

Brewing With Fruit

Kevin Wright – Hangar 24 Brewery

Overview

- Fruit Characteristics important to Brewing
- Available Fruit Products
 - Manufacture of
 - Processing Pros/Cons
- Adding Fruit to Beer
 - When in process
 - Yeast Impacts
 - Flavor Impacts
- Microbiological Impact

Nutrient Content (Fresh Fruit)

	Sugar (%)	Water (%)	Protein (%)
Fig	16.3	91.5	2.6
Grape (Table)	15.5	91.0	1.7
Pomegranate	13.7	90.9	1.4
Mango	12.7	89.0	1.4
Cherry (Sweet)	12.8	88.9	1.4
Banana	12.2	88.3	1.2
Kiwi	11.0	88.2	1.2
Tangerine	10.6	88.1	1.1
Apple	10.4	87.2	1.1
Blueberry	10.0	87.1	1.1
Plum	9.9	86.8	1.0
Pineapple	9.9	86.4	0.9
Pear	9.8	86.1	0.9
Orange	9.4	86.0	0.8
Apricots	9.2	85.8	0.8
Guava	8.9	85.2	0.8
Cherry (Sour)	8.5	85.0	0.7
Peach	8.4	84.2	0.7
Papaya	7.8	84.0	0.7
Currant (red)	7.4	83.7	0.7
Grapefruit	7.0	83.5	0.7
Watermelon	6.2	83.2	0.6
Strawberry	4.9	82.3	0.6
Blackberry	4.9	80.8	0.5
Raspberry	4.4	80.5	0.5
Cranberry	4.0	79.1	0.4
Lemon	2.5	77.9	0.4
Lime	1.7	74.9	0.3
Watermelon		91.5	2.6
Strawberry		91.0	1.7
Grapefruit		90.9	1.4
Lemon		89.0	1.4
Peach		88.9	1.4
Lime		88.3	1.2
Blackberry		88.2	1.2
Papaya		88.1	1.1
Plum		87.2	1.1
Cranberry		87.1	1.1
Orange		86.8	1.0
Apricots		86.4	0.9
Cherry (Sour)		86.1	0.9
Pineapple		86.0	0.8
Raspberry		85.8	0.8
Tangerine		85.2	0.8
Apple		85.0	0.7
Blueberry		84.2	0.7
Currant (red)		84.0	0.7
Pear		83.7	0.7
Mango		83.5	0.7
Kiwi		83.2	0.6
Cherry (Sweet)		82.3	0.6
Guava		80.8	0.5
Grape (Table)		80.5	0.5
Fig		79.1	0.4
Pomegranate		77.9	0.4
Banana		74.9	0.3
Guava			2.6
Pomegranate			1.7
Apricots			1.4
Currant (red)			1.4
Blackberry			1.4
Kiwi			1.2
Raspberry			1.2
Lemon			1.1
Banana			1.1
Cherry (Sweet)			1.1
Cherry (Sour)			1.0
Orange			0.9
Peach			0.9
Mango			0.8
Tangerine			0.8
Fig			0.8
Blueberry			0.7
Grape (Table)			0.7
Lime			0.7
Plum			0.7
Strawberry			0.7
Grapefruit			0.6
Watermelon			0.6
Pineapple			0.5
Papaya			0.5
Cranberry			0.4
Pear			0.4
Apple			0.3

<http://www.ars.usda.gov/SP2UserFiles/Place/12354500/Data/SR24/reports/sr24fg09.pdf>

Nutrient Content (Fresh Fruit)

	Sugar	Water	Protein
Apricot	9.2%	86.4%	1.4%
Blueberry	10.0%	84.2%	0.7%
Cherry(Sour)	8.5%	86.1%	1.0%
Cherry(Sweet)	12.8%	82.3%	1.1%
Orange	9.4%	86.8%	0.9%
Raspberry	4.4%	85.8%	1.2%

Sugar Breakdown (Fresh Fruit)

