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I. INTRODUCTION

The University of Saskatchewan, Plant Sciences Department operates one of the few publicly funded fruit breeding stations in the world for climatic zones 2b and colder. The others are in Northern Asia/Siberia. The Horticulture Science field plots, administered by the Department of Plant Sciences, covers 22 acres and includes collections of apples, dwarf sour cherries, pears, plums, hazelnuts, blue honeysuckles, sand cherries, cherry plums, three species of currants, raspberries, strawberries, sea buckthorn and roses (for rose hips). Also, there are various native fruit species such as saskatoon berries, chokecherries, pin cherries, high bush cranberries and buffalo berries.

Part of the strategic plan for the Domestic Fruit Program is to emphasize value added processing and to include as much as possible interested growers and processors in this research. With assistance from co-operators, the Domestic Fruit Program can evaluate large populations of seedlings and can select new cultivars much more efficiently than conventional breeding programs. The cooperating growers also benefit by learning cultural techniques and by selecting cultivars specifically well adapted to their production systems and sites.

II. EXECUTIVE SUMMARY

This project emphasized value-added processing and the selection of superior genotypes for processing needs. Previously, the fruit breeding program at the University of Saskatchewan based its selection criterion almost solely on fresh fruit when doing fruit quality evaluations. While cherries were emphasised in major experiments each year, numerous small experiments were conducted that gave insight into many aspects of fruit processing. Cherries were emphasized because of their emerging importance in the prairie fruit industry and that they are mainly a processed crop. Much processing research on Saskatoons had already been done by the discontinued Native Fruit Program. Experiments on Saskatoons, apples, plums, sea buckthorn, raspberries, strawberries and other fruits were also done.

It was assumed that at harvest time, fruit processors would not have the time to immediately process all their fruit fresh from the field. Rather, growers and processors are most likely to freeze their produce until time for secondary processing. Therefore, in this study, frozen fruit was used in processing research. Mostly, fruit was frozen in containers without sugar being added and some fruit was individually quick frozen (IQF). The main cherry experiments investigated juice in 2003, dried fruit in 2005, and canned fruit in 2006. Superior genotypes from our breeding program were identified those 3 areas. In general, it was found that when juice is made from frozen fruit, the juice has more intense colour probably due to each cell in the fruit being disrupted and more pigment being released. The skin of some cherry varieties cracked or greatly weakened when frozen. When subsequently dried, these cracks peel outward, resulting in an oddly angular sticky 'raisin'. Other selections did not have disruption of the skin and these fruit dried with their skins intact and were similar in texture to commercial raisins. When canned, some selections became quite mushy while others remained firm. When fresh and frozen fruit were both canned and compared, it was found frozen fruit was firmer, fruit colour was lighter, but juice colour was darker. Apparently, heating fruit during the canning process is not as effective as 'freezing plus canning' for causing the release of pigmentation. When the fruit from such experiments was distributed for testing, it was a common remark that our cherry products were superior to any cherries commonly found in North America. Tasters from Europe often commented that our cherries were just as good as those from their homelands.

Other value-added experiments included: vodka and fruit, brandy and fruit, cherry sausage, smoked and marinated buffalo, cherry pit flour, candy bars, blending fruit, freeze dried saskatoon berries, skin damage of frozen saskatoon berries, pitting efficiency of cherry fruit, pitting sandcherries, sea buckthorn-banana wine, oil content of *Prunus* species with emphasis on chokecherry pits, and substitution recipes. We also distributed fruit to various companies, students, chefs, and non-profit groups who developed their own products or did fruit research.

Orchards designed for mechanical harvesting were set up at the Prairie Ursuline Centre at Bruno and at the University of Saskatchewan in Saskatoon. Additional plantings at the Seager Wheeler Farm did not materialize so larger plantings were done at the other two

sites. Both sites have a complete collection of our newer cherries. They also have collections of blue honeysuckles, which is a new crop for Saskatchewan with potential for mechanical harvesting. The two sites had approximately 2.5 acres each established.

During this project, 5 new cherry selections were released for testing and then named and released. Also, superior blue honeysuckle and apples were identified. These are being propagated and will be released in 2006.

Breeding continued with an emphasis on Cherries, strawberries, plum and chokecherries. To a lesser degree breeding was also done with blue honeysuckles, hazelnuts, apples, sandcherries, Missouri currents, and pears. More than half the plant material generated has been distributed to cooperating growers.

III. PROJECT PERSONNEL

Bob Bors, Assistant Professor in the Plant Sciences Department was the primary investigator of the project. Rick Sawatzky, Technician IV was the chief technician for the field components and Linda Matthews was the part time technician who conducted most of the value-added processing research. Forrest Scharf, Jennifer Hall, and Alan Weninger were seasonal technicians during this project. Summer students included Qiuju Lu, Jie Qiu, Nathan Dzialo, Colin Wilson, and Lee Kalcsits. Part time workers included Vera Oster and Rory Cranston.

IV. PROJECT GOALS

The program has four components:

1. **Value added research**. New selections and older cultivars will be processed and compared to fruit products produced commercially to determine advantageous niches for Saskatchewan fruit. Students at the U of S with input from the food industry will develop new ad improved products. The new U of S varieties have superior attributes compared to traditional varieties, so quality measurements taken will be important marketing tools for the fruit industry.

2. **Establishment of mechanically-harvested demonstration orchards.** To supply fruit for future value added projects and to test new cultivars and training methods.

3. **Selection and distribution of superior clones for commercial production.** Through cooperation of nurseries, tissue culture companies and grower workshops, the new selections can be quickly propagated and established. Orchards will be established at the U of S and at the Seager Wheeler Agri-Arm sites to provide fruit for future research.

4. **Breeding and distribution of seedlings to growers.** With grower participation, it is possible to grow large numbers of seedlings and develop improved varieties with much lower costs than conventional breeding programs. The close cooperation between the U of S fruit breeding program and our cooperating growers allows for the development of varieties adapted to growers' farms and production systems. While grower participation probably reduces cost of our breeding program by 75%, funding is needed for maintenance of the trees used in breeding, pollination, propagation (including tissue culture) and seed processing. Cooperating with fruit processors results in development of new and improved products, and consequently new markets for growers.

V. RESEARCH

1.0 Value-added Research

1.1 Primary Processing Protocol

During an "average" year each variety of dwarf sour cherry has a three-week harvest window. SK Carmine Jewel is ready for harvest in late July; the remaining cultivars are harvested early to mid-August in the Saskatoon area. A protocol was developed during the 2003 harvest season for primary processing of dwarf sour cherries. Some changes were made to the protocol in 2005, which improved culling and cleaning portions of the protocol.

1.1.1 Harvest Method

1.1.1.1 Catch Frame Harvest Method

The catch frame method requires no machinery, is relatively easy to build, and is probably 20 times faster than picking by hand. They are easy and inexpensive to make, and we designed and built the catch frame at the University of Saskatchewan.
The catch frame is inserted into the shrub and branches are shaken by hand. A preferred technique is to grab a few branches in each hand and hit the branches into each other, like clapping hands. Three minutes, or less, is required to harvest each shrub, but the catch frame can only do half a bush at any one time. It is advisable to wear safety glasses to protect your eyes from branches when reaching into the bushes.
Using a catch frame results in high quality fruit because the fruit only falls a short distance due the dwarf size of the shrubs. The cherries sustain less damage than they do from mechanical harvesting methods (less bouncing around) but may have slightly more damage than hand picking.

1.1.2 Cleaning

As soon as possible after harvesting, it is important to remove debris and cool the harvested fruit to remove field heat and slow respiration, thus hindering post-harvest deterioration. During harvest operations fruit should be placed in a cool, shady spot until it can be transferred to a cooling facility where it can be cooled with air or water. Cooling greatly increases firmness and keeps the fruit from becoming sticky; both factors contribute to high pitting efficiency.

Except for hand picking, most methods of harvesting deposit some leaves, twigs, and damaged fruit in the harvested crop. At the University of Saskatchewan, we convey harvested fruit through a cleaning line with a built-in fan that blows away debris. The cherries then pass through a sorting line where they are visually inspected and removed if inferior.

1.1.3 Cooling

1.1.3.1 Air Cooling Harvested Fruit

1. Cleaned, inspected fruit is placed in shallow plastic baskets (only a few inches deep).
2. Fruit is lightly sprayed with water to remove dust. During the 2003 and 2004 harvest seasons, cleaned, inspected fruit was immediately transferred the rinsed fruit into the cooler. The fruit remained in the cooler until it was sent to the pitting machine. In 2005, we immersed the rinsed and sorted fruit in cold water for several minutes. Debris that was stuck to the fruit and diseased or damaged fruit floated to the water surface and was subsequently skimmed off. Cleaned fruit was then placed in the cooler until it was sent to the pitting machine.
3. Fruit is transferred a walk-in cooler set at 5–8°C (41–46°F) that contains a fan to force air through the baskets.
4. Fruit to remains in cooler until cooled to temperature of cooler—at the University of Saskatchewan we allow two hours for cooling.

At the university, we had an additional fan inside the cooler beside where we place baskets of fruit when they first enter the cooler. They stay in front of the fan for about 15 minutes while another batch of cherries is prepared.

1.1.4 Pitting

Round pits are optimal for pitting with manual or mechanical pitting machines. Elongated pits have a higher frequency of shattering in mechanical pitting machines. Pits can also be removed by mashing and decanting. While size of the pits does not seem to matter for mechanical pitting machines, cherries having large pits are easier to remove when using the hand-operated methods of pitting.

1.1.4.1 Commercial Pitter

In 2003, the Department of Plant Sciences purchased a $10,000 reconditioned Model E cherry pitting machine from Dunkley International, Inc. It is capable of pitting one ton of cherry fruit per hour. Operation of the pitting equipment requires stabilization or levelling blocks, a power source, a water line, and a pressurized air line. Cherries are fed into a vibrating hopper that fills each cylinder pocket on the rotating drum. As the drum turns, a series of pins come down and punch the pit out of the cherry. The pitted fruit falls into containers, and the pits are deposited into a pit tube. The pit tubes are flushed with water to expel the pits.

1.1.4.2 Pit Count

Introduction

Product specifications for cherry pie filling, according to the Cherry Marketing Institute, allow an average of one pit per sample with a maximum of two pits per sample. This criterion was used to test the pit count in one litre samples of pitted dwarf sour cherry fruit.

Materials and Methods

Pitted fruit was placed in one litre containers and stored in a -40 °C cooler. Later, each container of fruit was thawed and analyzed for pit count.

Results and Discussion

Of the 77 selections analyzed for pit count in 2003, 43 selections met the allowable pit count standard in one kilogram container of fruit. Pit count averaged 8 pits with the highest count being 74 pits in a one kilogram sample. The average standard deviation was 14.8 pits, which indicates a sizeable fluctuation in pit count.

Pit count for the selections analyzed in 2004 and 2005 all met the allowable pit count standard in one kilogram container of fruit. Fruit was harvested in cooler weather in 2004 and 2005 (than in 2005), which contributed to pitting efficiency. Some saskatoon growers harvest fruit in the evening to accommodate post harvest storability.

1.1.4.3 Pitting Weight Loss

Introduction

“Typically, pits make up about 5% of the weight of the cherries, and the fruit will lose 12-24% of their weight during the pitting process” (Bors and Matthews 2004).

Materials and Methods

Dwarf sour cherry fruit was weighed prior to and after pitting to determine the pitting efficiency of each selection.

Results and Discussion

Pitting losses are outlined for each harvest year in Figures 1.1, 1.2 and 1.3. Values below 15% are considered excellent and values above 15% are less common.

