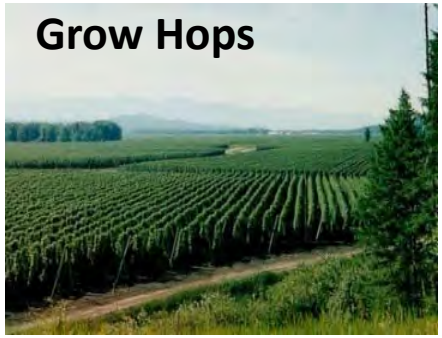
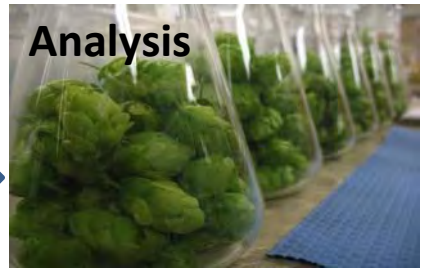
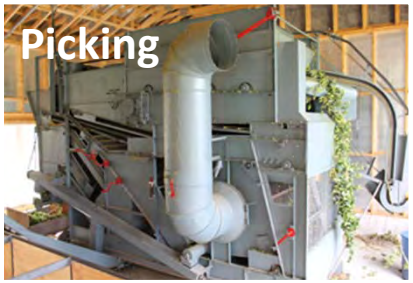
# Hop Value-Chain



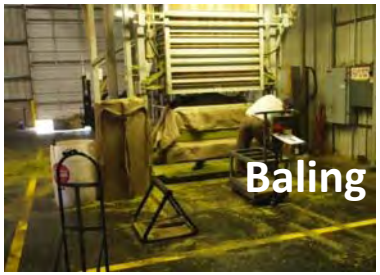



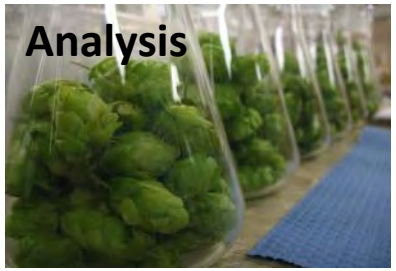











Hammer Mill & Pelletizer



Marketing/Sales

Whole cone


Pellets

# IX. Hop Analysis Services


- **Harvest Package $50**
- Combining Brewing Values and Dry Matter analysis, the Harvest Package is designed with hop farmers in mind. The results from this package provide growers with invaluable information about the content and characteristics of their hops and/or fields and can be utilized on an annual basis to establish trends within a given hop variety or lot location. Prior to harvest, these results specifically equip growers with the necessary information to plan peak harvest windows and make informed decisions regarding alpha content, hop cone maturity and overall hop quality. A 10% savings. *We require a 200g sample and a minimum 1 day turnaround.*

# Hop Analysis Services


- **Hop Profile Package** *$130*
- Developed for hop growers and craft brewers alike, the Hop Profile Package is our most comprehensive hop service. Combining Brewing Values, Oil Content and Volatile Oil Profile analyses, this package is designed to help customers determine the alpha acids, beta acids, hop storage index and oil content of their hops. By knowing the specific breakdown of components in a hop lot, brewers gain a better understanding of their raw ingredients and experience an increased ability to fine-tune recipes according to their desired results. Growers can utilize this same information to align the characteristics of their hops during harvest with the brewer's ideal brewing values. Overall, the Hop Profile Package provides line of sight into the essential brewing values and potential aroma characteristics of a given hop sample, increasing grower return, brew house efficiency and style consistency. A 15% savings.
  *We require a 200g sample of dried hops and minimum 2 day turnaround.*

# Hop Analysis Services


- **Brewing Values $35**
- Whether you are a hop grower, craft brewer, or home brewer – this service benefits you. Our Brewing Values service provides alpha acids, beta acids, and hop storage index (H.S.I.) values, allowing customers to verify the integrity of their product and ensure recipe consistency. The bulk of hop bitterness in beer is due to alpha acids, however, beta acids do provide some bitterness during storage as hops oxidize. H.S.I. is the ratio of two different wavelengths of UV light measured through the samples in question and measures the rate at which your hops age in storage. As the alpha and beta compounds degrade, the ratio widens and the H.S.I. increases. In addition to providing valuable hop quality information, this service will allow you to have the confidence that you need in your hops – from product integrity to peak harvest windows, recipe verification and more. We require a 200g sample and a minimum 1 day turnaround.

# Hop Analysis Services


**Dry Matters $20**

- By focusing on moisture content, dry matter analysis provides growers with the necessary information to forecast peak harvest windows based on hop cone maturity. Studies have shown a direct correlation between dry matter and cone color. As dry matter increases above 25%, hop quality begins to deteriorate, resulting in diminished color and off aromas. When utilized on a frequent and annual basis, dry matter analysis can predict moisture trends within a given lot and assist growers in refining their harvest schedules to be increasingly efficient. We require a 100g sample of un-dried, raw hops and a minimum 1 day turnaround.

# Hop Analysis Services


**Moisture $20**

- Unlike dry matter, moisture analysis is designed for craft brewers. Moisture content influences the stability of hops before processing or brewing and indicates if pellets have been properly produced. When left unchecked, moisture levels above 10% can result in rapid degradation and the possibility of spontaneous combustion. Through moisture analysis, brewers gain invaluable knowledge regarding the quality of their hops and their storage stability. We require a 100g sample of hop pellets and minimum 1 day turnaround.