	Total Sugars	Sucrose	Glucose	Fructose	Other
Grape (Table)	15.5%	1.0%	46.5%	52.5%	0.0%
Mango	13.7%	51.0%	14.7%	34.3%	0.0%
Cherry (Sweet)	12.8%	1.2%	51.4%	41.9%	5.5%
Banana	12.2%	19.5%	40.7%	39.7%	0.1%
Kwai	11.0%	0.5%	47.4%	51.7%	0.5%
Tangerine	10.6%	57.2%	20.1%	22.7%	0.0%
Apple	10.4%	19.9%	23.4%	56.8%	0.0%
Blueberry	10.0%	1.1%	49.0%	49.9%	0.0%
Plum	9.9%	15.8%	51.1%	30.9%	2.2%
Pineapple	9.9%	60.8%	17.6%	21.5%	0.0%
Pear	9.8%	8.0%	28.2%	63.6%	0.2%
Apricots	9.2%	63.5%	25.6%	10.2%	0.6%
Cherry (Sour)	8.5%	9.4%	49.2%	41.3%	0.0%
Peach	8.4%	56.7%	23.2%	18.2%	1.7%
Papaya	7.8%	0.0%	52.3%	47.7%	0.0%
Currant (red)	7.4%	8.3%	43.7%	47.9%	0.0%
Watermelon	6.2%	19.5%	25.5%	54.2%	1.0%
Strawberry	4.9%	9.0%	40.7%	49.9%	0.0%
Blackberry	4.9%	1.4%	47.3%	49.2%	2.0%
Raspberry	4.4%	4.5%	42.1%	53.2%	0.0%
Cranberry	4.0%	3.2%	81.2%	15.6%	0.0%

Sugar Breakdown (Fresh Fruit)

	Total Sugars	Sucrose	Glucose	Fructose	Other
Apricot	9.2%	63.5%	25.6%	10.2%	0.6%
Blueberry	10.0%	1.1%	49.0%	49.9%	0.0%
Cherry (Sour)	8.5%	9.4%	49.2%	41.3%	0.0%
Cherry (Sweet)	12.8%	1.2%	51.4%	41.9%	5.5%
Orange	9.4%	50.4%	23.2%	26.5%	0.0%
Raspberry	4.4%	4.5%	42.1%	53.2%	0.0%

Acidity (pH & TA)

- pH
 - Measure of [H+] ions
 - Dissociated
 - Gives indication of acidic "strength"
 - Many impacts (buffers)
 - Measured by Meter
 - More impact on Processes
- Total Acidity (TA)
 - Measures amount of Acids
 - Dissociated & Bound
 - Used Primarily in Wine & Mead Making
 - Measured by Titration
 - Malic, Citric & Tartaric
 - More impact on Taste & Mouthfeel
 - Wine Levels: 0.50% - 0.85%
 - Mead: 0.35% - 1.0%
 - Beer: 0.3% - 1.5%

Acidity (pH & TTA)

	Total Acidity (low - 5 High)	Taste	pH
Cranberry	5	Citric/Malic	2.4
Currant (red)	5	Citric	
Grapefruit	5	Citric	3.3
Kwai	5	Citric	
Lemon	5	Citric	2.3
Lime	5	Citric	1.9
Apricots	4	Malic	3.5
Blueberry	4	Citric	3.3
Cherry (Sour)	4	Malic	3.2
Guaia	4		
Orange	4	Citric	3.5
Raspberry	4	Citric	3.3
Tangerine	4		
Apple	3	Malic	3.6
Blackberry	3	Malic	4.2
Cherry (Sweet)	3	Malic	4.5
Grape (Table)	3	Tartaric/Malic	4
Pineapple	3	Citric	
Pomegranate	3		
Strawberry	3	Citric	3.4
Fig	2	Malic	
Mango	2		5.9
Peach	2	Malic	3.7
Plum	2	Malic	2.0
Banana	1	Malic/Citric	4.8
Papaya	1		
Pear	1	Malic	3.8
Watermelon	1		5.4

Acidity (pH & TTA)

	<u>Total Acidity</u>		
	1(low) - 5(High)	<u>Type</u>	<u>pH</u>
Apricot	4	Malic	3.5
Blueberry	4	Citric	3.3
Cherry(Sour)	4	Malic	3.2
Cherry(Sweet)	3	Malic	4.5
Orange	4	Citric	3.5
Raspberry	4	Citric	3.3