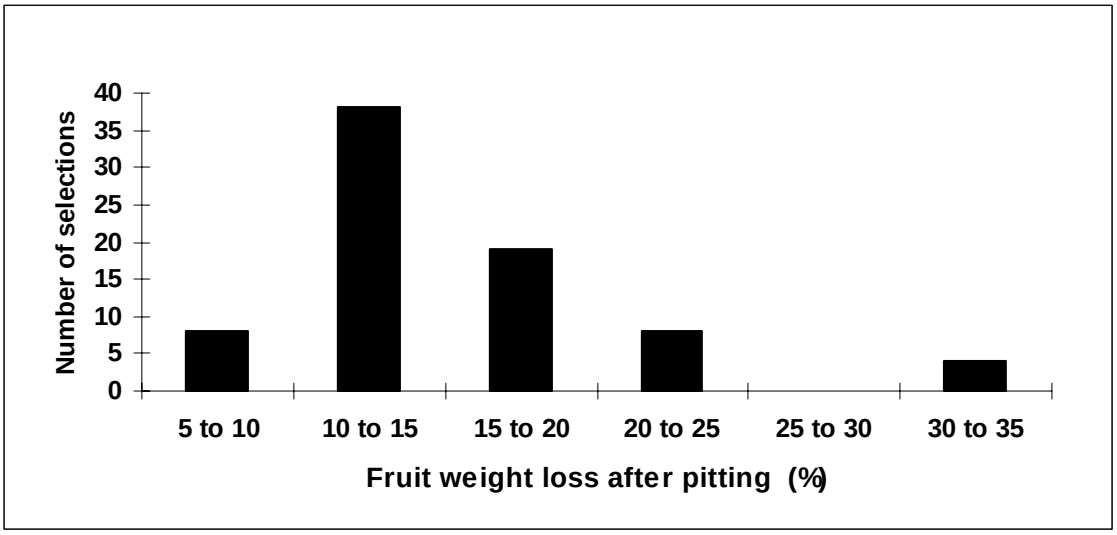

Figure 1.1 Pitting Losses of 77 Selections of Dwarf Sour Cherries in 2003

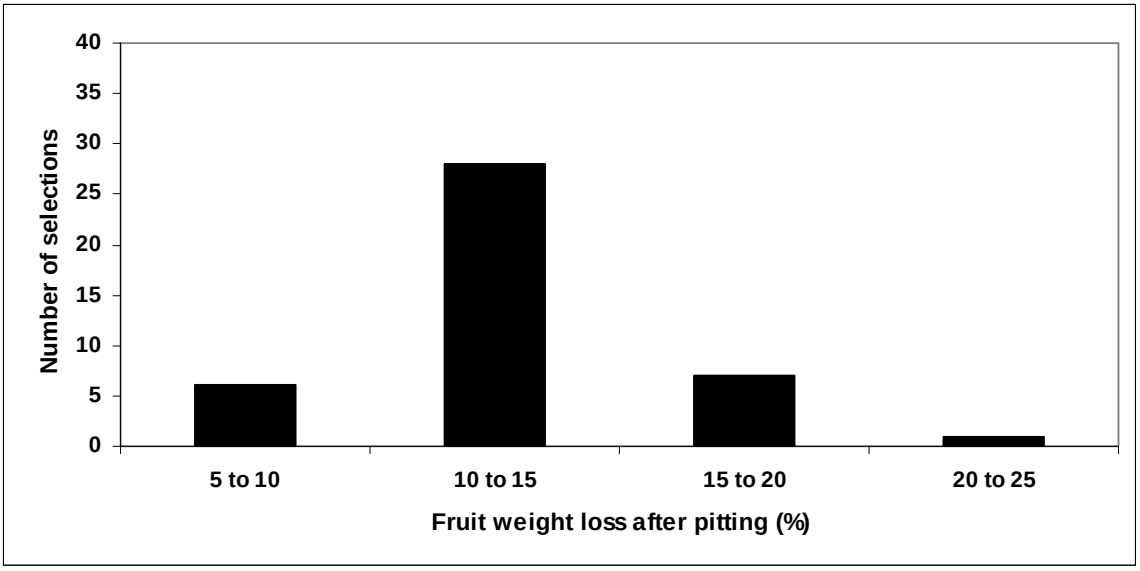

Figure 1.2 Pitting Losses of 42 Selections of Dwarf Sour Cherries in 2004

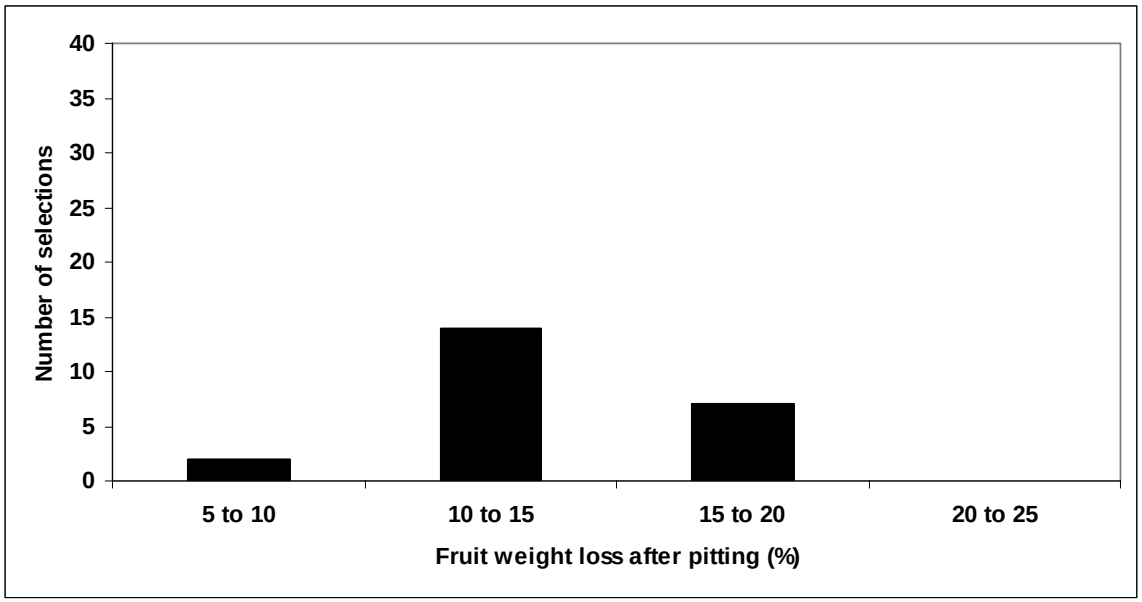

Figure 1.3 Pitting Losses of 22 Selections of Dwarf Sour Cherries in 2005

1.1.5 Pitting Frozen Cherries

Two co-operators brought in frozen cherry fruit to test the ability of the cherry pitter to remove pits from frozen fruit. We had contacted Dunkley International about the viability of pitting frozen fruit. We were informed that one their Polish clients routinely pits frozen fruit.

The first frozen cherry run plugged the pitting machine, and tripped the electrical breaker. This was caused by cherry flesh and juice crystals accumulating on the pin plate, which is designed to push the pitted cherries off the pins and keep them in the cups. Another cause was the pit tube plugging with pits, cherry flesh and juice crystals. After experimenting with hot water and increasing the cold water flow through the pit tube, a relatively successful (a sample showed 14.3% loss of weight from pitting) protocol was developed for pitting frozen cherries.

1.1.5.1 Protocol for Pitting Frozen Cherry Fruit

1. **EQUIPMENT: Spacer/blocks** for levelling the pitter. **Extension cord and power bar** with switch. **Grease and oil. Sponges and a pail.** Clean, hard **chairs** to put tubs on. **Sample containers.** Thin vinyl **gloves**. **Garbage can** for the pits. Lots of **tubs** or **totes** are required. **Baskets** that retain cherries and pits but drain readily are required: two to catch cherry pits and several to be used for surface thawing the cherries with a hot water spray. **Air** and **cold water** lines to the pitter. **Hot water** line with a spray gun. **Tables** to work on repackaging. **Balance** to record weights.

2. The **pitter** needs to be **set up** level on a sloping floor with a good drain or with a sump pit.
3. The cherries must be frozen so that they will separate (i.e. not in a block but like marbles). There should be as little possible juice or ice lumps and crystals in with them.
4. The cherries should be out of the freezer for a while; still firm and frozen but not as cold as freezer temperature. (More precise recommendations need to be determined here.)
5. The cherries must be large enough for pitting. **Small cherries are even more difficult to pit well when they are frozen.** Small cherries can be prepared for processing or wine making by using the mash and decant method (see below).
6. The cherries need to be sprayed with hot water to rinse off ice crystals and juice and to the point where ice crystals don't readily reform on their surface. They must remain frozen under the skin. **This is a surface thaw only.**
7. After the surface thaw the cherries must be taken to the pitter **immediately.**
8. Don't forget to turn on the **oiler.**
9. The parts of the **pitter** in contact with the cherries (especially the pins and pin blocks) must be well **warmed using hot water** prior to pitting and periodically after that to keep the cherries from sticking to it. A convenient interval is after emptying every catch tote. **Don't forget** to replace the catch totes.
10. Watch carefully that the **pit tube** doesn't plug. Frozen cherries plug this much more easily than fresh ones. A good flow of water is needed.
11. **PEOPLE: Two** people are needed to rinse cherries while **one** person can feed the pitter and watch for trouble. **Two more** people could be used for emptying catch totes and repackaging the cherries. However, if there are enough catch totes, repackaging can be done after the pitting has been completed.

1.1.6 Pit Removal by Mashing and Decanting

Small cherries can be cooked or fermented **without** the pits using this method.

1. Put the cherries in a food processor or blender (domestic or large capacity commercial) and add an equal amount of water (or juice from previous batches) by volume. There are air spaces around the cherries when measuring; therefore, more water/juice than cherries by weight is being used.
2. Run the equipment. When finished, the cherries should be broken up and the sound pits should settle to the bottom and the empty pits will float. If not, add more juice/water and run the equipment again.
3. Depending on the capacity of the equipment, many batches can be done and all added to five gallon pail(s) and decanted at one time more efficiently.
4. Some pits will float and these can be screened off the top and discarded **before decanting.**

5. To decant, make sure that the sound pits are sinking to the bottom after gentle stirring. If not, add more juice/water and stir again gently. Carefully pour the pulp and juice/water off into a clean pail. Gentle stirring will need to be done while pouring and it may be necessary to add some juice/water back into the pail to effectively remove most of the pulp.

N.B. Excellent quality juice can be drained and pressed from frozen cherries upon thawing. Actually, there is very little product left with the pits after thawing and thoroughly pressing some sour cherry selections/cultivars.

1.2 Dwarf Sour Cherry Juice Evaluation

Introduction

Future market availability of dwarf sour cherry fruit on the Canadian Prairies necessitates the development of processing options.

In 2002, dwarf sour cherry fruit grown at the University of Saskatchewan research plots was evaluated by Payne and shown to "have good commercial potential for their juice quality". Fruit obtained from the 2003 harvest at the U of S was evaluated for juice quality using the following criteria: flavour, colour, soluble solids content, and acidity. **Flavour** is defined as a combination of taste and aroma. Sensory evaluation or taste testing is the technique that incorporates taste and aroma. Taste is dependent on sugar (sweetness) and organic acid content (sourness). Aroma is dependent on the content of volatile organic compounds (acids, alcohols, aldehydes, esters, hydrocarbons, ketones) (Kaack et al., 1996). **Colour** is a determinant of visual appeal. Selections with darker juice allow dilution of the product while maintaining excellent colour. **Soluble solids** content is a measure of the sugar content in cherry juice and indicated as a Brix value. **Titratable acidity** measures the organic acid content in juice. Levels are expressed as grams/litre of tartaric acid. Sweeter tasting juice has a higher level of soluble solids and a lower level of acidity.

1.2.1 Flavour

Materials and Methods

Frozen, one litre containers of dwarf sour cherry selections were thawed and allowed to reach room temperature. Thawed fruit was poured into a sieve and the juice was collected and measured in to 50 ml sample sizes. A 20 ml sample of each selection was set aside for further analysis. Luh et al., 1986 states that "juice from the sour cultivars is usually too sour to please the average palate. A more palatable beverage may be obtained by diluting the juice with half its volume of water". Each sample was diluted with 50 ml of room temperature bottled water. Bottled water was used to ensure that the diluted sample was consistent on each testing date.

Sensory evaluation was performed by consumer panellists from the Fruit Program to determine the acceptability of the 2003 selections for juice quality. Samples were presented simultaneously in identical containers and evaluated in randomized order. The Hedonic Personal Liking Scale was used to measure the degree of liking for each selection. Panellists were presented with the samples and an evaluation form (Figure 1.4).

