is exceptionally grower friendly. It has limited fresh market appeal, but good processing potential. It has excellent health benefits and it is popular as a cold and flu remedy. American Elderberries appear quite pest resistant and could be grown without pesticides with little risk. Bird netting is a must for small plantings. This overlooked fruit has great potential, especially in southern Wisconsin.



<b>Economic potential</b>	Input requirements	Med
	First harvest	3+ yrs
	Machine harvest potential	High
<b>Health characteristics</b>	Nutraceutical content	☆☆☆
	Vitamin & mineral content	☆☆☆
<b>Environmental aspects</b>	Adaptability	Good
	Pest resistance	Good
	Invasive potential	Native
<b>Cultural information</b>	Mature height	Varies
	Hardiness zone	2
	Cultivars tested:	Smokey, Pembine, Parkhill, Honeywood
<b>Marketing potential</b>	Fresh market	Yes
	Processing versatility	Yes

**Saskatoon**  
*(Amelanchier alnifolia)*

Saskatoon is a North American native also known as Juneberry and Serviceberry. Adaptability appears to be cultivar specific, and pest susceptibility is similar to other pome fruits. Nutraceutical content is similar to blueberries. Pest intervention may be required on a commercial scale, although continued breeding and cultivar selection will improve grower friendliness. Saskatoon contains more protein, fat and fiber than most other fruits. Current processing demand is very high.



<b>Economic potential</b>	Input requirements	Med
	First harvest	1-2 yrs
	Machine harvest potential	High
<b>Health characteristics</b>	Nutraceutical content	☆☆☆
	Vitamin & mineral content	☆☆☆
<b>Environmental aspects</b>	Adaptability	V Good
	Pest resistance	Good
	Invasive potential	Low
<b>Cultural information</b>	Mature height	3'-5'
	Hardiness zone	4-5
	Cultivars tested:	8
<b>Marketing potential</b>	Fresh market	Yes
	Processing versatility	Yes

**Red, Pink and White Currants**  
*(Ribes rubrum, R. sativum, R. petraeum)*

While these currants cannot compete with black currants for nutraceutical value, they do rank high compared to other commonly grown fruits. They are the most grower friendly of the Ribes group, and less tart cultivars have fresh market appeal. They are well adapted to this region, are not an invasive threat and pest issues (leaf spot, anthracnose and mildew) can be addressed by using IPM and/or organic practices. Red currants have a clean, crisp taste that adds coloring and tartness.



<b>Economic potential</b>	Input requirements	Med
	First harvest	2-3 yrs
	Machine harvest potential	High
<b>Health characteristics</b>	Nutraceutical content	☆☆☆
	Vitamin & mineral content	☆☆☆
<b>Environmental aspects</b>	Adaptability	Best
	Pest resistance	Good
	Invasive potential	Native
<b>Cultural information</b>	Mature height	3'
	Hardiness zone	4-5
	Cultivars tested:	9
<b>Marketing potential</b>	Fresh market	Yes
	Processing versatility	Yes

**Gooseberries**  
*(Ribes uva-crispa, R. hirtellum)*

Gooseberries are only moderately grower friendly, but are well adapted to Wisconsin. Their unique flavor is good for both fresh eating and processing. While gooseberries have greater disease issues in the test plot than the other Ribes, this can be addressed by proper cultivar selection and continued plant breeding. American gooseberry mildew is the most serious disease and breeding programs have concentrated on developing resistant cultivars. Leaf spot and white pine blister rust are also problems. Gooseberries will require close scouting and occasional disease intervention, either organically or otherwise.