# Hop Analysis Services


**Oil Content $20**

- As one of the most relevant and volatile components of hops, essential oils are key in understanding hop aroma. In general, the higher the oil content, the more aromatic the hop. Hop growers and brewers alike benefit from this test. Growers can utilize the results to verify that varieties are performing within, or better, than historical averages, while brewers can verify the integrity of their hops and ensure recipe consistency despite annual variances in oil content. It is important to note, this service provides a value for the volume of oil in a hop sample, but does not provide a specific breakdown per oil compound. We require a 150g sample of hop pellets and minimum 1 day turnaround.

# Hop Analysis Services

**Volatile Oil Profile $100**

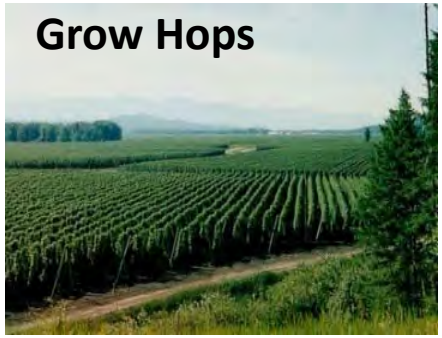
- Unlike Oil Content, the Volatile Oil Profile provides a specific value for the most important oil compounds. Currently, there are more than 300 compounds in hop oil which contribute to varietal aroma, which in turn affects the flavor in beer. Though it is true that nearly all flavors from hop oils are lost during boiling, distinct flavor characteristics from bitter hop resins will remain in the beer. Specific oil presence is dependent on hop variety and the particular harvest, however, the seven major contributors to flavor are: Humulene, Caryophyllene, Myrcene, Farnesene, Linalool, Geraniol, and Pinene. These volatile compounds contribute a variety of aromas based on their addition to the brewing process and the ratios of one to the other. By knowing the oil content of a hop, brewers can fine tune their recipes and dry hopping regimes to produce certain desired aromas and increase product consistency. In turn, growers can gain a better understanding of their hops and begin to track how different soils affect oil content. We require 150g sample of hop pellets and minimum 2 day turnaround.

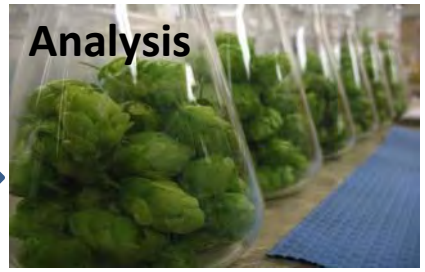
# Hop Analysis Services

- **Sample Submission:**
  Dried Hops: 200 grams – Collect a representative sample from the lot of interest, package the sample in a zip-lock bag (or vacuum pack) and place on a leak-proof cold pack.
- Fresh Picked, Green Hops: 200 grams – Collect a representative sample from the lot of interest, package the sample in a zip-lock bag leaving room for the hops to breathe, and place on a leak-proof cold pack.

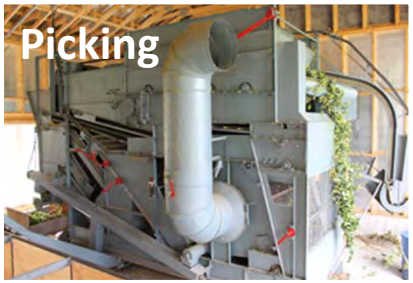
- **Green hops deteriorate very quickly during transit. If we are not testing dry-matter to determine harvest timing, and you are not in the Yakima Valley, you may get better results if you dry your hops. Hops should be dried to 8-12% moisture using a food dehydrator or similar method.*

# Hop Value-Chain



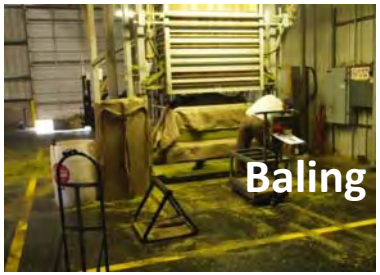



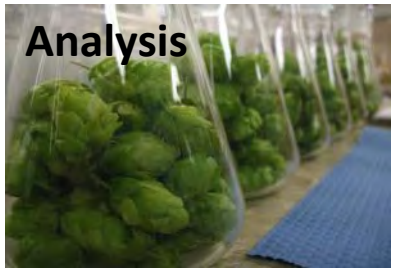











Hammer Mill & Pelletizer



Marketing/Sales

Whole cone


Pellets

# X. Pelletizing

Considerations

- Temperature
- Time
- Final product (eg. t-90 or t-45)
- Machine type
- Machine $$
- Facility

# The process

- Baled hops are broken up and passed into an air-stream which delivers them to a ¾” hammer-mill.
- Heavy, foreign materials drop out while metal fragments are removed using magnets.
- The hop cones are milled until they pass through a sieve, which is commonly composed of 9-12 mm mesh.
- The resulting powder is mixed and homogenized in a blender, and then conveyed to a pellet die, most commonly 4 or 6 mm in diameter.
- Once the pellets are formed, they are passed through a pellet shaker (to eliminate undersized product and remove residual loose powder) and immediately conveyed to a cooling tank where refrigerated nitrogen reduces the pellet temperature as rapidly as possible.
- From the cooling tank, the pellets are packaged with an airtight, nitrogen flush system.
- Hops of the same variety but with differing alpha contents are often blended to give a standard product with a constant alpha acid appropriate for each variety and growing season.