Dwarf Sour Cherry Juice Score Sheet

Date: _____ Time: _____

Circle the number that represents your personal liking (1=worst, 8= best).

Flavour

Selection Number	1	2	3	4	5	6	7	8

Aromatics

Selection Number	1	2	3	4	5	6	7	8

Eight-Point Hedonic (personal liking) Scale (1=worst; 8=best)

1	Disgusting	5	Fair
2	Not at all enjoyable	6	Good
3	Not to my personal liking	7	Very good
4	Possibly acceptable	8	Just right for me

Figure 1.4 Sensory Evaluation Form for Dwarf Sour Cherry Juice

Results and Discussion

Taste scores averaged 6.45 with a maximum score of 8.00 and an average standard deviation was 1.17. Aromatic testing indicated similar results with an average score of 6.60, a maximum score of 8.00 and a standard deviation of 1.05. Flavour averaged 6.51 with a maximum score of 7.83 and a standard deviation of 0.56, which indicates that most of the selections were acceptable for juice. Table 1.1 itemizes the average taste, aromatic and flavour values for each selection.

Table 1.1 Average sensory evaluation results for dwarf sour cherry juice.

Selection I.D.	Taste	Aroma	Flavour
17d32p0	7.00	5.00	6.00
21d0p5	4.33	4.33	4.33
21d13p9	6.67	8.00	6.17
25d2p5	7.00	7.00	7.00
25d15p1	6.00	5.67	5.84
29d3p5	5.67	6.33	6.00
2d45p40	5.33	6.67	6.00
5d59p0	5.67	5.67	5.67
21d17p3	7.67	7.33	7.50
23d22p55	6.67	6.00	6.34
2d59p0	4.67	5.67	5.17
3d8p7	7.00	6.00	6.50
17d17p35	6.33	7.33	6.83
31d3p2	6.33	6.33	6.33
21d30p5	5.00	7.67	6.34
23d37p7	6.67	6.33	6.50
27d32p6	7.33	6.00	6.67
31d23p0	6.33	6.67	6.50
17d21p4	6.33	6.33	6.33
19d17p2	7.00	6.67	6.84
21d1p0	7.00	6.67	6.84
21d22p35	7.67	6.00	6.84
3d2p15	5.00	6.67	5.84
15d40p3	6.33	6.33	6.33
21d13p25	7.33	7.33	7.33
27d15p3	6.67	7.33	7.00
17d27p0	7.67	7.33	7.50
19d28p9	5.33	6.67	6.00
23d21p5	6.00	6.67	6.34
25d29p3	7.33	5.67	6.50
17d34p05	6.67	7.00	6.84
21d34p5	6.00	6.00	6.00
23d5p0	5.67	7.67	6.67
29d28p7	6.00	5.67	5.84
19d9p50	5.67	6.33	6.00
19d27p6	7.33	7.33	7.33
31d1p0	6.33	6.33	6.33
31d22p0	7.67	7.00	7.34
21d25p0	6.33	6.33	6.33
23d5p560	6.67	6.67	6.67
25d2p0	6.67	7.00	6.84
2d32p4	6.67	6.67	6.67
2d19p35	6.33	7.33	6.83
19d18p2	6.67	7.00	6.84
25d31p0	7.00	6.67	6.84
29d12p2	6.67	6.33	6.50

31d12p3	6.00	5.67	5.84
6d22p0	7.33	6.00	6.67
17d12p4	5.67	6.33	6.00
21d27p0	6.00	6.67	6.34
17d29p75	6.00	6.00	6.00
19d36p7	5.67	6.00	5.84
23d13p3	6.00	7.33	6.67
31d6p0	5.67	6.33	6.00
32d10p7	5.67	7.00	6.34
19d39p0	7.00	6.33	6.67
21d31p0	7.67	8.00	7.84
27d28p5	6.67	7.33	7.00
27d28p5	6.00	6.33	6.17
21d16p3	7.67	6.33	7.00
25d24p5	7.00	5.67	6.34
27d2p0	5.67	7.00	6.34
29d33p05	7.00	7.00	7.00
CJ	5.67	6.67	6.17
17d42p95	6.00	6.00	6.00
23d21p0	7.00	6.67	6.84
29d10p2	8.00	6.88	7.17
31d12p5	6.33	7.67	7.00
25d12p0	8.00	6.00	7.00
27d10p11	6.00	7.33	6.67
29d37p0	6.00	7.33	6.67
31d21p5	6.00	7.00	6.50
19d42p0	6.00	6.00	6.00
23d3p5	7.00	7.33	7.17
29d8p3	6.67	6.67	6.67
29d29p05	6.67	7.00	6.83

1.2.2 Colour

Materials and Methods

A Hunter Colorimeter was used for colour analysis. The colorimeter was standardized and a sample of juice was then placed under the apparatus for analysis. Colour is measured in terms of reflectance from a flash of light generated by the colorimeter and displayed as L, a, and b values. The L value is a measure of lightness and darkness where a value of L=100 is white and a value of L=0 is black. The ‘a’ value is a measure of red and green where +a=red and –a=green. The ‘b’ value measures yellow and blue where +b=yellow and –b=blue. Colour is determined in a planar model by combining the component values of L, a, and b.

Results and Discussion

ΔL*, Δa*, Δb* color differences are always calculated as sample minus standard values. 'SK Carmine Jewel', the first dwarf sour cherry cultivar released by the University of Saskatchewan was used for the standard for the calculations in Table 1.2. 'SK Carmine Jewel' is a dark coloured, morello type sour cherry, which was selected for the intense red color of its skin, flesh and juice. Highlighted selections yielded darker coloured juice than 'SK Carmine Jewel' and should be considered for future juice studies when larger quantities of fruit are available.

- If ΔL is positive, the sample is lighter than the standard.
- If ΔL is negative, the sample is darker than the standard.
- If Δa is positive, the sample is more red (less green) than the standard.
- If Δa is negative, the sample is more green (less red) than the standard.
- If Δb is positive, the sample is more yellow (less blue) than the standard.
- If Δb is negative, the sample is more blue (less yellow) than the standard.

Table 1.2 L, a, and b colorimeter values for dwarf sour cherry juice samples.

Selection #	L	a	b	ΔL	Δa	Δb
CJ (Standard)	**14.23**	**1.29**	**-0.71**			
17d32p0	9.19	5.13	0.87	5.04	-3.84	-1.58
21d0p5	8.73	1.35	-0.35	5.50	-0.06	-0.36
21d13p9	8.74	2.73	-0.06	5.49	-1.44	-0.65
25d2p5	9.38	7.10	1.12	4.85	-5.81	-1.83
25d15p1	10.42	11.27	2.55	3.81	-9.98	-3.26
29d3p5	7.22	3.25	0.48	7.01	-1.96	-1.19
2d45p40	8.44	2.39	-0.19	5.79	-1.10	-0.52
5d59p0	10.60	10.51	2.27	3.63	-9.22	-2.98
21d17p3	10.94	13.28	3.02	3.29	-11.99	-3.73
23d22p55	11.40	4.93	0.32	2.83	-3.64	-1.03
2d59p0	9.16	8.86	1.69	5.07	-7.57	-2.40
3d8p7	9.87	2.27	-0.13	4.36	-0.98	-0.58
17d17p35	13.95	8.95	1.71	0.28	-7.66	-2.42
31d3p2	10.71	9.28	2.14	3.52	-7.99	-2.85
21d30p5	10.53	3.90	0.29	3.70	-2.61	-1.00
23d37p5	10.98	8.32	2.35	3.25	-7.03	-3.06
27d32p6	9.56	1.13	-0.77	4.67	0.16	0.06
31d23p0	9.48	6.05	1.32	4.75	-4.76	-2.03
17d21p4	11.45	7.88	1.14	2.78	-6.59	-1.85
19d17p2	11.76	1.75	-0.65	2.47	-0.46	-0.06
21d1p0	12.68	4.89	0.19	1.55	-3.60	-0.90
21d22p35	13.79	7.56	0.84	0.44	-6.27	-1.55
3d2p15	11.59	4.67	0.34	2.64	-3.38	-1.05
15d40p3	11.84	2.87	-0.63	2.39	-1.58	-0.08

21d13p25	10.41	0.45	-1.27	3.82	0.84	0.56
27d15p3	11.88	3.38	-0.29	2.35	-2.09	-0.42
17d27p0	10.30	2.47	-0.43	3.93	-1.18	-0.28
19d28p9	11.29	3.50	-0.43	2.94	-2.21	-0.28
23d21p5	11.96	7.04	0.80	2.27	-5.75	-1.51
25d29p3	10.85	3.12	-0.02	3.38	-1.83	-0.69
17d34p05	10.65	3.75	0.10	3.58	-2.46	-0.81
21d34p5	11.38	3.10	-0.17	2.85	-1.81	-0.54
23d5p0	10.99	2.05	-0.40	3.24	-0.76	-0.31
29d28p5	10.76	1.68	-0.33	3.47	-0.39	-0.38
19d9p50	11.95	8.55	1.67	2.28	-7.26	-2.38
19d27p6	10.80	6.06	0.59	3.43	-4.77	-1.30
31d1p0	11.25	7.83	1.44	2.98	-6.54	-2.15
31d22p0	10.39	2.59	-0.09	3.84	-1.30	-0.62
21d25p0	12.17	0.93	-0.93	2.06	0.36	0.22
23d5p560	10.26	1.10	-0.32	3.97	0.19	-0.39
25d2p0	9.98	4.61	0.41	4.25	-3.32	-1.12
2d32p4	16.85	3.19	-0.22	-2.62	-1.90	-0.49
2d19p35	10.38	3.75	0.03	3.85	-2.46	-0.74
19d18p2	10.98	2.58	-0.36	3.25	-1.29	-0.35
25d31p0	11.24	11.05	2.48	2.99	-9.76	-3.19
29d12p2	16.50	2.76	-0.16	-2.27	-1.47	-0.55
31d12p3	7.52	1.51	0.18	6.71	-0.22	-0.89
6d22p0	15.32	3.12	-0.10	-1.09	-1.83	-0.61
17d12p4	9.78	6.15	0.80	4.45	-4.86	-1.51
21d27p0	7.74	2.37	-0.25	6.49	-1.08	-0.46
23d18p0	8.46	4.74	0.38	5.77	-3.45	-1.09
17d29p75	10.93	8.33	1.24	3.30	-7.04	-1.95
19d36p7	10.38	6.80	1.02	3.85	-5.51	-1.73
23d13p3	9.88	6.10	0.62	4.35	-4.81	-1.33
31d6p0	9.64	4.31	0.28	4.59	-3.02	-0.99
32d10p7	7.28	1.64	-0.14	6.95	-0.35	-0.57
19d39p0	7.17	0.94	-0.39	7.06	0.35	-0.32
21d31p0	9.91	5.69	0.70	4.32	-4.40	-1.41
27d38p5	8.86	6.94	1.05	5.37	-5.65	-1.76
29d19p6	16.94	8.51	1.60	-2.71	-7.22	-2.31
21d16p3	8.14	4.61	0.25	6.09	-3.32	-0.96
25d24p5	7.92	2.89	-0.12	6.31	-1.60	-0.59
27d2p0	14.90	2.02	-0.48	-0.67	-0.73	-0.23
29d33p05	9.42	4.27	0.12	4.81	-2.98	-0.83
17d32p95	7.62	3.42	0.25	6.61	-2.13	-0.96
23d21p0	9.73	7.18	0.85	4.50	-5.89	-1.56
29d10p2	11.34	1.17	-0.42	2.89	0.12	-0.29
31d12p5	11.48	7.36	0.90	2.75	-6.07	-1.61
25d12p0	14.96	2.41	-0.38	-0.73	-1.12	-0.33
27d10p11	11.28	12.28	2.81	2.95	-10.99	-3.52
29d37p0	8.00	2.14	0.19	6.23	-0.85	-0.90
31d21p5	10.89	6.99	1.09	3.34	-5.70	-1.80
19d42p0	9.24	4.64	0.40	4.99	-3.35	-1.11
23d3p5	8.91	5.96	0.89	5.32	-4.67	-1.60

29d8p3	14.45	1.08	-0.65	-0.22	0.21	-0.06
29d29p05	12.11	17.19	4.39	2.12	-15.90	-5.10
Average	10.73	4.98	0.51	3.50	-3.69	-1.22
Maximum	16.94	17.19	4.39	7.06	0.84	0.56
Minimum	7.17	0.45	-1.27	-2.71	-15.90	-5.10
Std. Dev.	2.16	3.32	1.04	2.16	3.32	1.04

1.2.3 Soluble Solids Content and Titratable Acidity

Materials and Methods

From Payne 2002:

"Soluble solids measure the sugar content of the juice, using a refractometer. A few drops of juice were placed on the lens of the refractometer which was held up to a light source to get an accurate measure of the soluble solids as expressed in Brix units.