<b>Economic potential</b>	Input requirements	Med
	First harvest	1-2 yrs
	Machine harvest potential	Low
<b>Health characteristics</b>	Nutraceutical content	☆☆☆
	Vitamin & mineral content	☆☆☆
<b>Environmental aspects</b>	Adaptability	Good
	Pest resistance	Good
	Invasive potential	Low
<b>Cultural information</b>	Mature height	22'
	Hardiness zone	4
	Cultivars tested:	Aromatnaya, Kuganskaya
<b>Marketing potential</b>	Fresh market	Yes
	Processing versatility	Yes

**Russian Quince**  
*(Cydonia oblonga)*

Quince is more grower friendly than most other commercially grown tree fruits, but our test varieties are susceptible to fire blight. It is not an invasive threat, seems to have good regional adaptability, blooms late to avoid spring freezes and has demonstrated pest resistance. Quince have fewer carbohydrates and higher nutritional value than apples and are used to add flavor to applesauce. The fruits are dense, firm and aromatic with some fresh market appeal. Fruits are large (nearly one pound each) and bruise resistant. Freezing temperatures may improve texture and long-term cold storage may be possible.

## Carandale's Fruit Trial

Carandale Farm has been growing fruit for over thirty years. During this time, our customers' values have shifted from an emphasis on low prices to a desire for convenient, locally grown, healthy food.

To increase the diversity of locally grown fruit, we have established an extensive on-farm trial to learn what non-traditional fruit crops can be sustainably grown and marketed locally. Our three-acre test plot includes over 500 plants representing over 100 cultivars of 42 fruit crop species. We are evaluating fruit varieties for horticultural suitability, pest and disease issues, marketing potential, and their potential for becoming invasive species.

This trial emphasizes fruits that are known to have or are suspected of having high levels of antioxidants and other compounds that protect against cancer and other diseases—also known as nutraceutical value. Much of this fruit has been used for its health enhancing properties for centuries.

Of the many cultivars and species tested in our plot, Aronia, Elderberry, Sea Berry and European Black Currant (described inside this brochure) show the most promise for sustainable production in southern Wisconsin. Saskatoon, Red Currant, Gooseberry and Aronia-Ash Cross also show potential, but require further testing. Other fruits of interest include Cornelian Cherry, Honeyberry, Russian Quince, Fruiting Rose and Mulberry.



### About Carandale Farm

Carandale farm is the largest and longest established pick-your-own farm in Dane County. We are easy to find, but far enough away that sights and sounds of suburbia are replaced by wildlife, rolling hills and woodlands.

Our mission is:

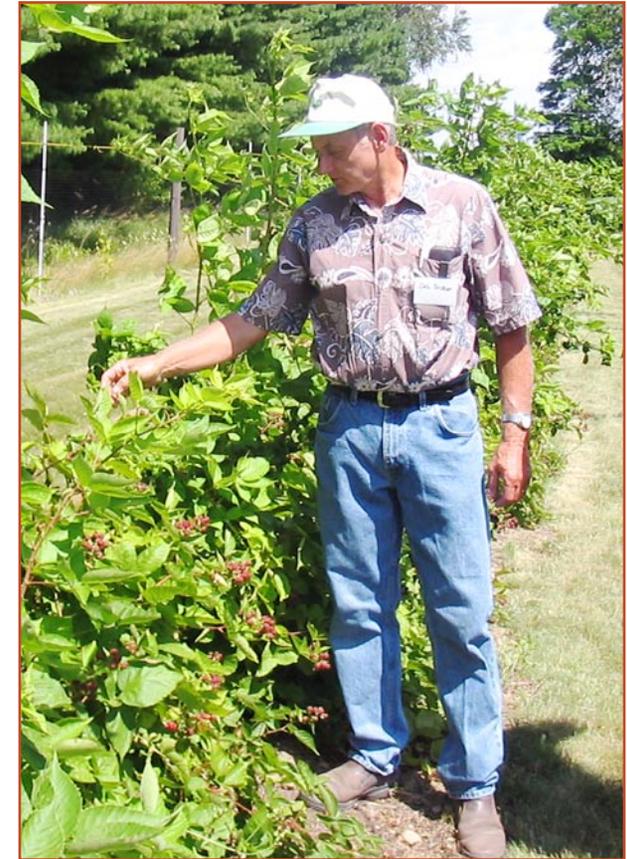
- To provide our customers with safe, nutritious fruit grown in an environmentally conscientious manner,
- To provide a relaxed and friendly atmosphere where people can enjoy a personal experience in a natural setting, and
- To provide our young people with an educational experience and an appreciation of nature.