# Forms of Pelletized Hops

Pelletised hops are made by milling whole hops and compressing the hops into pellets. These are generally packaged under vacuum or in an inert gas such as nitrogen to reduce the rate of deterioration. Pelletised hops are available as:

1. Regular pelletised hop, (type 90 pellets)

2. Enriched pellets (type 45 pellets), where some of the vegetative (non-alpha acid bearing material) is removed to give a constant product with a much higher alpha acid.

The type designation refers to the approximate percentage yield from the volume of row hops processed.

If 100 kg of row hops are processed into Type 90, the yield is approx. 90 kg. If they are processed into Type 45 the yield is approx. 45 kg.

# Pelletized Hops

*Major advantages*

Volume reduction, potential for greater storage stability, standardization and consistency and enhanced utilization.

*Potential disadvantages*

The relatively slow-release of oils from whole glands of leaf hops allows time for oxidation of the major hydrocarbons such as humulene to humulene epoxides, etc. thought to be responsible for good hop aroma in beer.

The ruptured glands in powder pellets may lose the vast majority of these hydrocarbons by volatilization before the oxidation products have a chance to form.

http://www.probrewer.com/resources/hops/products.php

# Pelletized Hops

3. Isomerised hop pellets are produced in a similar way to standard pellets with about 2% magnesium oxide added

- These “stabilised” pellets, packed in an inert atmosphere are heated to 50°C for approximately 14 days, when up to 99% of the alpha acids are isomerised in situ, giving wort utilisation rates of 80 to 90%, and final beer utilisation rates of up to 70%
- Disadvantage #1- perception by some brewers of the negative effect of heating of the hops and its effect on the essential oils. The contribution of isomerized pellets to hop flavor and aroma is unlikely to be positive and may be neutral or negative.
- Perception of some brewers that they are a chemically processed product. In Germany, for example, the product could not be used as it falls outside the terms of the "Rheinheitsgebot" or German Beer Purity Law

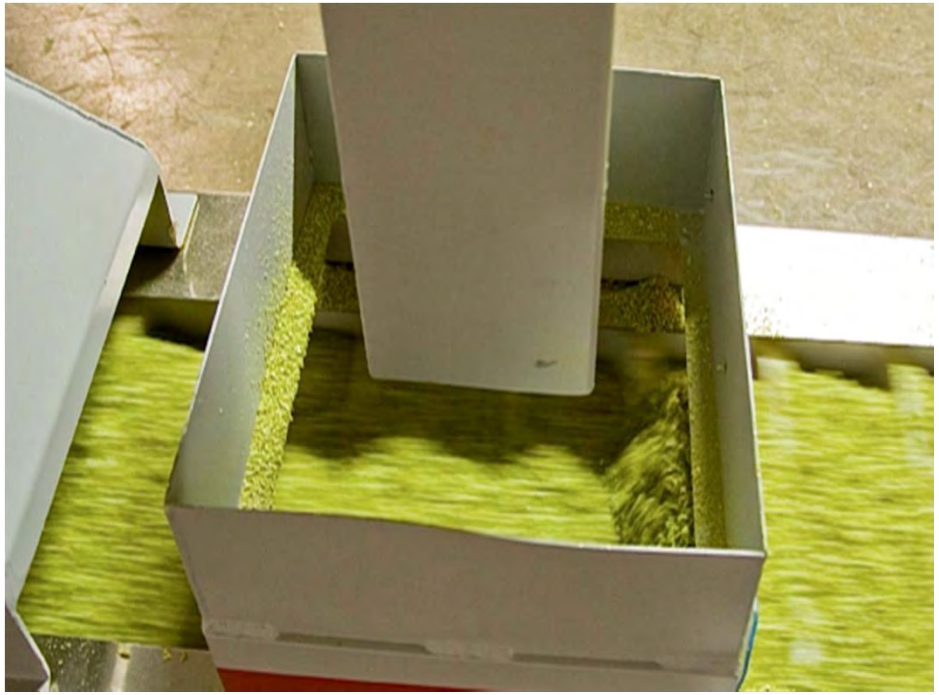
# Small-scale MI processors

- Pelletizing http://www.youtube.com/watch?v=hn3nc1UBiNY


LM $36,000
350-1000 lbs/hour
Max- 50 C

http://www.makepellets.ca/Hophead%202-1.jpg

# Indie Hops



Patient, but Prompt
In less than 20 minutes from breaking up the fresh hop bales, we have the pellets cooled to ambient temperature.  Nitrogen flush vacuum packing follows, then immediate storage in the freezer.

Steady as She Goes
Jim Solberg, our fearless leader, architect and operator of the all-important broom handle, dialing in the speed and volume.


The holy grail of hop pelleting is to convert the form of the whole cone without sacrificing essential oils and acids. Heat, in a word, kills. The industry standard hovers around 130F. We've clocked our hops at the pellet die consistently at or under 110F.