Titratable acidity level of the sour cherry juice is a measure of the organic acid content of the juice being analyzed. It determines the amount of organic acids that can be neutralized by a dilute alkali solution at pH 8.2. De-ionized water was measured into a beaker, boiled, and cooled to room temperature. Boiling the water removed the CO_2 from the water. The beaker of boiled water was placed on a magnetic stir table with a stir bar inside the beaker, directly under a titration apparatus. A standardized pH probe was immersed in the solution away from the stir bar. Juice was added to the beaker and rapidly titrated with the standard base NaOH, to pH 8.2. After the sample was standardized, a juice sample was added to the solution and titrated to pH 8.2. The total volume of base was used to calculate the titratable acidity of the sample."

Results and Discussion

Soluble solids content and acidity levels varied with the 2003 dwarf sour cherry selections. Range for soluble solids content was 13.6 – 24.9 Brix with an average of 18.4 Brix. Average acidity level was 21.2 g/L tartaric acid with a range of 12.6-34.8 g/L tartaric acid. Table 1.3 itemizes soluble solids content, acidity levels and pit count for the 2003 selections.

Table 1.3 Soluble solids content and acidity level for dwarf sour cherry juice samples and pit count for one kilogram samples of dwarf sour cherry fruit.

Selection	Brix	Titratable Acidity g/L Tartaric Acid	pH	Pit Count
17d32p0	17.0	17.6	3.5	3
21d0p5	18.2	22.6	3.5	1
21d13p9	16.8	31.2	3.3	10
25d2p5	13.6	20.8	3.5	1
25d15p1	17.2	25.4	3.4	0
29d3p5	14.2	13.5	3.9	1
2d45p40	16.2	15.1	3.7	1
5d59p0	18.1	23.6	3.5	10
21d17p3	17.8	20.0	3.4	1
23d22p55	17.0	28.0	3.3	8
2d59p0	14.9	27.4	3.3	5
3d8p7	19.5	26.4	3.6	2
17d17p35	17.0	16.8	3.6	0
31d3p2	17.8	21.5	3.5	14
21d30p5	18.0	28.5	3.4	10
23d37p5	18.8	17.1	3.7	0
27d32p6	24.9	26.1	3.6	24
31d23p0	17.5	12.6	3.9	3
17d21p4	16.2	23.2	3.6	15
19d17p2	19.8	33.0	3.4	10
21d1p0	16.2	20.2	3.5	0
21d22p35	16.9	20.1	3.5	3
3d2p15	15.6	19.6	3.6	11
15d40p3	16.8	25.0	3.4	0
21d13p25	19.5	15.0	3.7	66
27d15p3	19.0	16.0	3.7	5
17d27p0	19.0	17.0	3.4	1
19d28p9	18.8	15.4	3.6	2
23d21p5	18.9	22.5	3.6	64
25d29p3	21.0	24.4	3.4	13
17d34p05	16.3	16.0	3.8	0
21d34p5	18.9	26.4	3.5	14
23d5p0	19.2	19.4	3.5	1
29d28p5	18.2	25.4	3.4	54
19d9p50	18.4	28.0	3.3	15
19d27p6	18.8	20.3	3.6	0
31d1p0	17.8	17.3	3.5	10
31d22p0	19.2	17.5	3.5	0
21d25p0	19.8	24.7	3.2	9
23d5p560	19.2	14.3	3.5	2
25d2p0	17.9	17.3	3.3	3
2d32p4	17.2	13.3	3.4	0
2d19p35	17.8	13.4	3.4	5
19d18p2	20.8	28.0	3.1	1
25d31p0	19.4	24.4	3.2	28

29d12p2	19.7	16.4	3.4	6
31d12p3	17.8	20.8	3.3	0
6d22p0	22.6	22.4	3.3	0
17d12p4	18.8	18.5	3.4	5
21d27p0	20.8	24.8	3.2	2
23d18p0	21.0	29.3	3.0	0
17d29p75	18.2	16.0	3.4	2
19d36p7	15.4	27.8	3.1	2
23d13p3	18.4	21.4	3.1	0
31d6p0	14.6	17.0	3.2	1
32d10p7	17.1	14.3	3.5	0
19d39p0	19.8	31.6	3.2	19
21d31p0	19.2	14.9	3.6	0
27d38p5	18.4	16.6	3.4	1
29d19p6	19.8	26.9	3.3	1
21d16p3	22.0	18.4	3.4	0
25d24p5	20.4	17.2	3.5	1
27d2p0	16.8	20.2	3.3	1
29d33p05	19.7	17.1	3.5	2
CJ	19.0	23.9	3.2	1
17d32p95	16.2	23.1	3.2	16
23d21p0	20.0	21.4	3.4	20
29d10p2	23.8	21.3	3.4	3
31d12p5	19.0	22.2	3.3	0
25d12p0	19.8	22.5	3.2	6
27d10p11	17.8	18.9	3.4	1
29d37p0	16.6	18.5	3.3	1
31d21p5	18.0	13.4	3.5	1
19d42p0	19.5	34.8	3.2	74
23d3p5	20.0	22.2	3.2	1
29d8p3	18.6	27.1	3.2	20
29d29p05	17.8	21.4	3.3	2

1.3 Canned Dwarf Sour Cherry Texture Analysis

Harvest is a busy time for producers. Excess produce is often frozen and sold at a later date. The option of processing frozen produce into value added commodities is beneficial to the producer. To date, frozen dwarf cherries have been successfully processed into jams, jellies and preserves and dehydrated into dried fruit. With this criterion in mind, we questioned whether individually frozen, pitted dwarf sour cherries could be processed into canned fruit. Preliminary testing began in February 2005.

1.3.1 Dwarf Sour Cherry Canned Fruit Preliminary Trial

Individually frozen cherry fruit was placed into 500 ml canning jars. Hot, medium-sweet sugar syrup (recommended by Bernardin Ltd. as appropriate syrup for tart cherries) was

poured over frozen fruit and processed in a hot water bath for 20 minutes. There was a high degree of skin cracking with this method.

In the next trial, individually frozen cherry fruit was placed in the jars and allowed to thaw. Hot, medium-sweet sugar syrup was poured over the frozen fruit in the jars and processed in a hot water bath for 20 minutes. Thawing the cherry fruit before the addition of hot syrup greatly reduced the degree of skin cracking. Preliminary taste tests yielded positive texture results, however the syrup was too sweet. The success of the preliminary test on canned cherry fruit led to a large canned cherry processing trial in 2005.

1.3.2 Canned Dwarf Sour Cherry Fruit Trial 2005

Introduction

Our preliminary trial proved that individually frozen cherry fruit could be canned into an acceptable product.

Is there a difference between fresh-canned and frozen-canned dwarf sour cherry fruit? Is there a cultivar difference between fresh-canned and frozen-canned dwarf sour cherry fruit? What is the effect on the fruit texture of the finished product?

Materials and Methods

Dwarf sour cherry fruit was harvested, cleaned, pitted and placed in single layers on trays in a -40°C freezer to obtain individually frozen fruits. On that same harvest day, freshly harvested fruit was prepared into a canned product. For each dwarf sour cherry selection (that yielded and adequate amount of fruit), an equal portion of fresh cherry fruit and previously frozen fruit was processed into canned fruit using the method developed in February 2005. Dwarf sour cherry fruit bred at the University of Saskatchewan has higher sugar content than ‘Montmorency’ cherry fruit, which is typically processed into canned products. Medium-sweet syrup is recommended for ‘Montmorency’ cherry fruit but the recommendation does not hold true for dwarf sour cherry fruit in the canning process. Due to the higher sugar content of dwarf sour cherry fruit than ‘Montmorency’ cherry, light syrup was used for the process. Canned fruit was stored in a 0°C cooler. Texture analysis was performed on a Model TMS-90 Texture Test System fitted with a standard shear compression cell model CS-1.

Results and Discussion

Table 1.4 Texture analysis results.

Selection #	Frozen Ave. (lbs.)	Fresh Ave. (lbs.)	Difference
7-5-41.3	41.53	43.36	-1.83
7-7-24.5	62.73	50.37	12.36
7-17-12.4	68.00	68.00	0.00
7-17-17.35	32.56	40.32	-7.76
7-17-27.4	52.31	64.53	-12.22
7-17-31.2	62.12	42.80	19.32
7-19-27.3	77.49	78.00	-0.51
7-19-28.7	55.13	64.93	-9.80
7-1-16.3	46.79	41.16	5.63
7-21.17.3	32.54	15.06	17.48
7-21-22.35	54.25	61.93	-7.68
7-21-25.5	44.45	58.86	-14.41
7-23-5.0	63.17	57.39	5.78
7-23.22.55	39.19	29.02	10.17
7-25-29.4	79.62	65.43	14.19
7-27-14.9	60.38	48.40	11.98
7-27-27.5	38.02	21.49	16.53
7-29-3.5	63.83	53.96	9.87
7-29-12.8	62.44	45.40	17.04
7-29-19.4	42.14	35.71	6.44
7-29-32.2	50.41	35.05	15.37
7-32-10.7	69.37	59.05	10.32
Average	54.47	49.10	
Maximum	79.62	78.00	
Minimum	32.54	15.06	
Std. Dev.	13.67	15.93	

Texture analysis (results shown in Table 1.4) was performed on 22 selections. Of the 22 selections tested, 14 selections of frozen-canned had higher texture analysis readings than fresh-canned; 7 selections of fresh-canned had higher texture analysis readings than frozen-canned; one selection showed no difference. Texture analysis performed on cherry fruit extracted from E.D. Smith pie filling and canned sour cherries from Poland. The analysis yielded similar results to the average texture analysis performed on both fresh-canned and frozen-canned dwarf sour cherries. Average texture analysis for fruit extracted from E.D. Smith pie filling was 51.47 pounds of force and average texture analysis on canned sour cherries from Poland was 55.79 pounds of force.

1.4 Dried Dwarf Sour Cherry Evaluation

Introduction

Drying is one of the oldest techniques of fruit preservation. Products of drying have moisture contents below a level at which microbial spoilage can occur. Microorganism growth is inhibited because "the osmotic pressure of the product sugars suppresses growth" (Somogyi and Luh 1986). Advantages and uses of dried fruit are outlined in Table 1.5.

Table 1.5 Advantages and uses of dried fruit.

Advantages

- unlimited shelf life
- decreased transportation, handling and storage costs
    - no refrigeration required
    - weight of 1/7 to 1/9 of original
- maintains caloric value and mineral content per fruit piece
- fruit not suitable for the fresh market can be used
    - drying conceals imperfections such as split skin, cracking, bird pecking and hail damage
- no sulfuring and no sugar addition results in a natural food product

Uses

- light weight, convenient snack food good for hikers and campers
- pastries and confectionery products
- ice cream and frozen deserts
- fruit salad
- cheese, yogurt

Adapted from Somogyi and Luh 1986; McLellan 1996.

Dried dwarf sour cherry fruit from the 2004 harvest was evaluated. Selections yielding a minimum of 2 kilograms of harvested fruit were used in the evaluation to ensure that there was enough fruit for testing. As soon as possible after pitting, one kilogram of selected fresh dwarf sour cherry fruit was dehydrated to 25% moisture level. The same amount of fruit for each selection was individually frozen on trays in a minus -40 ºC cooler. Individually frozen fruit was later dehydrated to a moisture level of 25%. Kaack et al., 1996 states that either fresh or frozen cherry fruit can be used for drying. Neither fresh nor frozen fruit was pre-treated with sulfur and no sugar was added, which resulted in a natural dried cherry product. Dried fruit was evaluated for taste by consumer panellists using a paired preference test.