Tannins

- Polyphenol Compounds found in Grain Husks, Hops, Spices, Fruits, etc
- Astringency sensation in Mouthfeel
- Haze
- Balance in character
- Wide variety & intensity in Fruit Products
- Decrease as Fruits Ripen

Tannins in Fruit

- High Tannins
 - Apricots
 - Berries (Black, Blue, Rasp)
 - Currants
 - Peaches
 - Persimmons
 - Pomegranates
- Medium Tannins
 - Apples
 - Cherries
 - Grapes
- Low or No Tannins
 - Bananas
 - Citrus Fruits
 - Pineapple
 - Strawberries
 - Watermelon



Image 1

Pectin

- Polysaccharide found in Plants
- High concentration in Skins
- Used primarily in Jam Production also in Pharmaceuticals
- Can Cause Haze in Beer
- Needs High Temp to "Set" (180F)
- Cleared with Pectinases

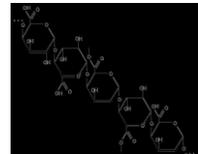


Image 2

Fruit Products Available

- Fresh
- Frozen
- Puree
- Concentrate
- Dehydrated
- Freeze-Dried
- Powdered
- Extract & Essence

Fresh Fruit

- Locally Picked/Sourced
- Ripeness important – ripe flavor & aroma vs appearance
- Use resources to obtain
 - Work with Local Farmers
 - Farmers Markets
 - Contact Packing Houses
 - Fruit Boards
 - Ag. Department



Image 3

Fresh Fruit Pros & Cons

- | | |
|--|---|
| <ul style="list-style-type: none"> • Pros <ul style="list-style-type: none"> ◦ Local Partnership ◦ Authenticity ◦ Flavors & Aromas ◦ Variety ◦ Know the Source ◦ Can be Cheaper <ul style="list-style-type: none"> • Local = Less Shipping • Less than Perfect Appearance | <ul style="list-style-type: none"> • Cons <ul style="list-style-type: none"> ◦ Availability <ul style="list-style-type: none"> • Seasonality • Regionality ◦ Difficult to Process ◦ Consistency ◦ Difficult to Incorporate ◦ Pesticides & Fertilizers ◦ Microbial Contamination Risk ◦ Shelf Life ◦ Solids |
|--|---|

Processing Fresh Fruit

- Juicing
- Pureeing



Fruit Press

Image 4



Image 5

Doing it Yourself vs. Sourcing Out – Talk with Growers

Frozen Fruit

- Commercially Bought or Do-It-Yourself
- Effect on Cellular Structure
 - Flash Freezing vs. Regular Freezing
- Similar Pros & Cons to Fresh Fruit
 - No Seasonality
 - Less Contamination Risk
 - Potential Flavor Loss
 - Storage Space/Costs
 - Check for Additives



Image 6

Fruit Puree

- Should be 100% fruit
- Fruit pressed through various sized screens
- Some Loss of Material
 - ~20% (by weight) for Pitted Fruit
 - ~12% for Seeded Fruit
- Flash Pasteurized
- Packaged Aseptically



Images 7 & 8

Fruit Puree Pros & Cons

- | | |
|--|---|
| <ul style="list-style-type: none"> • Pros <ul style="list-style-type: none"> ◦ Easier to work with ◦ Aseptic ◦ Consistent ◦ Availability | <ul style="list-style-type: none"> • Cons <ul style="list-style-type: none"> ◦ Expensive ◦ Heavy ◦ Heat Pasteurization <ul style="list-style-type: none"> • Flavor Degradation • Pectins ◦ Source ◦ Storage ◦ Solids |
|--|---|

Fruit Puree – Solids Testing

- 15 mL puree (6 samples each) Massed
- Centrifuge 10 min
- Supernatant Liquid Removed
- Precipitate Massed
- Percentages (average)
 - Apricot: 34.2% Solids
 - Blueberry: 55.2% Solids
 - Cherry: 51.4% Solids
 - Raspberry: 39.9% Solids
- Some Potential Breakdown by Yeast