Freshness Never Smelled So Hoppy! Final pellets ready for an inert environment and 26F storage until it's their turn to show off at your local brewery.

# All pellets are not created equal

Chad Kennedy (Brewmaster at Laurelwood Brewing Co.) to Hop Merchants: Less Flower Powder, More Flower Power. June 2010

Comparison of Indie Hops cascade pelletized in new lower temperature mill vs. industry standard

Spoonful of Sugar Makes the Medicine Go Down. Chad Kennedy starting his day out right.

http://inhoppursuit.blogspot.com/2010/06/chad-kennedy-to-hop-merchants-less.html

Old Guard Cascades on Left, Indie Hops on Right. Size Matters. The Key? Reduce surface area vis-a-vis the volume. Why? Surfaces absorb heat and air.

- Indie hops “have a gummier, oilier, leafier feel . The other pellets feel dry. Your pellet appears to hold up better in packaging. The others are smaller, chipped, and fragmented. They’re friable.”
- Indie hops look and feel like a hop plant. They’re true to the source. The others are pulverized just about beyond recognition. What are they? Alfalfa? Rabbit food? You can’t tell.”

http://inhoppursuit.blogspot.com/2010/06/chad-kennedy-to-hop-merchants-less.html

"I mean, look. The purpose of pelletizing is simply to increase the hop density for ease of storage. That doesn't mean you have to pulverize the plant into powder. You might get more weight, less volume, but is the quantity really worth the sacrifice in quality? Isn't the point of our little craft beer revolution to put hand-crafted quality over mass quantity?"

Booh-Yah! Check out the buoyancy. Which behaves more like a real flower? Old Guard on the left, Indie Hops on the right.

- "The goal is extraction. During dry hopping, we want to extract as much of the hop's natural oil as we can. To do that with a pellet, we need to surround the particle with the wort.
- The gold standard for dry hopping is the whole cone, since it's lupulin glands haven't been nearly as damaged as much as a processed cone.
- But if the pellet particles immediately settle at the bottom of the tank, like a silt, then I'm not sure we're getting near the flavor that we could with a less processed, or coarser pellet."

http://inhoppursuit.blogspot.com/2010/06/chad-kennedy-to-hop-merchants-less.html

# A coarser grind

- Again, what does this mean? Says Chad, “It tells me that a coarser grind in solution behaves more like a natural flower. A natural flower will float on top much longer than a finely ground pellet and slowly settle down, imparting its flavors all the way down. The coarser the grind, the greater likelihood of extracting a hop’s natural flavors.”

http://inhoppursuit.blogspot.com/2010/06/chad-kennedy-to-hop-merchants-less.html

# Hop Oils are a Terrible Thing to Waste: keep 'em cool!

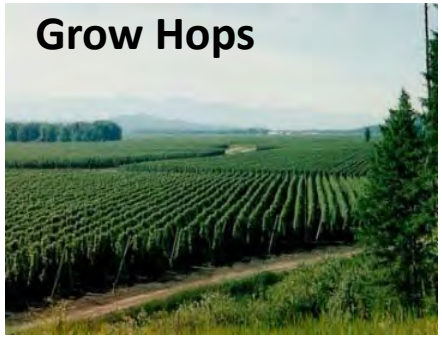
- “There is published evidence that hops should not be pelletized at temperatures in excess of 55°C (131°F).
- The process of milling and pelletizing hop cones dramatically increases the rate of hop acid and oil oxidation.
- When the processing temperature is lowered, the quality of the essential oils in the pellet are better preserved and closer to that of an unpelletized hop, which from an aroma perspective is a good thing for a brewer.”

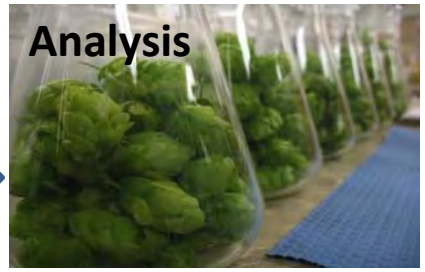
Tom Shellhammer, Ph.D., Nor'Wester Professor of Fermentation Science, Oregon State University

# HopUnion video

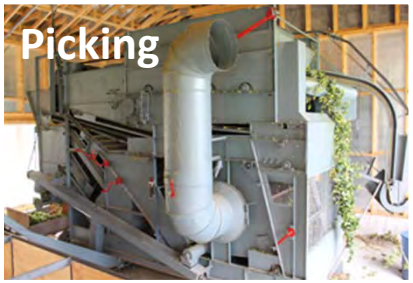
- http://www.youtube.com/watch?v=QlPurdOX7-s

# Hop Value-Chain



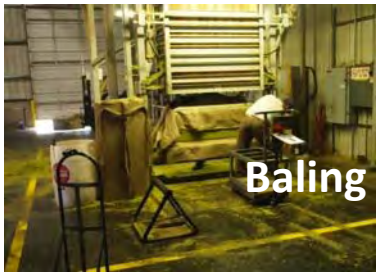



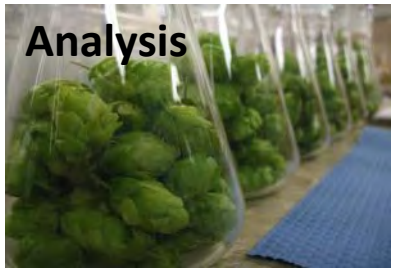











Hammer Mill & Pelletizer



Marketing/Sales

Whole cone


Pellets

# XI. Packaging and Storage


Considerations

- Photosensitivity
- Oxygen
- Package size and quality
- Cold storage
- Hops are photosensitive and, therefore, long exposure to light changes their biochemical structure as is shown by a typical red-brown colour, which is commercially undesirable.