1.4.1 Drying Process

Conventional hot air drying was used to dehydrate the fruit. Heat needed for drying is provided by convection with hot air in direct contact with the product.

Fresh and frozen dwarf sour cherry fruit was placed on dehydrator trays and inspected for debris and remaining pits. Individually frozen fruits were not thawed prior to placement on the dehydrator trays. After the fruit was dried, it was inspected again for debris, discoloured fruit and pits. Fruit was held in sealed containers for one week @ 2 °C to equalize the moisture throughout the pieces. Finished product was stored at -40 °C until the sensory evaluation was conducted.

1.4.2 Conducting the Sensory Evaluation (Taste Testing)

Introduction

A consumer-oriented paired preference test, which allows consumers to express a choice between samples, was conducted on 19 dried dwarf sour cherry selections. Consumer panellists tested fresh-dried cherry fruit and frozen-dried cherry fruit to provide initial information on product acceptability. Based on Kaack's statement, there is no difference between fresh-dried and frozen-dried cherry fruit.

Materials and Methods

- Panellists were provided with two coded samples of each dried dwarf sour cherry selection (one fresh dried sample and one previously frozen and dried sample of the same selection) and asked which sample they preferred.
- "No preference" was not an option; panellists were told that they must choose one sample over the other.
- Samples were marked "A" and "B" and coded with a three-digit random number.
- Panellists were instructed to start with either sample "A" or sample "B".
- Each presentation order was given an equal number of times.
- Panellists were explained the importance of sensory testing, the test method and procedure.

A sample of the paired-preference test form supplied to panellists is shown in Figure 1.5.

Taste the two dried sour cherry samples, starting with sample A. Circle the sample that you prefer (either A or B). You must choose a sample. Guess if you are unsure.

A	B
231	456

Figure 1.5 Paired Preference Form for Dried Dwarf Sour Cherry Fruit

Results and Discussion

There was a difference between fresh-dried and frozen-dried dwarf sour cherry fruit. Of the 19 selections tested, four selections showed no preference between dried products prepared from fresh or frozen fruit; eight selections produced superior dried fruit from frozen fruit; seven selections produced superior product from fresh fruit. Table 1.6 lists the results of the paired preference evaluation.

Table 1.6 Results of paired preference evaluation for dried dwarf sour cherry fruit.

Unit #	Selection Number	Fresh Score	Frozen Score	Preference
1	5-2-25.5	2	2	No preference
2	5-2-33.45	3	1	Fresh
3	5-2-35.8	0	4	Frozen
4	5-30-42.9 (CJ)	4	0	Fresh
5	5-32-8.3	1	3	Frozen
6	6-71-34.8	2	2	No preference
7	7-8-2.6	1	3	Frozen
8	7-17-12.4	4	0	Fresh
9	7-19-36.7	2	2	No preference
10	7-21-22.4	3	1	Fresh
11	7-21-25.0	1	3	Frozen
12	7-25-19.6	4	0	No preference
13	7-27-18.8	3	1	Fresh
14	7-27-26.0	1	3	Frozen
15	7-29-32.2	3	1	Fresh
16	7-32-4.3	0	4	Frozen
17	7-32-6.7	1	3	Frozen
18	7-32-10.7	3	1	Fresh
19	7-32-32.2	3	1	Frozen

1.5 Dwarf Sour Cherry Sausage and Meat Tenderizing Trial

Introduction

Research at Michigan State University by Britt et al., 1998 determined that adding 11.5% tart cherry compounds to ground beef patties reduced the formation of heterocyclic aromatic amines (HAAs) by approximately 90%. HAA's develop naturally during cooking, particularly in meats cooked at high temperatures for long periods of time. HAAs have been shown to cause cancer in some animals (rodents and monkeys), and are **suspected** to cause cancer in humans. Reaction inhibitors found in cherry fruit decrease production of HAAs during cooking; however the inhibitory mechanism in cherry fruit is not completely understood but antioxidant activity is anticipated. Also, fat content of a ground beef serving is reduced because cherry fruit becomes a part of the portion.

Utilization of cherry products as a source of antioxidants and as a fat reducing component in meat products could be used as an effective marketing tool to target health conscious consumers.

1.5.1 Dwarf Sour Cherry Sausage

Cherry juice was extracted and shipped away to a company for chemical analysis. After the juice extraction, we were left with a substantial amount of cherry meal, the by-product of juicing.

On the Canadian Prairies, sausage on a bun is a common food choice served at social events such as fairs, festivals and exhibitions. The idea of producing beef sausage containing sour cherry fruit was developed because of the availability of cherry meal, the popularity of sausage on a bun as a food choice on the Prairies and the known inhibitory mechanism of cherry fruit to prevent HAA formation.

Boryski's Butcher Block Ltd. located in Saskatoon prepared two types of beef sausage containing dwarf sour cherry meal.

- 500 gram rings of smoked farmer sausage rings
- 55 gram sausage links, raw and not smoked

Sausages containing dwarf sour cherry products were tender and less chewy than many other types of sausage. From this observation, the question of using dwarf sour cherry products as a meat tenderizer arose. With the cooperation of Paul Rogers and Ryan Sefton from The Meat Group in the Department of Applied Microbiology and Food Science in the College of Agriculture, we conducted a meat tenderizing trial using dwarf sour juice and bison roasts.

1.5.2 Meat Tenderizing Trial

Introduction

Water retention improves the tenderness of meat. Myosin and actin are myofibrillar proteins in meat that are salt soluble. Myofibrillar protein is solubilized with a combination of lean meat, salt and mechanical action. Salt soluble protein traps water thereby increasing tenderness. Brine solutions are typically prepared with water, salt and sodium tripolyphosphate and tumbled under vacuum. Sodium tripolyphosphate is added to raise the pH of the meat to neutral or slightly alkaline to aid in the uptake of water by salt soluble proteins.

Materials and Methods

Brine solutions containing combinations of water, dwarf sour cherry juice, salt and sodium tripolyphosphate were injected into bison roasts with a needle injector.

Table 1.7 describes the treatments applied to three bison roasts used in the meat tenderizing trial.

Table 1.7 Bison roasts tenderizing treatments.

Treatment #1	No treatment	
Treatment #2	Control brine:	9.36% water 1.00% salt 0.35% sodium tripolyphosphate
Treatment #3	Test brine:	3.36% water 6.00% dwarf sour cherry juice 1.00% salt 0.35% sodium tripolyphosphate

Adapted from Sefton 2004.

All treatments were tumbled (mechanical action) under vacuum at 9 RPM for 3 hours to ensure that the brine was evenly distributed throughout the meat. Treated bison roasts were cooked in a covered container at 350°F until the internal temperature reached 71°C. Treatments were cooled at room temperature for ½ hour and then placed in a 4°C cooler overnight. Next day, the meat was cut into uniform core samples ½" x ½" x 1.5" and tested for tenderness in a shear press. A model TMS-2000 texture system manufactured by the Food Tech. Corp. was used to perform shear tests that simulate biting.

Results and Discussion

Adding dwarf sour cherry juice as a component of the treatment brine resulted in a more tender meat product than the untreated sample. The dwarf sour cherry treatment #3 was less tender than the product that was treated with the control treatment #2 using water, salt, and sodium tripolyphosphate. Sodium tripolyphosphate is added to raise the pH of the meat to neutral or slightly alkaline. This is necessary to move the meat further from the isoelectric point, which is pH 5.2 in muscle (meat). Adding dwarf sour cherry juice to the brine solution affected the pH of the brine because cherry juice is acidic. The pH was not moved sufficiently toward alkalinity thereby negatively affecting the water holding capacity of the meat, which in turn affected the tenderness of the meat. However, as mentioned earlier, samples from treatment #3 were tenderer than samples from untreated meat. Table 1.8 outlines the shear test values of the three treatments.

Table 1.8 Shear test values for treated bison roasts.

	Treatment #1	Treatment #2	Treatment #3
	59.01	73.21	55.53
	65.53	56.80	57.64
	77.20	51.64	27.45
	60.79	41.75	63.21
	67.63	52.59	38.60
	63.84	64.48	28.71
	76.68	65.53	48.91
Average	67.24	58.00	45.72
Minimum	59.01	41.75	27.45
Maximum	77.20	73.21	63.21
Std. Dev.	7.2	10.5	14.3

University personnel were allowed to taste the three meat products and asked their opinion. Initial reaction to the addition of cherry juice to the brine solution was favourable.

Salt soluble protein traps water thereby increasing meat tenderness. Enzymatic breakdown of connective tissue in muscle fibres also contributes to tenderness. Enzymes contained in pineapples are known to tenderize meat but it is unknown if dwarf sour cherries contain enzymes that contribute to tenderness. Further testing is required to ascertain whether or not dwarf sour cherries contain enzymes responsible for tenderizing meat.

1.6 Antioxidant Testing

There are various methods available for the measurement of antioxidant capacity. Published journal articles contain antioxidant values for numerous food products. It is difficult to compare the values because a standardized method is not used to determine the antioxidant capacity. Therefore, it is important to develop a standardized protocol for our own use to measure the antioxidant capacity of Prairie grown fruit.

Preliminary protocol development for antioxidant activity of dwarf sour cherry selections located at the University of Saskatchewan Research Facility was done at the Saskatchewan Structural Science Centre on the University of Saskatchewan campus. Equipment used for preliminary protocol development was the Bruker Electron Paramagnetic Resonance machine. It was apparent early in the project that we did not have sufficient funding in this grant to spend the time required for further protocol development.

1.7 Freeze Dried Fruit

Saskatoon berries and dwarf sour cherries were freeze dried by personnel from the Department of Applied Microbiology and Food Science. Excellent products were created from both fruits. Freeze dried dwarf sour cherries are being utilized by students from an Agricultural Economics class to fulfil a request from the College of Agriculture. Following is a summary of the protocol supplied by the dean's office.

College of Agriculture
Proposal: Chocolate, Cherry, Chickpea Cluster
Prepared by: Jon Treloar
Community Liaison Coordinator

The College of Agriculture is pursuing the development of a one piece confectionary to be used as a promotional product and gift. The proposed item is a chocolate, cherry, chickpea cluster to be packaged with College of Agriculture insignia. The product incorporates dried sour cherries and dehydrated chickpea varieties developed and/or grown by the College of Agriculture.

In the simplest form, the chocolate will be available as a give-away at trade and education fairs around western Canada. An elaborate gift box of the chocolates will also be created to have on hand in the College to give away as a unique, made in Saskatchewan gift.

Student Enrolment and Services Division has expressed interest in purchasing large quantities of the product to be used to promote the University of Saskatchewan.

1.8 Product Development

Cherry fruit harvested for processing quality was utilized in for product development.

1.8.1 Fruit Integrity Experiment

Introduction

Rumtopf is a popular European fruit product that is served during the festive Christmas season with ice cream, yogurt, waffles, pancakes and pound cake. It is fruit that has been aged and fermented in either rum or bourbon. Fruit is sprinkled with sugar, covered with the choice of liquor and left to stand a cool place for approximately three months. Preparation instructions suggest using previously frozen fruit, and in particular, fruit that does not disintegrate after freezing. Individual rumtopf recipes were prepared with previously frozen prairie hardy fruits to test their integrity after freezing and soaking for several months in a rum and sugar solution. Locally grown fruits chosen for the study included dwarf sour cherries, saskatoon berries, and 'Patterson Pride' plums. Domestic

blueberries from British Columbia were also tested to compare their integrity with saskatoon berries.

Results and Discussion

Dwarf sour cherries, saskatoon berries and 'Patterson Pride' plums maintained their integrity. Domestic blueberries essentially disintegrated in the solution. Individual rumtopf recipes were tested as cake and ice cream topping and as a component of a beverage. The ability to identify the fruit was received favourably when tested compared to the unidentifiable blueberry recipe.

The ability of previously frozen fruit to maintain its integrity after heating will be tested in 2005 during the preparation of fruit cups using Prairie hardy fruits.

1.8.2 Substitution Testing

Introduction

Dwarf sour cherries and domestic cranberries (*Vaccinium macrocarpon*) have astringent fruit; also, there is an abundance of recipes available using fresh, frozen and dried cranberries. From these two observations, tests were conducted substituting dwarf sour cherries for cranberries in several recipes. Composition of cranberry and dwarf sour cherry fruit is outlined in Table 1.9.