We use Integrated Pest Management (IPM), which minimizes or eliminates pesticide application through maximizing sunlight, air and water drainage in our fields, removing diseased foliage, planting resistant varieties, and preserving natural predators.

We sell much of our produce right from the farm, both pre-picked and pick-your-own. We also attend the Dane County Farmers' Market. In the fall, we supply apples to several school lunch programs.

For more information about our farm, visit [www.carandale.com](http://www.carandale.com).

# Uncommon Fruits at Carandale Farm



Fruit trials at Carandale Farm were sponsored by an Agricultural Development and Diversification (ADD) grant from the Wisconsin Department of Agriculture, Trade and Consumer Protection.

# Based on our trial, the four most promising fruits are...



**Aronia** (*Aronia melanocarpa*), also known as “chokeberry,” is native to eastern North America. It has been used as an edible landscape plant but virtually ignored as a fruit crop in this country.

Aronia fruit is blueberry sized with a deep purple color. It is extremely

rich in antioxidants, with anthocyanin and flavonoid levels over five times higher than those found in cranberries. Preliminary studies have shown that Aronia may prevent colorectal cancer and cardiovascular disease.

Raw Aronia fruit has an astringent flavor that many people find unpleasant. It is delicious in juice, wine, jam, jelly and baked goods.

The two varieties of Aronia grown in the Carandale test plot have shown a high level of disease and insect resistance. This makes Aronia a good choice for sustainable and organic production.

While the economic potential for **European Black Currants** (*Ribes nigrum*) is virtually untapped in the

United States, 800,000 metric tons of black currants are grown across Europe each year. Black currants were popular here until Congress banned their production in 1911 because they can spread white pine blister rust. This ban



shifted to state jurisdiction in 1966, and Wisconsin, has since legalized production.

Some varieties of black currants have four times the Vitamin C of oranges, twice as much potassium as bananas, and twice the antioxidants found in blueberries. They may protect against Alzheimer’s disease and prevent urinary tract infections.

Black currants are used in juice, jam, jelly, syrup and other products. While they have a somewhat astringent taste, many people enjoy eating them raw.

Although European Black Currants are somewhat disease prone, continued plant selection will result in disease-resistant cultivars.

**Sea berry** (*Hippophae rhamnoides*), also known as sea buckthorn, is grown across Europe and Asia. Other varieties are native to the Himalayas.

This shrub produces orange berries that are rich in Vitamins A, C and E. Sea berries contain more vitamin C per serving than oranges, strawberries and kiwis. The berries are rich in oil that contains Omega-3 fatty acids and is used medicinally in parts of Asia.

Harvesting sea berries is challenging because the fruit is surrounded by large thorns. The branches are often cut off and frozen, as the frozen fruit shakes off easily. This method limits harvesting to once every two years, however. The fruit can also be harvested mechanically, and Carandale Farm is testing different



cultivars for their mechanical harvesting potential.

Sea berry is used in juice, beer, wine, sauces and jam. While the raw fruit is tart, many people find it tasty. The tartness is reduced by frost and cooking.

This shrub exhibits vigorous root growth that can protect against soil erosion. It can tolerate a wide range of soil types, pH, fertility, and moisture.



**American Elderberry** (*Sambucus canadensis*) is native to North America. For centuries, both Native Americans and Europeans have used elderberry to treat colds, flu, and other ailments. Native Americans used crushed elderberry leaves as an insect repellent and crafted flutes from its stems.

The elderberry shrub produces large white flowers and dark purple berries. Elderberries are loaded with antioxidants, specifically the anthocyanins that provide their color. While the flowers and berries are edible, other parts of this plant are toxic if ingested.

Raw elderberries are not particularly tasty, but they are delicious when cooked or dried. The berries are used in baked goods, preserves, juice and wine.