Fruit Concentrate

- Fruit cleaned, separated, pureed & pasteurized (if concentrate is frozen)
- Cold Extraction
- Evaporation Plant
- Finished Sugar Concentration: 10 – 65 Brix
- Pasteurization
- Concentrated Puree
- Concentrated Juice (more processing)

Fruit Concentrate Pros & Cons

- Pros
 - Easy to Use
 - Consistent
 - Less Storage Space
 - Aseptic
- Cons
 - Flavor Degradation
 - Heat processing = pectin
 - Costs?
 - Processing Aids
 - Origin
 - Solids (Puree)

Dehydrated Fruit

- Start with Fresh Whole or Sliced Fruit
- Dehydrator to Dry (Slight Heating)
- Finished Product has 10-15% Moisture



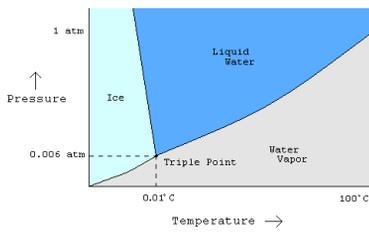
Image 9

Dehydrated Fruit Pros & Cons

- Pros
 - Flavor Concentration
 - Less Space
 - Lower Cost
 - Less Water Added
- Cons
 - Processing Aids
 - Preparing for Use
 - Flexibility
 - Flavor Extraction
 - Flavor Degradation
 - Consistency
 - Origin
 - Solids

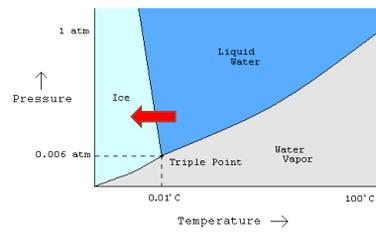
Freeze Dried Fruit

- Freeze Drying Process



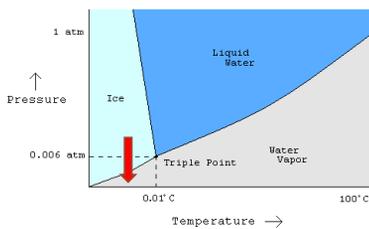
Freeze Dried Fruit

- Fruit Rapidly Cooled to Freeze Water
 - Rapid Freezing Protects Cellular Structure



Freeze Dried Fruit

- Pressure Reduced with Slight Heat to Promote Sublimation
 - Finished Moisture ~1%



Freeze Dried Fruit Pros & Cons

- Pros
 - Availability
 - Very Light
 - Very Stable
 - Less Needed
 - Flavor Integrity
 - Minimum Water
 - Astronaut Technology
- Cons
 - Check for Processing Aids
 - Use in Production
 - Cost
 - Consistency?
 - Origin

Fruit Powder

- Starts as Dehydrated Fruit
- Dried to 3% Moisture
- Milled to Size (Pieces, Granules, Powder)
- Pros & Cons Similar to Dehydrated
 - Easier to Use
 - Faster Flavor Extraction



Image 10

Fruit Extract

- Natural vs. Artificial
 - Natural: "Natural" Source (WONF)
 - Artificial: Manufactured Flavor & Aroma Chemicals
- Solvent Extract
 - Alcohol
 - CO2
 - Propylene Glycol
- Cold Press/Maceration & Settling
- Homogenized Oils
- Powdered Extract = Spray Dried

Fruit Extract Pros & Cons

- | | |
|---|--|
| <ul style="list-style-type: none"> • Pros <ul style="list-style-type: none"> ◦ Simple to Use ◦ Extremely Consistent ◦ Low Cost ◦ Easy Storage ◦ No Pectins | <ul style="list-style-type: none"> • Cons <ul style="list-style-type: none"> ◦ Flavor Authenticity ◦ Production Of ◦ Balance Needed ◦ "Real" vs "Not Real" ◦ Labeling |
|---|--|



Image 11

Adding Fruit

- Mash
- Kettle
- Whirlpool
- Fermenter
- Long-Term Storage
- At Packaging



Image 12

Mashed Fruit?