# Packaging

N Flush
Vacuum seal
O2 and light proof packaging material
3-ply Al-folium bags under inert N2 atmosphere

# Package Size

Who are you selling to?

- Home brewers? 1 oz.
- Brewers- 1 lb-10 lbs +?



HOPS
HOP PELLETS
(Humulus Lupulus)
Styrielbract
Alpha 14.1 %
100g net
PACKAGED BY:
HOPS
HOP PELLETS
(Humulus Lupulus)
Nelson Sauvin
Alpha 12.3 %
Batch 11179-04
100g net
PACKAGED BY:


MONTANA STATE
FOOTBALL

# Cold Storage

- For AB-This freezer keeps the hops stored within at a constant 18-26 degrees Fahrenheit at a 70% relative humidity.

http://www.fwwarehousing.com/divisions/5/cold-storage.html

# The effects of storage temperature on the chemical composition of hop pellets

A. Canbaş *, H. Erten, F. Özşahin

*Department of Food Engineering, Faculty of Agriculture, University of Cukurova, 01330, Adana, Turkey*

Received 28 August 2000; received in revised form 1 January 2001; accepted 21 January 2001

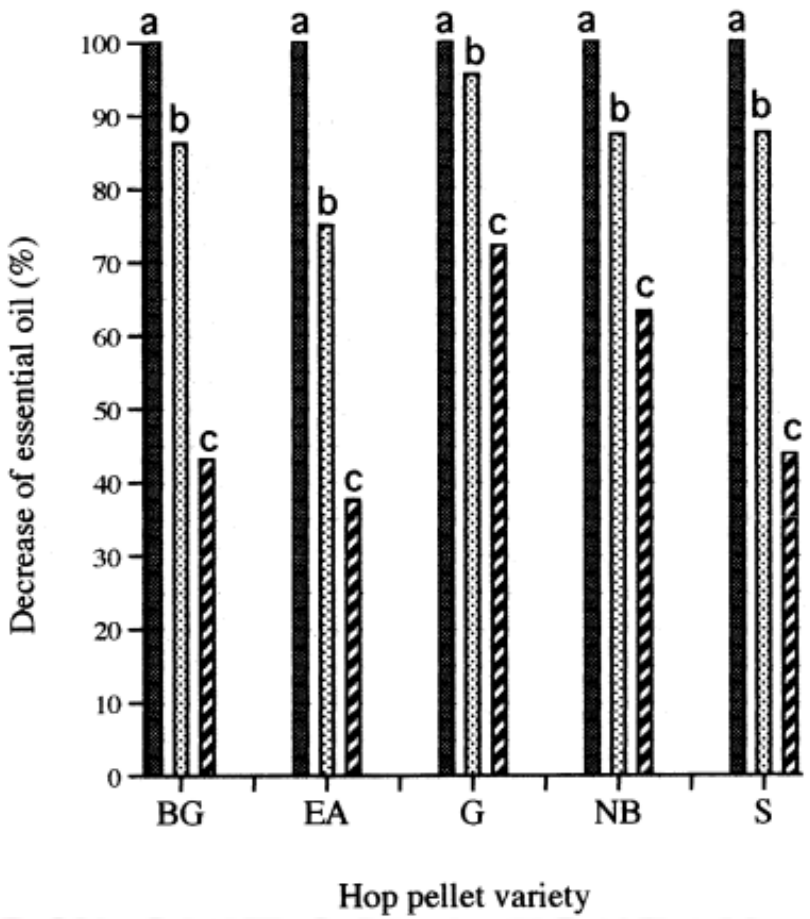



Fig. 5. The effect of 6 months storage on essential oil of hop pellets. BG, Brewers Gold; EA, Efes Aroma; G, Galena; NB, Northern Brewer; S, Saaz; a, Initial; b, 3°C storage; c, Room temperature storage.

Process Biochemistry 36 (2001) 1053-1058.