The elderberry shrub tolerates both cold and drought, grows in most soil and drainage conditions, and resists diseases and pests, which makes it a good addition to organic and sustainable farming systems.

## WHY A REGIONAL MARKETING SYSTEM?

Dale D. Secher

December 18, 2006

A regional marketing system could address seemingly different issues that have resulted from emphasis on a highly centralized system. One issue is the lack of social and environmental sustainability including poor nutritional quality and environmental pollution that has contributed to increased health care costs. The other is the loss of “family farms” (ag in the middle) that provide the basis for rural economies and land stewardship for a sustainable agricultural future.

### What would be the specific goals?

1. A short supply chain which would
  - a. Maintain the superior nutritional qualities of locally grown and processed foods
  - b. Eliminate (or reduce) the need for chemical additives
  - c. Maintain accountability between producer and consumer
  - d. Give producers a more equitable share of the food dollar
2. To keep more income flow in the local economy
  - a. Stimulate the local economy (provide jobs, capital investment, need for services)
  - b. Increase the multiplier effect of the food dollar within the community
3. Reduce environmental impact
  - a. Lower greenhouse emissions associated with transportation
  - b. Lower point source pollution associated with processing, etc.

### What would be the characteristics?

1. Be able to handle significant amounts of agricultural products in an economically efficient manner.
2. Encompass an area demographically large enough to have a consumer base that would support investment in infrastructure.
3. Be geographically large and diverse enough to support production needs for the entire spectrum of agricultural products.
4. Be geographically small enough to maintain a sense of local identity (this is a value-added feature in itself) and to minimize the environmental impact of distribution.
5. Some processing could be multi-regional to have economic efficiency and supply product to more than one region and still meet the general criteria outlined above.

### How would it benefit Ag in the middle?

Mid-sized family farms continue to decline due to economic uncertainty and over-dependence on farm subsidies. They can benefit from the bottom-up demand for more local/regionally produced food because they are the ones that have the resources, dedication and potential management skills to support an alternative local/regional marketing system. They would not have to invest in major start-up costs, could continue current farming practices as desired and access additional income flow with minimal additional investment.

### What are the challenges?

There are three major components. The first is supply. Supply could be provided by tapping into the resources and management skills of Ag in the middle in addition to those direct marketers who are capable and willing to take the next step in supplying local foods. The challenge will be to demonstrate financial sustainability, reduce risk, and provide technical support. This will require state and local resources for education, training, loans, grants, business planning and perhaps tax incentives.

The second is the need for infrastructure and/or strategic partnerships (sometimes referred to as value chains) for processing, storage and distribution. This will be required to supply a continuous, uniform, reliable, consumer ready product stream that will meet consumer, institutional and wholesale demand. This is the most challenging component. It will require an in-depth analysis to determine specific needs encompassing the entire spectrum of agricultural products. There may be a need for incentives to expand existing facilities and create new ventures. Financing and management could be accomplished in different ways. Private entrepreneurship should be encouraged, producer cooperatives may be a good option and even quasi-public ownership is a possibility. Start-up risks may have to be underwritten by public entities. The third component is to assure consumer demand of local/regionally produced foods that this system could provide. The latent desire for an economically and socially sustainable food system is virtually untapped. The challenge will be to educate the buying public about the many social and environmental benefits of purchasing local agricultural products. When people fully understand the true cost of food in terms of health, social justice and environment, Demand could easily support what a local/regional marketing system could provide even with a price premium to offset the short-term economic benefits of scale enjoyed by the industrialized system. State and local agencies and non-governmental organizations will play an important role in education and outreach.

# RATING SHEET FOR YOGURT DRINKS

We would like your comments about the fruit/yogurt drinks. Please rate according to taste for potential marketability. Thank you.