- Most Practical for Whole or Pureed
- Easy to Add
- Easy to Clean up “Fruit Trub”
- No Risk of Contamination
- Limited Pectin

Mashed Fruit?

- Significant Loss of Flavor
- Bad Bang for Buck
- Color Pickup
- No Real Benefit for Concentrate, Powder or Extract
- Verdict: Not Most Practical

Kettle Addition

- Easy To Add
- No Contamination Risk
- Removal of “Fruit Trub”
- Pectin Issues
- Calandria Issues
- Pumping/Transferring Issues
- Volatilization of Aromas
- Verdict: Practical in Some Applications

Whirlpool Addition

- Easy to Add
- Limited Contamination Risk
- Removal of “Fruit Trub”
- Pectin Issues
- Pumping & Transferring Issues
- Heat Exchanger Issues
- Mechanical Separation
 - Decanter
 - Centrifuge?
 - Filter
 - Settling
- Verdict: Practical in Some Applications

Pre Heat Exchanger Bag Filter



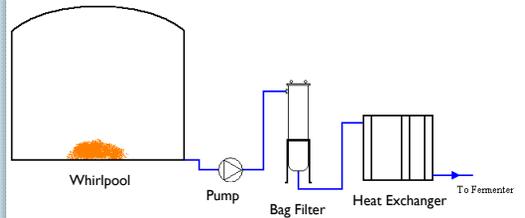
Stainless Steel Filter Housing
Multiple Sizes 4" – 8" Diameter



Polyester Filter Bag
Multiple Mesh Sizes: 10 – 800 micron

(McMaster #s 9307T7, 98315K66)
Images 13 & 14

Pre Heat Exchanger Bag Filter

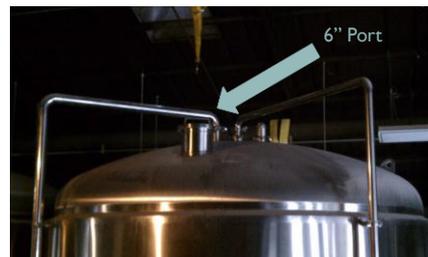


Fermenter

- Volatilization (Primary Fermentation)
- Greatest Risk for Microbial Contamination
- Challenges Adding
 - Flavor Extraction (Time)
 - Secondary Fermentation
 - Minimal Pectin
 - Difficult Removal of "Fruit Trub"
 - Maximum Flavor Pickup for Many Forms
- Verdict: Practical in Many Applications

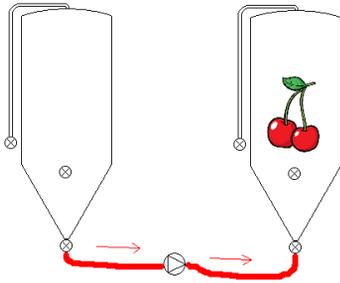
Ways to Add Fruit

- Open Fermenter or Large Top Access



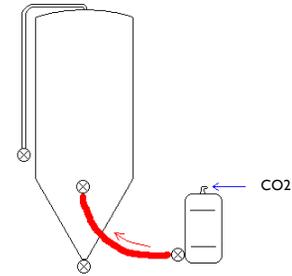
Ways to Add Fruit

- Secondary Vessel



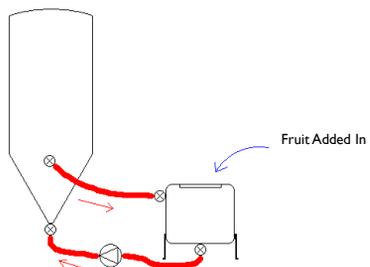
Ways to Add Fruit

- Push in Puree/Concentrate/Liquid



Ways to Add Fruit

- Recirculation with Secondary "Dosing" Tank



Ways to Remove "Fruit Trub"

- Leave Behind
 - Racking Arm
 - Stand Pipe
- Removal
 - Filtration
 - Centrifuge

Long Term Aging

- In Tanks
- In Barrels
- Long Flavor Extraction
- Some Challenges Adding Fruit
- Settling of Pectins
- Microbial Contamination – May be Desired for Sour Beers
- Verdict: Practical for Some Applications

At Packaging

- Need for Control
- Direct into BBT
 - Aroma Loss if Force Carbonating
- In line into Bottling/Kegging
- Challenge Adding
- Verdict: Practical for Liquid and Maybe Powdered Extract

How Much Fruit To Add?