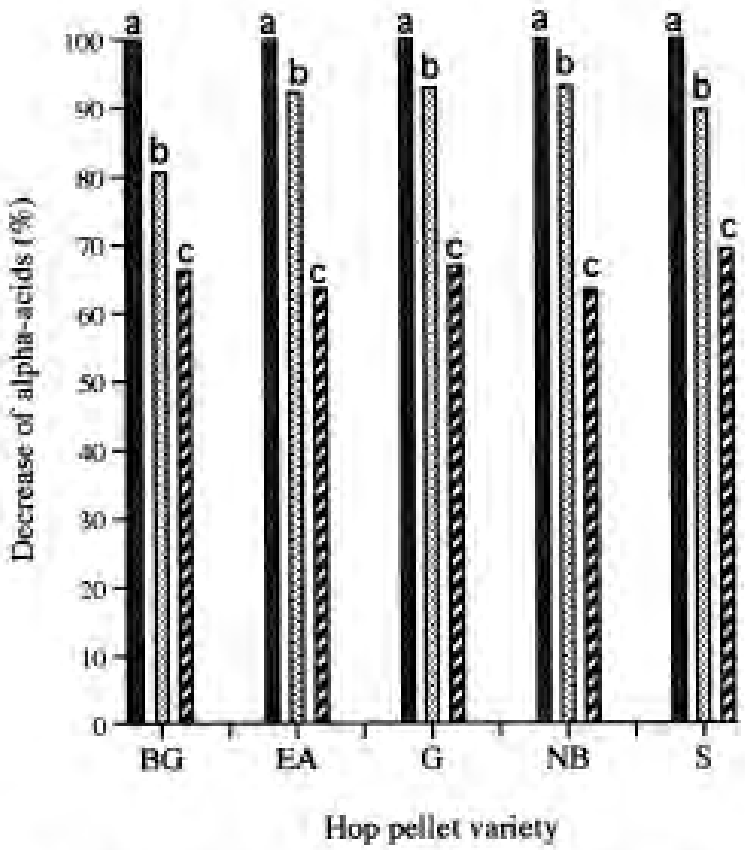
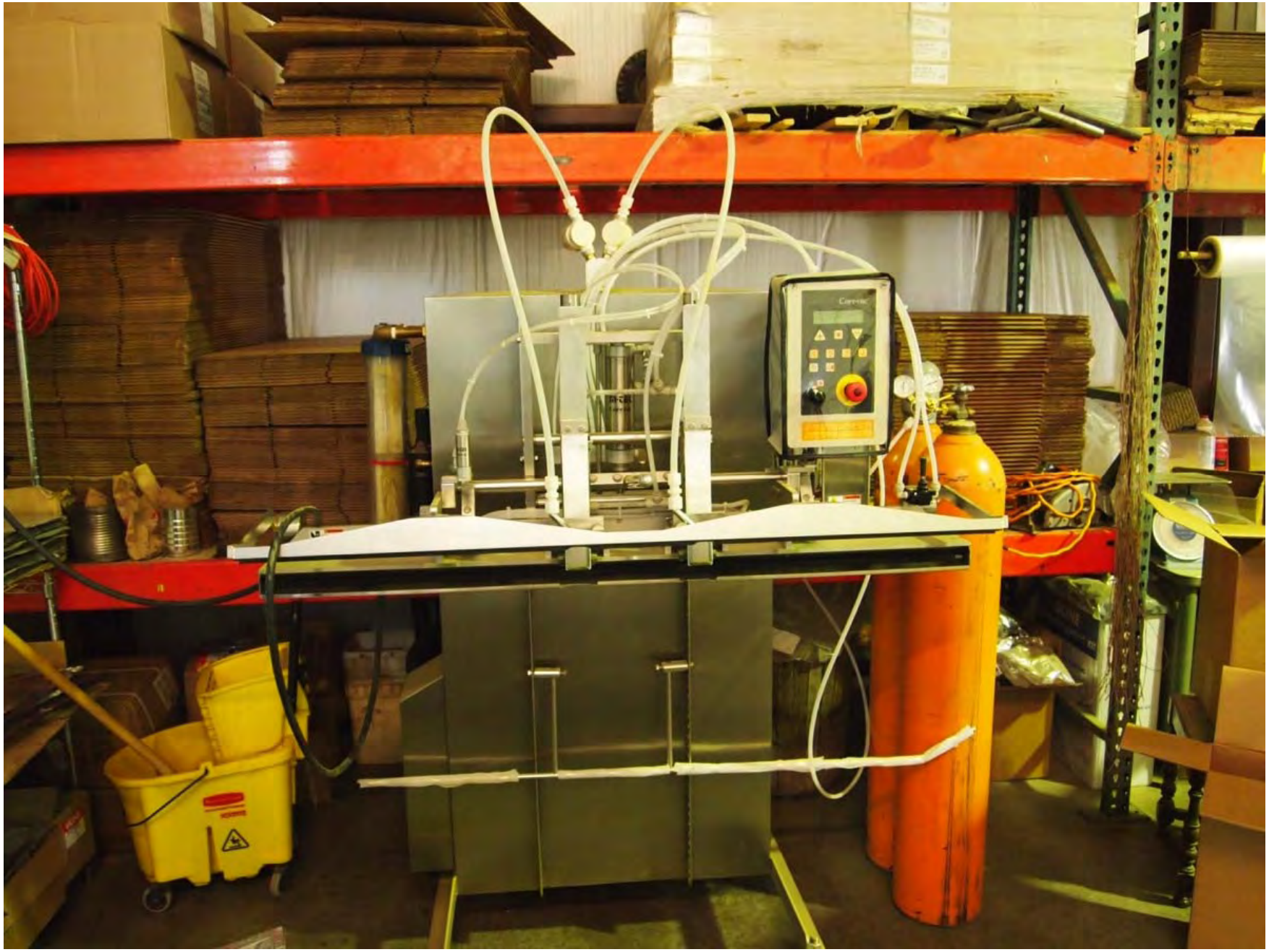



Fig. 1. The effect of 6 months storage on alpha-acids of hop pellets. BG, Brewers Gold; EA, Efes Aroma; G, Galena; NB, Northern Brewer; S, Saaz; a, Initial; b, 3°C storage; c, Room temperature storage.