Table 1.9 Composition of cherry and cranberry fruit.

Fruit	% Water	Titratable Acidity meq	Brix
Cranberry	88.00	30.0	4.0
Dwarf Sour Cherry	82.00	21.2	18.4

Cranberry data from http://members.tripod.com/~BRotter/CalcInfo/FruitIn.htm and Eck 1990.

Materials and Methods

Dwarf sour cherries were substituted in recipes to test their performance against domestic cranberries. Dwarf sour cherry and cranberry quantities were substituted one for one in all recipes. Water and sugar quantities were not altered. Recipes tested for ingredient substitution are outlined in Table 1.10.

Table 1.10 Recipe and ingredient substitution of cranberries with dwarf sour cherries.

Recipe	Original Ingredient	Substituted Ingredient
Plum Conserve	Dried Cranberries	Dried Dwarf Sour Cherries
Cranberry Scones	Dried Cranberries	Dried Dwarf Sour Cherries
Cranberry Ketchup	Fresh/Frozen Cranberries	Frozen Dwarf Sour Cherries

Results and Discussion

All recipes containing the substituted ingredient were as good as or superior to the recipe containing the original ingredient. Initial testing suggests that substituting dwarf sour cherry fruit for cranberry fruit is an option for future processors and consumers on the Canadian Prairies.

1.8.3 Prairie Berry Pie Filling

Various combinations of dwarf sour cherry, saskatoon, and apple fruit were tested in pie filling preparations. It was observed that dwarf sour cherry fruit and saskatoon fruit have competitive flavours when used in pie filling making it difficult to develop a unique flavoured product. More testing was planned in 2005using 'Patterson Pride' plums as an ingredient in an attempt to develop a pie filling with unique flavour. No further testing was performed in 2005 on products containing saskatoon berries. The saskatoon berry crop at the Horticulture Research Plots were decimated by entomosporium leaf and berry spot in 2005.

1.8.4 Saskatoon Berries Destined for the Fresh Market and the Implication of Stem Scar Tearing

Introduction

Fresh market fruit is susceptible to pathogen invasion and dehydration at stem scars. Tearing at the stem scars increases the probability of these problems from occurring.

Materials and Methods

Hand-harvested saskatoon fruit from the 2003 growing season was thawed and observed for stem scar tearing. One-hundred berries from four cultivars were observed for the presence/absence of tearing at stem scars. Results are outlined in Table 1.11.

Table 1.11 Saskatoon berry stem scar tearing.

Cultivar	Number of berries out of 100 with tearing at the stem scar
Honeywood	34
Smoky	33
Northline	14
Thiessen	10

Results and Discussion

The highest frequency of stem scar tearing was observed on the cultivars Honeywood and Smokey. Decreased frequency of tearing was observed in less ripe fruit from 'Honeywood' berries. The two cultivars Northline and Thiessen had the least amount of tearing at the stem scar site. 'Northline' berries have an inherently cleaner stem scar than the larger berries of 'Thiessen'. Less juice was released from the stem scars of 'Northline' berries than from 'Thiessen' berries. Initial testing suggests that 'Northline' fruit may be the best fruit destined for the fresh market. Less tearing at the stem scar decreases the opportunity for pathogen invasion and less juice released at the cleaner stem scars decreases dehydration.

1.9 Apple Sensory Testing

At least 31 people evaluated 40 apple selections using the Hedonic Personal Scale and one data sheet for each apple selection. The score indicates an average of appearance, texture and flavour that has been converted to a percentage (Table 1.12). The results are based on all sensory data collected for the fall 2004 crop.

Table 1.12 Apple sensory data 2004 fall crop.

Selection Number	Score	Selection Number	Score
s4-10-43	80.4	s18-23-20	72.5
s18-10-32	80.0	s18-6-11	72.5
s18-7-9	79.6	Haralson	72.1
s5-2-52	79.6	s5-2-43	71.7
s5-12-22	78.3	s4-16-14	71.3
s4-6-48	78.3	s5-2-47	70.8
s18-4-6	77.9	s5-5-42	70.4
Moose Jaw	77.5	s5-4-14	70.0
s4-11-48	77.1	s18-11-5	70.0
s18-7-10	76.7	s5-2-47	69.6
s4-4-34	76.3	s18-17-25	69.2
s18-4-14	75.8	s18-22-23	68.8
s18-4-6	75.8	s18-8-9	68.3
s4-11-44	75.8	Norkent	68.3
s5-19-20	75.4	Goodland	67.9
s5-19-20	75.4	s4-6-46	67.9
s18-9-8	75.0	s5-6-33	67.1
s18-22-23	75.0	s4-18-13	67.1
s18-19-13	74.6	s18-17-11	66.3
s5-9-33	74.2	s5-5-79	63.8
s18-19-13	74.2	Carlos Queen	63.3
s18-5-18	73.8	s18-10-19	63.3
s5-12-22	73.8	s4-16-26	61.3
s18-17-11	73.8	s4-6-30	59.6
s4-4-35	73.3	s4-13-43	59.2
s18-17-3	73.3	s5-18-8	58.8
s18-10-32	72.9		
		Average	**71.8**

Table 1.13 itemizes the best apple selections shortly after harvest from the 2004 growing season. The score indicates an average of appearance, texture and flavour that has been converted to a percentage. Results are based on 2004 score sheets that were dated October 22nd and earlier.

Table 1.13 Best apple selections shortly after harvest (October 22, 2004 and earlier).

Selection Number	Score	Selection Number	Score
s5-2-52	81.7	s18-7-10	73.8
s18-10-32	80.8	s5-5-42	73.3
s18-7-9	80.0	s18-9-8	73.3
s4-10-43	80.0	s5-12-22	73.3
s18-11-5	78.8	s4-16-14	72.1
Moose Jaw	78.8	s18-23-20	71.3
s4-11-48	78.8	s5-6-33	70.4
s4-11-44	78.3	s18-22-23	70.4
s5-9-33	77.5	s18-17-11	70.4
s18-4-14	77.1	s4-18-13	70.4
s5-12-22	76.7	s18-17-25	70.0
s5-19-20	76.3	s5-5-79	70.0
s18-6-11	75.8	s4-4-35	70.0
s18-17-3	75.8	s18-17-11	69.6
s18-19-13	75.8	Goodland	68.8
Norkent	75.8	s18-8-9	68.3
s5-4-14	75.0	s18-22-23	65.8
s4-6-48	75.0	s4-16-26	65.4
s5-2-43	74.6	Carlos Queen	64.6
s4-6-46	74.6	s18-10-19	63.8
s18-4-6	74.2	s4-13-43	62.1
s18-10-32	73.8	s5-18-8	57.1
		Average	**72.9**

Table 1.14 itemizes apple selections with storage potential from the 2004 growing season. The score indicates an average of appearance, texture and flavour that has been converted to a percentage. Results are based on 2004 data sheets dated October 23rd and later.

Table 1.14 Apples with storage potential (data sheets dated October 23, 2004 and later).

Selection Number	Score	Selection Number	Score
s4-10-43	83.3	s18-6-11	71.3
s4-6-48	82.9	s18-17-3	70.8
s18-7-10	82.1	s5-2-47	70.4
s18-10-32	80.4	s18-22-23	69.6
s5-12-22	79.6	s18-8-9	69.6
s5-2-52	77.5	s18-17-25	69.2
s18-22-23	77.1	s4-16-14	69.2
s18-7-9	76.7	s5-12-22	68.8
s18-9-8	76.7	s5-2-43	67.9
s18-4-6	76.3	Goodland	66.3
s4-11-48	75.8	s4-6-46	65.8
s18-4-6	75.8	s5-4-14	65.4
s18-17-11	75.8	s5-9-33	65.0
s5-19-20	75.4	s18-17-11	64.2
s4-11-44	75.4	Carlos Queen	63.8
s5-19-20	75.4	Norkent	63.8
Moose Jaw	75.4	s4-18-13	63.8
s18-23-20	75.0	s18-10-19	62.9
s18-19-13	75.0	s18-11-5	62.5
s4-4-35	75.0	s5-5-42	61.3
s4-4-34	74.6	s4-16-26	60.8
s18-19-13	74.2	s5-6-33	60.4
s18-10-32	73.8	s5-18-8	59.6
s18-5-18	73.3	s4-6-30	59.6
s18-4-14	73.3	s5-5-79	57.1
s5-2-47	72.5	s4-13-43	56.3
Haralson	72.1		
		Average	**70.7**

2.0 Establishment of Mechanically-harvested Demonstration Orchards

2.1 Seager Wheeler Orchard

Dwarf sour cherry plants were raised by the University of Saskatchewan for the orchard but they were not planted in 2004 because the irrigation system was not fully implemented.

2.2 Bruno Demonstration Orchard

The demonstration orchard was completed; 900 dwarf sour cherry seedlings and a windbreak were planted, and a fence was installed.

2.3 University of Saskatchewan Research Orchard

The cherry orchard in block 18 that is designated for mechanical harvesting was doubled in size to ½ acre (X hectares). Rows were extended northward with seedlings and clonally propagated plants. Seedlings were planted closer together to allow for selection. Clonally propagated plants were spaced correctly.

More blue honeysuckle plantings were established; one rep was dispersed with strawberry plants; 2 reps x 6 plants x 40 cultivars were planted in the field.

3.0 Selection and Distribution of Superior Clones for Commercial Production

3.1 Advanced Cherry Selections and Licensed Propagators

There are currently 11 licensed propagators of dwarf sour cherries. Approximately 4000 sets of 5 numbered cherries were sold in 2004. 'SK Carmine Jewel' is being sold at a higher frequency at Garden Centres.

4.0 Breeding and Distribution of Planting Material to Growers

4.1 Breeding

4.1.1 Breeding Summary

Dwarf sour cherries, strawberries, plums, sandcherries, and chokecherries were emphasized for crossing in recent years. In most cases, open-pollinated seeds were selected from specific individuals with desirable traits and not from all members of any given population (Table 4.1).

Table 4.1 Fruit breeding at the University of Saskatchewan.

	Crosses Done		
Crop	**2003**	**2004**	**2005**
Apple	X		
Blue honeysuckle		X, OP	X, OP
Cherry, Dwarf Sour	XX, OP	X,OP	X,OP
Chokecherry *			XX
Hazelnuts	OP	OP	OP
Missouri Currents *		OP	
Plum	X	XX	
Sandcherry*	X	XX	
Saskatoon *		OP	
Strawberry	XX,OP	OP	X,OP

X = some crosses were done (< 500)
XX = crosses, major emphasis (>500)
OP = Open Pollinated seeds collected
* = Native crops relatively new to our program

4.1.2 Fruit Breeding and Germplasm Development

Our fruit program has the only large collection of fruit species in the Prairie Provinces and is in fact the coldest location in North America where there is a large collection of fruit species and varieties. We are located in hardiness zone 2 while most other fruit programs in Canada are hardiness zone 5 or warmer. We maintain 22 acres of fruit and hundreds of varieties and 10 of thousands of seedlings of more than 30 species.

With limited financial resources we have adopted the practice of cycling through crops for breeding. Larger numbers of crosses are done with those crops that are close to being a commercial crop. Perhaps $1/4^{th}$ of our efforts during crossing season in any year are for long term germplasm improvement. With the recent disbanding of the Native fruit program, we have started some cycling through the native crops. When we do such cycling through minor crops, excess seeds and seedlings are made available to cooperating growers.

4.1.3 Fruit Breeding by Crop

Breeding of **Dwarf Sour Cherries** used the best parent identified in ADF # 98000082. With this cycle of breeding we hope to recombine the high quality and larger fruit size on the European cultivars used in the last cycle of breeding.

Breeding of **Strawberries** used the best parents identified in ADF# 19990319-42BX. The goal for this cycle of breeding is enhanced flavour and disease resistance.

Plums and **Sandcherries** (actually a miniature plum, not a cherry) were intercrossed and some large plum varieties from B.C. were used as parents. Plums have not been

improved on the prairies for over 40 years. Recently we discovered that the sandcherry was easily pitted using our sour cherry pitting machine. It may be that small sized fruit (like a sandcherry) could be mechanically harvested if it were borne on a larger tree (like a plum).