<i>PRODUCT</i>	<i>POOR</i>	<i>FAIR</i>	<i>GOOD</i>	<i>VERY GOOD</i>	<i>EXCEL</i>	<i>COMMENT</i>
<b>ARONIA</b> YOGURT DRINK						
<b>BLACK</b> <b>CURRANT</b> YOGURT DRINK						
<b>SEA</b> <b>BERRY</b> YOGURT DRINK						

## RATING SHEET FOR JAMS/JELLIES

We would appreciate your comments about the jams/jellies. Please rate according to taste for potential marketability. Thank you.

<b>PRODUCT</b>	<b>POOR</b>	<b>FAIR</b>	<b>GOOD</b>	<b>VERY GOOD</b>	<b>EXCELLENT</b>	<b>COMMENTS</b>
<b>ARONIA JAM</b>						
<b>ARONIA JELLY</b>						
<b>ARONIA-ASH JELLY</b>						
<b>BL CURRANT JAM</b>						
<b>BL CURRANT JELLY</b>						
<b>ELDERBERRY JELLY</b>						
<b>GOOSEBERRY JAM</b>						
<b>GUMI JELLY</b>						
<b>MEDLAR JELLY</b>						
<b>SASKATOON JAM</b>						
<b>SEA BERRY JELLY</b>						

***A listing of outreach activities from December 6, 2006 through August 17, 2007 follows:***

December 6, 2006-- made a presentation to the Agri-Ventures group consisting of progressive farmers and agri-business representatives. Prepared a handout.

January 4, 2007—attended the Wisconsin Local Food Summit at Stevens Point, WI. Participated in group discussions about local food systems.

January 7-9, 2007—Attended the Wisconsin Fresh Fruit and Vegetable Conference at Oconomowoc, WI. Networked with other growers to promote interest in alternative fruits.

January 31, 2007—met with Bill O'Brien and Dale Nelson (O'Brien Seeds) to discuss Aronia as an alternative crop. The Agri-Ventures presentation had sparked their interest.

February 8-9, 2007—Participated in the Citizen's Advisory Committee (CAC) meeting with CIAS staff and associates. Conducted taste testing and presented poster display which became the basis for two fact sheets.

February 13, 2007—Cindy conducted a taste testing event for teachers at Lapham Elementary School, Madison, WI

February 17, 2007—Made presentation at West Waubesa Coalition meeting held at the Promega Center in Fitchburg, WI. Prepared handout material.

February 28, 2007—Made presentation and conducted a taste testing event during a brown bag lunch for DATCP employees.

March 2, 2007—Did a taste testing event in conjunction with a soft fruit production workshop that I conducted at the Michael Fields Institute at East Troy, WI.

March 7, 2007—Participated in Madison Public Market meeting held at West Madison Agricultural Research Station, spoke in behalf of grant objectives for regional marketing opportunities.

March 8, 2007—Conducted taste testing event during and eco-berry questionnaire session held at DATCP.

March 12, 2007—Made presentation and conducted a taste testing event for the Dane County Extension Staff.

March 13, 2007—Made a presentation to the Oregon, WI Rotary Club. Invitation was by one of the Agri-Ventures attendees.

March 23-24, 2007—Taste testing conducted by CIAS staff during the Family Farmed.Org Expo held at the Chicago Cultural Center.

March 26, 2007—Presentation and taste testing at the “Planting Seeds for our Future” conference sponsored by the Dane County Food Council and held at the Alliant Energy Center, Madison, WI. Sugar River Dairy and Carandale Farm provided Black Currant and Aronia yogurt for more than 100 attendees during lunch. Prepared hand out material.

April 14, 2007—Conducted a roundtable discussion during the “Future of Farming and Rural Life in Wisconsin” statewide conference sponsored by the Wisconsin Academy of Sciences, Arts and Letters. Prepared handout material.

June 9, 2007—Sugar River Dairy introduced Aronia and Sea Berry yogurt drink for participants at the Dane County Dairy Breakfast.

August 17, 2007—Hosted Unusual/Minor Fruit Crop IPM Field Day at Carandale Farm. Networked with potential growers of unusual fruits and provided Aronia, Sea Berry, Black Currant, and Elderberry yogurt drinks as well as various jellies for taste testing.