- Wide Variations Depending on Source

	<u>lbs/gal</u>	<u>lbs/bbl</u>	
Apples	0.5 - 1.0	15 - 30	
Apricots	0.25 - 2.0	8 - 60	
Blackberries	0.5 - 4.0	15 - 120	
Blueberries	0.5 - 3.0	15 - 90	
Cherries(Sour)	0.25 - 2.0	8 - 60	
Cherries(Sweet)	0.33 - 4	10 - 120	
Citrus	0.25 - 1.0	8 - 30	
Currants	0.33 - 1.5	10 - 45	
Peaches	0.5 - 5.0	15 - 150	
Pears	0.5 - 2.0	15 - 60	
Plums	0.5 - 2.0	15 - 60	
Raspberries	0.25 - 2.0	8 - 60	

Equivalencies

	<u>Fresh</u>	<u>Puree</u>	<u>Concentrate</u>	<u>Dehydrated</u>	<u>Freeze Dried</u>
Apricots	1.00	0.80	0.20	0.25	0.15
Blackberries	1.00	0.90	0.15	0.30	0.10
Blueberries	1.00	0.90	0.15	0.25	0.15
Cherries(Sour)	1.00	0.85	0.30	0.25	0.10
Cherries(Sweet)	1.00	0.85	0.30	0.25	0.13
Citrus	1.00	0.85	0.15	0.25	0.10
Currants	1.00	0.95	0.15	0.25	0.10
Peaches	1.00	0.80	0.20	0.40	0.12
Plums	1.00	0.80	0.20	0.40	0.12
Raspberries	1.00	0.90	0.13	0.30	0.10
Strawberries	1.00	0.90	0.15	0.25	0.15

Fermentation Pilot Specs

- 92% 2-row, 8% Caramel 10
- 12 Plato S.G.
- 152 F Mash
- 15 IBU
- 60 min boil
- 1 mil cells/mL/P
- Fermented @ 70 F

Flavor Impact Studies

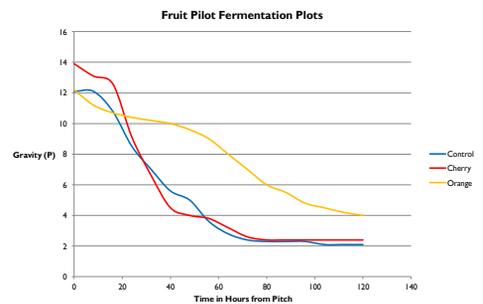
- 20 lbs per bbl (Equivalent Fruit Weight) Cherry(sweet) Puree added to Mash
 - No Perceivable Flavor Impact
 - Appreciable Color Pickup
- 10 & 20 lbs per bbl (EFW) Cherry(sweet) Puree added to Whirlpool
 - Perceivable Flavor Difference
 - Very Subtle Flavor Contribution
 - Specific Fruit Flavor Unidentifiable
- 5, 10 & 20 lbs per bbl (EFW) Cherry(sweet) Puree added to Fermenter after Primary Fermentation
 - 5 – No Real Flavor Perception (Slight Color)
 - 10 – Flavor/Color Perception Slight. No Identification of Cherry Flavor
 - 20 – Flavor/Color Perception. Split Identification of Cherry Flavor

Flavor Impact Studies

- Dosing in Cherry Extract to Light Lager
 - Recommended Rate 0.35% - 0.65%
 - 0.35% - Strong Aroma, "Cherry Candy" Flavor
 - 0.65% - Overly Strong Aroma & Flavor
 - Acid addition (Phosphoric) at 0.025%
 - pH drop approximately 0.2
 - Improved Mouthfeel & "Brightness" of Flavor
- Overall: Better Aroma w/ Extract, Flavor is Subjective