Chokecherries were bred following a co-operative project with Dr. Martin Reaney. After analysis of several large-seeded species in our collection, Dr. Reaney concluded that Chokecherry seeds have high levels of oils and that they could in fact out-produce any field grown oil crop on a per acre basis. The crosses done were between the best high-oil types and those having characteristics desirable for mechanized harvesting.

The other crops listed above were done for general improvement of the collection. The Blue honeysuckle will be covered in later section as it has special importance.

4.1.4 Plant Material Sent to Growers as Part of the Co-operative Fruit Breeding

While we grow much of out breeding material ourselves we have also release large numbers of seedling and advanced selections for testing (Table 4.2). Each co-operator signs an agreement with us that allows them the use of the trees or bushes for fruit production while the University retains rights to any new varieties that may arise.

Table 4.2 Plant material distributed to co-operators.

Fruit crop	Form	2003	2004	2005	Estimated numbers
Apple	rootstocks	X	X	X	500
Apple	budwood	X	X	X	25,000
Blue honeysuckle	clones		X	X	2,000
Blue honeysuckle	seedlings	X	X		700
Chokecherry	clones		X		60
Dwarf Sour Cherry	seedlings	X	X	X	25,000
Dwarf Sour Cherry	seeds	X	X	X	15,000
Pear rootstock	clones	X			50
Plum	seedlings	X	X		200
Plum	clones	X	X	X	50
Sandcherry	seedlings		X		600
Saskatoons	clones		X		250
Saskatoons	seedlings			X	200

Except for apple rootstock testing and exchanges of material with other researchers, much of this plant material in Table 4.2 was made on a cost recovery basis. Cooperating growers either made a donation to the program or paid a rental fee to cover greenhouse expenses. With sour cherries, growers assisted us by planting seeds in our greenhouse.

4.1.5 Blue Honeysuckle Trial and Breeding

During the last few years we have amassed the largest collection of Russian cultivars in North America and the second largest collection of Japanese seedlings. Table 4.3 and Table 4.4 list the cultivars and seedling lines in our collection. In addition to the Cultivar trial of 34 Russian varieties we have approximately 2000 seedlings of Russian descent and 2000 seedlings of Japanese descent in the field and an additional 1200 seedlings in the greenhouse.

The Russian seedlings were derived from crosses made between our original 4 cultivars obtained in 1998. 12 advanced selections were selected in 2005 that seem to have superior fruit size and acceptable flavour.

The Japanese seedlings and clones were all from the collection of Dr. Maxine Thompson (retired, University of Oregon). Early in 2005 Maxine sent seeds from controlled crosses to the U of S. In May of 2005, Bob Bors visited Dr. Maxine Thompson and assisted with the evaluation of her Blue Honeysuckle / Haskap collection. The clones in table 4.1 were selected and collected at that time. Dr. Thompson also had a sizable collection of Japanese Haskap products that were photographed (see figure 4.1). Dr. Thompson shared her expertise and collection of scientific papers that greatly assisted our understanding of this crop and of the Japanese market.

Tissue culture experiments were done by students with the six blue honeysuckle cultivars obtained from 'Magma Exports'. The University of Saskatchewan obtained propagation rights for these plants and sold plants to fruit growers and gardeners for test trials.

We have vegetatively propagated the 34 'Russian type' cultivars, which we received from Northwoods Nursery in Oregon, Vavilov Institute in Russia, and Magma Exports in Quebec, for a cultivar trial on the Horticulture Science field plots in Saskatoon. Two replications of six plants each of 18 blue honeysuckle cultivars were planted. A smaller trial was planted in Bruno, SK; there were three plants each of 18 cultivars.

There has been much work done this last year on developing this fruit crop. Plants of named cultivars and seeds have been collected from various sources. Dr. Maxine Thompson, who is associated with Oregon State University in her retirement, has been very co-operative in this regard in 2005.

A potentially huge market is developing with a Japanese food processors for blue honeysuckle (they call it 'haskap' or 'hasukappu') fruit produced in Saskatchewan and other Prairie Provinces. We are at the stage of developing a working relationship that will begin by exchanging fruit samples to determine how our fruit compares to theirs. The Northern Japanese Research Council for Agriculture and Fisheries has recently voted to make the 'Canadian Haskap Project' their first project. In the appendix are various publications we have sent to growers during the time of this grant that explain various aspects of this emerging opportunity.

Table 4.3 Blue honeysuckle collection (Russian types).

Variety	Source
Blue Bell	Northwoods Nursery Inc.
Blue Bird	
Berry Blue	
Blue Forest_ (Magadan)	
Blue Lightning_ (Zarnitsa)	
Blue Magic_ (N-17)	
Blue Moon_ (Sergey)	
Blue Nova_ (Novinka)	
Blue Pacific_ (F-1-9-58)	
Blue Sky_ (Valery no. 2)	
Blue Velvet	
Kamchatka_ (Kamchatskaya)	
Smoky Blue_ (Dimka)	
Altair	Vavilov Institute
Amfora	
Fialka	
Kamchadalka	
Lebedushka	
Malvina	
Morena	
Narymskaya	
Nimfa	
Omega	
Pushkinskaya	
Roksana	
Slavyanka	
Suvenir,	
Solovey	
Volkhova	
Berel	Magma Exports
Gerde	
Golunoe Vereteno	
Lazurnaya	
Narymskaya	
Ognenni Opal	
Total # of Accessions 34	

A variety trial containing the varieties listed in Table 4.3 was established in 2003 and 2004 at the University of Saskatchewan. A smaller observation trial was also established at Bruno, Saskatchewan in 2003 consisting of varieties from the Vavilov Institute. Using this collection as parents, 3000 seedlings have been raised.

Table 4.4 Blue honeysuckle collection (Japanese types).

Clones		Seedling Lines				
		Controlled crosses			Open pollinated	
22.14	45.14	20.21	X	20.63	21.16	44.76
22.34	46.55	20.21	X	28.21	21.58	44.96
22.42	56.15	20.85	X	21.17	22.14	45.14
22.61	64.72	20.85	X	19.81	22.34	46.55
22.72	66.53	21.73	X	21.78	22.42	56.15
26.72	66.89	21.73	X	22.37	22.61	65.59
40.134	73.39	21.73	X	22.63	22.72	66.53
41.83	77.87	22.26	X	20.04	26.72	71.14
41.9	c10	22.26	X	20.21	40.134	71.49
42.45	g14	22.26	X	20.39	41.83	74.68
43.87	g20	22.26	X	20.63	41.90	77.38
44.39	g23	22.26	X	21.20	42.45	77.67
44.76	Lon 22	22.64	X	19.87	43.87	77.74
44.96	Lon 29	22.64	X	20.39	43.87	77.87
		22.73	X	19.38	20.04 x 21.17op bulk	
		22.73	X	20.85	20.04 x Magadon	
		22.73	X	21.31	66.83 (20.21op)	
					Dovey (ornamental)	
					Dr. Nishimura's 6 selections mixed	
28 Clones						
17 Seedling lines from controlled crosses						
33 Seedling lines from open pollination						

The collection listed in Table 4.4 was obtained from Dr. Maxine Thompson of Oregon State University in 2005. Dr. Bors visited Dr. Thompson and selected the clones and open pollinated seeds. Controlled crosses were done by Dr. Thompson. Approximately 3500 plants resulted from this collection. Half were field planted in fall of 2005. The remaining plants are being grown in the greenhouse over the winter of 2005/2006.

4.2 Distribution of Planting Material to Growers

4.2.1 Cherry Seedling Distribution

Our co-operators were invited to the Agriculture Greenhouse Facility in February 2004 to plant stratified cherry seeds. This cost recovery operation supplied growers with media and containers (to be returned at a later date) in exchange for their labour and greenhouse space rental. For each tray of seeds that growers planted for themselves, a tray of seeds was planted for the fruit program. Trays of planted seeds were placed on the flood floor in the greenhouse facility and left to grow and develop for approximately four months. Participating growers were responsible for picking up their own trays of seedling plants. Most of the seeds that were planted had already germinated in the stratification medium; therefore the success rate of seedling establishment was high.

Seeds from the best 42 selections out of the original 2500 dwarf sour cherry plants were harvested in 2004. Seeds were cleaned and placed in stratifying medium in January. Seed treatment was deliberately delayed for the seeds from the 2004 harvest. Seeds from the 2003 harvest were treated too early resulting in early germination and overgrown plants in the greenhouse environment.

4.2.2 Distribution of Blue Honeysuckle Plants

Seedlings were sold to growers in 2004 at cost recovery. Approximately 2500 seedlings from the cultivars Blue Belle and Berry Blue were distributed to growers to establish plantings with the objective of selecting plants with better vigour for zones 2a and 2b. Observation of fruit size, fruit quality and variability in ripening dates will also be observed.

4.2.3 Apple Budwood Distribution

In 2004, 3 apple selections were described as 'most promising' and 16 apple selections were described as 'promising'. Budwood distribution dates in 2004 were August 6th, August 12th, and August 19th. Shipments sent to co-operators totalled 35. Co-operators requested bud wood of 58 selections and 7 check cultivars to bud a total of 8757 trees. Approximately ten percent extra buds were sent to allow for practice and mistakes. Some of the extra buds were used to redo buds on trees that did not take in 2003.

VI. EXTENSION ACTIVITIES

ACTIVITIES 2003

Pruning Apprenticeship/Workshops
These were scheduled from Monday, April 21, 2003 till Friday, April 25, 2003. There were morning and afternoon sessions with between one and three growers per session. Twelve growers participated. We considered these workshops successful and are planning more for late April 2004, probably on April 22, 23, 26, 27 and 28.

Apple Thinning Apprenticeship/Workshops
These workshops were held in the University of Saskatchewan orchards on June 26 and 27, 2003 and were attended by four growers. We anticipate that interest will increase as the test orchards mature. These workshops will be held on June 29 and 30, 2004.

Horticulture Field Day and Apple Propagation Workshops 2003
A propagation workshop and field tour was held on August 8, 2003 with 46 people attending. The people were divided into two groups. While one group did the propagation workshop the other group went on the field tour. The groups switched activities in the afternoon.

The field tour briefly covered a majority of the projects being done on the Horticulture field plots but most of the time was spent in the orchards and nurseries where various stages of fruit tree propagation and culture were shown.
The propagation workshop was held in the Horticulture Field Lab. The focus again this year was bud grafting techniques, specifically T-budding and Jones budding. Attendees were asked to bring their own budding knife. The apple budwood and stock that were used for practice were cut from University of Saskatchewan trees.
Another propagation workshop was offered at Seager Wheeler Farm in Rosthern on August 12, 2003. Of the 70 people who attended very few were co-operators in our program or had an interest in co-operating with us. Most were hobbyists. Because this large turn-out was unexpected, we didn't have enough materials and demonstrators there to teach the propagation techniques properly.
This summer we plan to have the propagation workshop and field tour on Friday, August 6, 2004 and a backup propagation workshop in Bruno on Saturday, August 14, 2004 during the Cherry Weekend.

Days for Apple Samples
Originally called 'Apple Tasting Days, the new name for this event will be 'Apple Samples Day' to be more descriptive of our new procedure. In 2002 co-operators and others came to the Horticulture Field Lab to taste the apples and complete evaluation forms. This was both awkward and tiring. Peoples' sensory ability wore out quickly. In 2003 growers and interested people collected and labelled an apple of each selection and took them home along with evaluation forms and instructions to do the sensory work at their convenience. The mailed or delivered the sensory forms when they were finished. This worked well and large amount of data was collected. Sixty six people evaluated up to 56 samples giving us 10 data points per apple including date. Approximately 21,000 points of data were summarised and analysed.

Last year we had two days to pick up apple samples, one for early ripening apples and one for later ripening apples. We received many suggestions to make this more convenient by having just one samples day. This year we will keep the earlier ripening samples in cold storage at zero degrees Celsius and distribute them with the later ones in early October.

Hazelnut Interest
Hazelnuts were the subject of a magazine article written by one of our former students and published in the Gardener for the Prairies magazine. The article outlined the hazelnut breeding and development work that has been done on the Canadian Prairies since the early 1900s and is continuing at the University of Saskatchewan under the Domestic Fruit Program. It was stated in the article that we are looking for co-operators who could offer test sites for developing this nut crop and to date 84 interested growers have responded.