LIBERTY




HOPS DIRECT, LLC
www.hopsdirect.com
BRAVO
alpha acid 14.2%
11#-type 90
hop pellets

# Studies of the Volatile Composition of Hops during Storage

Roland Tressl,* Lothar Friese, Friedrich Fendesack, and Hans Koppler. 1978. J Agric Food Chem, 26(6): 1426-1430.

- Studied individual aroma constituents (over 120) of Spalter hops during storage and processing. Followed for 3 years.
- Measured at harvest, then again measured again after three years of storage in a dark chamber at 0 degrees C.
- After 3 years:
  - Amount of terpene and sequiterpene hydrocarbons decreased considerably
  - Amount of aldehydes and fatty acids (known as off-flavor constituents) are formed
  - Hop oil content decreased from 1.63g/100g of hops to .88 g/100g

# Transport of the hop product

- A temporary warm transport phase (e.g. 30°C) during a few weeks causes considerable damage.
- An overseas transport taking place at moderate temperatures of maximum 25°C causes α-acid losses in the range of about 5% relative.
- A transport at temperatures of around 40°C, causes α-acid losses of about 20 % relative.

From EBC Manual. Hops and Hop Products.

# XII. Hops in brewing

**The function of hops in brewing**

Hops are exclusively used to provide aroma and bitterness in beer. They add the following properties:

- Provide the bitter taste in beer (with alpha acid the principal precursor)
- The oils provide aroma.
- Modify yeast performance during fermentation.
- Contribute to beer texture (mouth-feel).
- The bacteriocidal properties protect beer against some biological spoilage organisms.
- Reduce over foaming during wort boiling.
- Aid in protein coagulation during the boil.
- Act as a filter medium when a hop back is used.
- Foam active agent in beer improving foam performance and cling.
- Cone hops contribute tannins which may increase the reducing power of a beer, and hence its resistance to oxidative staling.
- Tannins may also contribute to a tendency to produce chill haze.

O'Rourke, T. 2003. Hops and hop products. Technical summary 11. The Brewer International 3(1): 21-25.

## Table 1. Summary of benefits from using whole hop

| | |
|---|---|
| Preparation | Bales from growers |
| Major use | Bitterness and aroma |
| Method of use | Direct addition to kettle during boiling or cask for dry hopping |

| **Composition** | % | |
|---|---|---|
| Total resins | 15 | **Advantages:** |
| Soft resin – alpha acids | (8) | Traditional form |
| beta acids | (4) | Free from extraction solvents |
| Hard & uncharacterised resins | (3) | Standard aroma & bittering product |
| Essential; oils | 0.9 | Aids hot break formation & settling |
| Tannins/polyphenols | 4 | |
| Protein (N x 6.25) | 15 | **Disadvantages:** |
| Water | 10 | Bulky and expensive to store |
| Monosaccharides | 2 | % alpha and aroma varies each year |
| Lipids and waxes | 3 | Subject to loss of alpha and aroma on storage |
| Amino acids | 0.1 | Possible contaminates from debris and pesticide |
| Pectin | 2 | Low utilisation (25 – 30%) |
| Ash | 8 | Higher losses of wort in spent hops |
| Cellulose & lignin | 40 | Costs of disposal of spent hops |

Resins and oils will vary according to variety

O'Rourke, T. 2003. Hops and hop products. Technical summary 11. The Brewer International 3(1): 21-25.

## Table 2. Summary of benefits from using pelletised hop

| | |
|---|---|
| Preparation | Leaf hops are cleaned, milled, palletised and vacuum packed |
| Major use | Bitterness and aroma |
| Method of use | Direct addition to kettle during boiling |

| **Composition** | |
|---|---|
| Type 90 pellets – similar to leaf hop but may be standardised for alpha | **Advantages:** |
| Lower moisture content | Traditional product |
| Better utilisation through ruptured resin glands | Free from extraction solvents |
| | Standard aroma & bittering product |
| | Aids hot break formation & settling |
| | Significant reduction in volume |
| Type 45 pellets – increased alpha due to concentration of lupulin gland. | Improved storage properties |
| | Improvement in % hop utilisation |
| Between 40 to 50% of vegetative material is removed | Easier disposal of spent hop debris |
| Resin/oil concentration is approximately double. | **Disadvantages:** Bulky than extracts |
| | Possible contaminates from debris and pesticide |
| | Low utilisation (25 – 35%) |

O'Rourke, T. 2003. Hops and hop products. Technical summary 11. The Brewer International 3(1): 21-25.

## Table 3. Summary of benefits from using iosmerised hop pellets

| | |
|---|---|
| Preparation | Magnesium oxide is added to milled hops and gently heated before being palletised and vacuum packed |
| Major use | Bitterness with good aroma properties |
| Method of use | Direct addition to kettle during boiling – can be added part way through the boil |

| **Composition** | |
|---|---|
| Similar to Type 90 pellets | **Advantages:**<br>Similar to hop pellets |
| Almost all the alpha acid is converted to the equivalent magnesium iso-alpha acid. | Better keeping properties<br>Better utilisation (50 to 60%) |
| Slight reduction in beta acid content | |
| Presence of magnesium and magnesium oixide | **Disadvantages:** |
| | Similar to hop pellets |
| | MgO could be perceived as a chemical addition |
| | Low utilisation (25 – 30%) |

O'Rourke, T. 2003. Hops and hop products. Technical summary 11. The Brewer International 3(1): 21-25.