Yeast Health Impact Studies



Microbial Impact

- All Fresh Fruit has Microbes on Surface
- Some Studies show 100s of Different
- Small Scale Collection & Growth Project
 - Succeeded in Growing Bacteria & Yeast
 - Limited Translation to Beer
 - No Identification Yet
- Peracetic Acid Wash
 - 80 ppm wash
 - Interesting Results – Need More Experimentation

Sources of Fruit Products

Company	Fruit Types	Website
American Spice	Powder, Dehydrated	www.americanspice.com
Bare Fruit	Dehydrated	www.barefruitproducts.com
Bella Viva Orchards	Dehydrated	www.bellaviva.com
Beta Foods	Puree, Concentrate, Frozen, Dehydrated	www.betapure.com
Bulk Foods	Dehydrated	www.bulkfoods.com
Dennick Fruit Source	Puree, Concentrate	www.dennickfruitsource.com
Faerie's Finest	Extract, Powder	www.faesfinest.com
Fruit Fast	Concentrate	www.brownwoodacres.com
Greenwood Associates	Juice, Concentrate, Puree, Essence	www.greenwoodassociates.com
Hill View Packing Co.	Juice, Concentrate	www.hillviewpacking.com
IT Tropicals	Puree, Concentrate	www.ittropicals.com
Juice Products Unlimited	Concentrate	none (312) 654-5000
Just Tomatoes	Freeze Dried	www.justtomatoes.com
Kanegrade	Concentrate, Puree, Essence, Freeze Dried	www.kanegrade.com
Kerr Concentrate	Concentrate, Puree, Essence	www.kerrconcentrates.com
Mayan Sun	Powder	www.mayansun.net
North Bay Trading Co.	Freeze Dried	www.northbaytrading.com
Northwest Berry Co-op	Puree, Concentrate	www.nwberrycoop.com
Northwest Naturals	Concentrate	www.nwnaturals.com
Northwestern Extracts	Extract	www.nwextract.com
Oregon Fruit Puree	Puree	www.oregonfruit.com
Perfect Puree	Puree, Concentrate	www.perfectpuree.com
San Francisco Herb Co.	Dehydrated, Powder	www.sfherb.com
Traverse Bay Farms	Concentrate, Dehydrated, Powder	www.traversebayfarms.com
Vita-Pakt Citrus	Puree, Juice, Frozen, Dehydrated	www.vita-pakt.com

Flavor Impact Studies

- Raspberry Puree addition at 60 lbs per bbl (EFW) to Fermenter after Primary Fermentation (Brown Porter Base Beer)
 - Overpowering Flavor & Aroma
- Freeze Dried Apricot addition at 13 lbs per bbl (EFW) to Whirlpool (Wit Base Beer)
 - Perceivable Apricot Flavor & Aroma
 - Taste for Yourself
- Raspberry Extract (WONF) addition at 0.5% total Volume at Packaging (Strong Porter Base Beer)
 - Perceivable Raspberry Flavor & Aroma
 - Taste for Yourself

Questions???

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Bibliography

- Daniels, Ray. Designing Great Beer. Brewers Publications, Boulder, CO. 2000.
- Kunze, Wolfgang. Technology Brewing & Malting. Versuchs und Lehranstalt, Berlin, Germany. 2004.
- Lewis, Michael J & Young, Tom W. Brewing 2nd Edition. Aspen Publishers, New York, NY. 2001.
- Mosher, Randy. Radical Brewing. Brewers Publications, Boulder, CO. 2004.
- Rivard, Dominic. The Ultimate Fruit Winemaker's Guide. Bacchus Enterprises Ltd. 2009.
- Schramm, Ken. The Compleat Meadmaker. Brewers Publications, Boulder, CO. 2003.
- Sparrow, Jeff. Wild Brews. Brewers Publications, Boulder, CO. 2005.
- USDA Nutritional Facts. 2012. USDA. April 2, 2012, <<http://www.ars.usda.gov/SP2UserFiles/Place/12354500/Data/SR24/reports/sr24fg09.pdf>>.

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