Other Extension Activities
In total six workshops and three field tours were held for growers. Presentations were made to the Alberta Horticultural Congress and the Saskatchewan Fruit Growers

Association. It seemed that the phone never quit ringing and that the email was incessant. Written information and notices were given and sent to co-operators. Some are appended.

Propagators Licensed to Grow and Sell Our Test Fruit Selections
Three more companies have just been added to the following list.

ACTIVITIES 2004

During 2004, numerous extension activities were undertaken that acknowledged the work of the Domestic Fruit Program and the support received from the Agricultural Development Fund.

March 15, 2004, 7:00 p.m. to 9:00 p.m.

> **Dr. Bob Bors** spoke about key factors for **building a fruit industry in Saskatchewan** including mechanized fruit production, organic fruit and co-operatives. This was part of the environmental stewardship series held in the Legion Hall at Craik, SK.

March 27, 2004, 12:00 noon

> **Dr. Bob Bors** spoke on **"Fruit for Saskatchewan"** at Gardenscape, Western Canada's largest garden show in Saskatoon, SK, at Prairieland Exhibition Park.

April 1, 2004, 1:00 p.m. to3:00 p.m.

> **Dr. Bob Bors** spoke on **"Growing Fruit in Saskatchewan: Apples, Cherries and more"** at the Exhibition Centre on the Exhibition Grounds, 6th Ave & 10th St. E. in Prince Albert, SK.

April 3, 2004, 11:15 a.m. to 12:00 noon

> **Dr. Bob Bors** spoke on **"Breeding in Horticulture"** as part of 'Seedy Saturday' sponsored by a local group that saves seeds, mostly heirloom vegetables and flowers. There were various speakers, displays and seed and plant sales from 10:00 a.m. to 5:00 p.m.

April 22, 23, 26, 27, 28, 2004

> **Pruning Workshops** were held at Horticulture Field Lab, 2909 14th Street, Saskatoon SK. Participants learned how to prune dwarf and standard apple trees by asking questions and working with the domestic fruit crew in the University of Saskatchewan orchards. This was a good opportunity for the growers to get personal instruction.

June 2, 2004

Dr. Bob Bors and **Rick Sawatzky** gave **orchard tours at Seeding Trends**, which was held at the Seager Wheeler Farm National Historic Site, east of Rosthern, SK on Hwy 312.

August 6, 2004

Propagation Workshop and Field Tour. The objective at the workshop was to help growers become comfortable and competent in budding their own apple trees. The field tour and fruit propagation workshop was held at the Horticulture Field Lab, 2909 14th Street, Saskatoon SK.

Activities:

10:00 a.m. Approximately half the group did a tour of the horticulture research plots (The other half did the propagation workshop). Basic information was given on all of the department's on-site field activities but the focus was on the Domestic Fruit Program's research and development projects.

12:00 Noon Everyone was responsible for their own lunch.

1:30 a.m. The people who did the field tour in the morning attended the apple propagation workshop in the afternoon focusing on the bud-grafting technique (budding). (The others went on the field tour.) Participants were given detailed instruction and an opportunity to practice. Participants had ample opportunity to receive individual attention from the instructors and to ask questions related to domestic fruit production.

3:30 p.m. The workshop was officially over by this time but some stayed for extra help and to ask questions.

August 14 and 15, 2004

The Bruno Cherry Festival was held in Bruno, SK. Most of the activities focused on fruit growing in Saskatchewan, specifically on cherries. Dr. Bob Bors and staff of the Domestic Fruit Program taught propagation techniques and were among the speakers who addressed a variety of topics.

Dr. Bob Bors spoke about **Starting an Orchard.**

Linda Matthews spoke about **Fruit Processing Research** and the **Saskatoon Food Centre** facility.

The University of Saskatchewan, Extension Division and the Department of Plant Sciences along with SAFRR, the Carlton Trail Agricultural Society and the Saskatchewan Fruit Growers Association sponsored the event.

October 4, 2004, 12:00 noon to 4:00 p.m.

Apple Samples Pick Up. Co-operators and other interested people were invited to stop by the Horticulture Field Lab in the afternoon to pick up and take home a bag containing one apple each of many of our apple selections. Each participant labelled and bagged their own samples (bags and sticky labels were provided). Also, available were a page of instructions and some score sheets, which were completed and returned to us at a later date. Samples of products prepared by Linda Matthews as part of the value added research were available for tasting.

November 29, 2004, 4:00 p.m. to 6:00 p.m.

Book launch for the publication ***Dwarf Sour Cherries: a Guide for Commercial Production*** was held at the Faculty Club, University of Saskatchewan.

The cover is shown in Figure VI.1, and the guide contains information of the following topics:

- new cultivars and the history of their development
- propagation
- orchard establishment
- cultural practices, including water and soil requirements, weed control, and pruning
- pests and disease control
- organic production
- harvest, post-harvest handling, and storage
- processing
- marketing

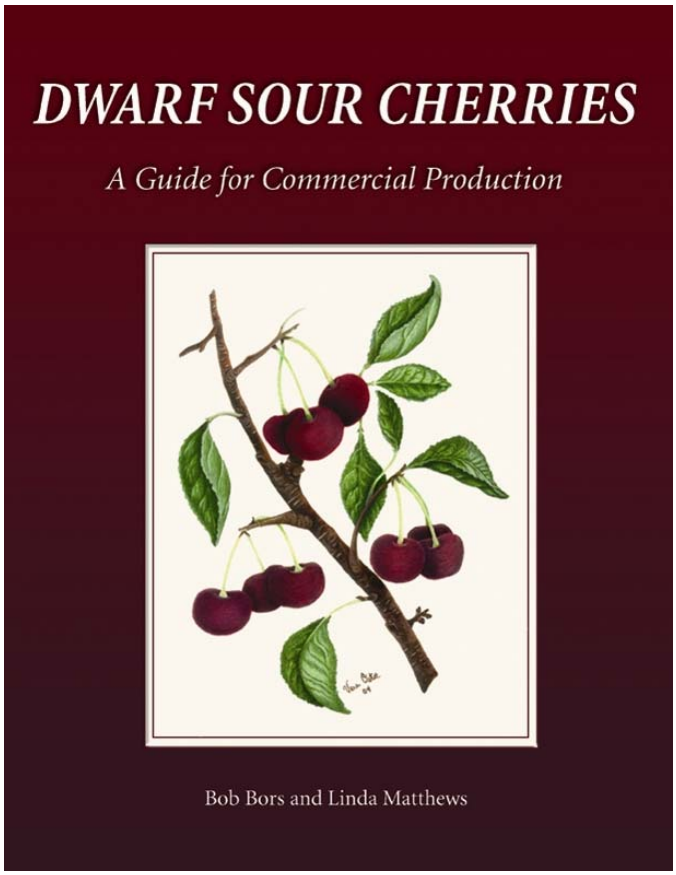

Figure VI.1 Cover of Dwarf Sour Cherry Guide

Funding for writing the manual was provided by the Cyril Capling Fund, administered by the College of Agriculture at the University of Saskatchewan.

Funding for research material included in the guide was provided by the **Agriculture Development Fund (Domestic Fruit Development Program: grower-assisted fruit breeding and value-added research).**

ACTIVITIES 2005

February 5, 2005, 10:00 a.m. to 4:00 p.m.

> **Linda Matthews** spoke on **"Processing Your Harvest"** and assisted a local chef with **preparation of food containing dwarf sour cherries, 'Patterson Pride' plums and saskatoon berries** at the Master Gardener Update held at the University of Saskatchewan.

February 23, 2005, 7:00 p.m. to 9:00 p.m.

Bob Bors and Linda Matthews spoke about dwarf sour cherries at a **book launch** for the publication ***Dwarf Sour Cherries: a Guide for Commercial Production*** at McNally Robinson Booksellers at 3130 – 8th Street East, Saskatoon.

February 24, 2005

Cost of Cherry Production Workshop**, Prairie Ursuline Centre, Bruno, Sask. Joe Novak from SAFRR presented a draft version about the cost of sour cherry production and requested input from growers about the draft.**

February 26, 2005

Presentation: ***'Tree Fruit Production'*** -Saskatchewan Farmers Market Association, North Battleford

March 4 & 5, 2005

Alberta Berry School, Niskew Alberta
Bob Bors & Clarence Peters spoke at this event

April 2 and April 3, 2005

Bob Bors was the **guest speaker at Gardenscape**, Western Canada's largest show in Saskatoon, SK, at Prairieland Exhibition Park. He promoted the **Dwarf Sour Cherry Manual.**

Linda Matthews spoke about **processing dwarf sour cherries** at Gardenscape, Western Canada's largest garden show in Saskatoon, SK, at Prairieland Exhibition Park.

The Plant Sciences booth featured fruit species.

April 22, 2005

Pruning Workshop, Radville, SK

April 25 to 29, 2005

Pruning Workshops

Learn how to prune dwarf and standard apple trees. Hands-on workshop in the University of Saskatchewan orchards (Horticulture Field Lab). This was a good **opportunity to get personal instruction.**

May 11, 2005

Spring Workshop, Seager Wheeler Farm, Rosthern, SK

June 2005

Blue Honeysuckle Day

Growers came see the blue honeysuckles when they were ripe at the U of S. Blue honeysuckle plants were available for sale/pickup at that time. Unlike previous years where seedlings were sold, 6 named varieties from Russia were sold for testing. Plants were raised in the greenhouse.

June 3, 2005

Seeding Trends, Seager Wheeler Farm, Rosthern, SK

June 23, 2005

Fruit Thinning Workshops

Location: Horticulture Field Lab, 2909 14th Street, Saskatoon SK.
Agenda: There were two identical sessions starting at 8:30 a.m. and 1:00 p.m.

July 24 to 27, 2005

International Master Gardener's Conference, Saskatoon, SK

August 13 and August 14, 2005

Bruno Cherry Festival

Bob Bors spoke **about cherry production** and participated in **grower panels**.

Rick Sawatzky participated in **grower panels**.

Linda Matthews spoke about the **Health Benefits of Dwarf Sour Cherries** and **Value Added Research 2004**.

August 12, 2005

Propagation Workshop and Field Tour

The objective of the workshop was to help you become comfortable and competent in budding your own apple trees.

Location: The field tour and fruit propagation workshop was held at the Horticulture Field Lab, 2909 14th Street, Saskatoon SK.

Agenda:

10:00 AM Approximately half the group will do a tour of the horticulture research plots (The other half will do the propagation workshop). Basic information will be given on all of the department's on-site field activities but the focus will be on the Domestic Fruit Program's research and development projects.

12:00 Noon Everyone will be responsible for their own lunch.

1:30 PM The people who did the field tour in the morning will now do the apple propagation workshop focusing on the bud-grafting technique (budding). (The others will go on the field tour.) Participants will be given detailed instruction and an opportunity to practice. Participants will have ample opportunity to receive individual attention from the instructors and to ask questions related to domestic fruit production.

3:30 PM The workshop should be over by this time but extra time is available.

August 12, 18 and 25, 2005

Budwood Shipping Dates

September 9, 16, and 23

Volunteer Picking

Location: Horticulture Field Lab, 2909 14th Street, Saskatoon SK. Please phone Rick at 306 978 8316 or email rsawatzky@sasktel.net to make an **appointment.**

APPENDIX A

Fruit Articles

a) Recommended Fruit Varieties, 2005
b) Opportunities for Cherry Production in Saskatchewan
c) History of Commercial Apple Production on the Prairie
d) Dwarf Sour Cherries for the Prairies
e) Plums on the Prairies
f) Opportunities for Fruit Production in Saskatchewan
g) Hardy Sour Cherries: Choosing Varieties, Systems and Markets
h) Blue Honeysuckle
i) Haskap Growers Unite
j) Shocking News about Haskap for Growers
k) Haskap & Japan
l) Haskap Research & Opportunities

APPENDIX B

Province of Saskatchewan

Certificate in Safe Food Handling

Linda Matthews

has successfully completed all requirements of the

Food Handler - Food Safe

Dated this 17 day of August 20 05

L. Rea

Public Health Officer

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