## Table 4. Summary of benefits from using hop extracts

| | |
|---|---|
| Preparation | Resins and oils are extracted from the hops using solvents which are then driven off. |
| Major use | To provide bitterness to beer |
| Method of use | Direct addition to kettle during boiling |

| Composition | Whole hops | Organic solvent extract | Super critical $CO_2$ | Liquid $CO_2$ |
|---|---|---|---|---|
| Total resin | 12 – 20% | 15 – 60% | 75 – 90% | 70 – 95% |
| Alpha acid | 2 – 12% | 8 – 45% | 27 – 55% | 30 – 60% |
| Beta acid | 2 – 10% | 8 – 20% | 23 – 33% | 15 – 45 % |
| Essential oils | 0.5 – 2% | 0 – 5% | 1 – 5% | 2 – 10% |
| Hard resins | 2 – 4% | 2 – 10% | 5 – 11% | None |
| Tannins | 4 – 12% | 0.5 – 5% | 0.1 – 5% | None |
| Waxes | 1 – 5% | 1 – 20% | 4 – 13% | 0 1 – 10% |
| Water | 8 – 12% | 1 – 15% | 1 – 7% | 1 – 5% |

**Advantages:**
Less bulk storage
Good storage properties (several years)
Improved utilisation (45 to 65%)
Reduced pesticide residues
Minimal wort/beer losses

**Disadvantages:**
Different brewing operation compared to whole hops
**Solvent extract**
Solvent residue (minimal)
Altered aroma profile
Presence of “chemicals”
**Supercritical $CO_2$**
Altered aroma profile
Highest cost of extraction
Possible impurities
**Liquid extract $CO_2$**
Lower yield than supercritical
Higher cost per unit alpha than other extracts.

O’Rourke, T. 2003. Hops and hop products. Technical summary 11. The Brewer International 3(1): 21-25.


# Brewer Needs

- Hops are generally purchased as extracts, whole flower, or pelletized with quality defined by:
- α-acid, B-acid (as % dry weight)
- Cohumulone content (as % α-acid)
- Total Oil (as % dry weight)
- Hop Storage Index

Results:

- Pelletized: All but one!!
- α-acid: 80%, cohumulone: 14%
- Storage or packaging: 23%

# Brewing


Where are hops added?

- On the hot side
  - To boiling wort
    - At the beginning (primarily for bitterness)
    - At the end (primarily for aroma)
  - After boiling but right before cooling (just aroma)
- On the cold side – dry hopping
  - Solely for aroma

# Dry hopping

Involves adding hops to the fermenter after fermentation. Dry hops add no bitterness to the beer, but the technique does add fragile aromatic oils that are normally lost in the boiling process. Dry hops are allowed to soak in the finished beer for anywhere from several days to several weeks. The result is a burst of hoppy aroma.

http://beersmith.com/blog/2008/05/21/dry-hopping-enhanced-hops-aroma/

# XIII. Quality: From a brewer's perspective

Brewing Quality Control Manual Series. It starts with the raw materials – series. (3): Hops and Hop Extracts. From Brewing and Distilling Analytical Services, LLC.

1. Ask for samples and perform a hop inspection including a "rub". Break open the package and rub the hops to disintegrate and allow the hop resins to show their character.
2. Sniff and feel the hops for quality. Using hop pellets? –if so crumble a few and see and smell for freshness and aromatic qualities – look at the color and feel for over moist (wet-crumble) or over dry brittle pellets.
3. Whole cone hops – look at the color of bracts and the lupulin glands (bright yellow-orange?), moisture (spongy or crumbly – do they "spring-back"?).
4. Ensure no seeds, leaves or other non-hop or extraneous matter – look at cone integrity and look for damage by insects, molds or weather, (discoloration of leaves or telltale spots).
5. Finally evaluate the aroma (and make hop teas via boiling a portion in a sugar solution to examine flavor).

http://www.alcbevtesting.com/wp-content/uploads2012/01BDASQualityManualSeriesPt3HopsJune2012.pdf

# From Shellhammer and Sharp

- *"Quality is the indicator for the condition in which hop constituents are when being added to the beer/wort, i.e. the definition of quality indicates whether degradation took place from picking to dosage."*
- Forster, A. The quality chain from hops to hop products. In *48th IHGC Congress, Canterbury, Barth-Haas Research & Publications (http://www. barthhaas. com)*; 2001.

MASTER BREWERS ASSOCIATION OF THE AMERICAS

# EVALUATION OF DISEASED AND DAMAGED HOPS IN FINISHED BEER

**Andreas Gahr,** Head of the Research Brewery, Hopfenveredlung St. Johann, Germany
**Laura Hansen,** Brewing Material Supply Manager, MillerCoors LLC, Golden, CO

MBAA 123rd Anniversary Convention
Brewing Summit 2010
June 18 – 20, 2010
Rhode Island Convention Center
Providence, Rhode Island

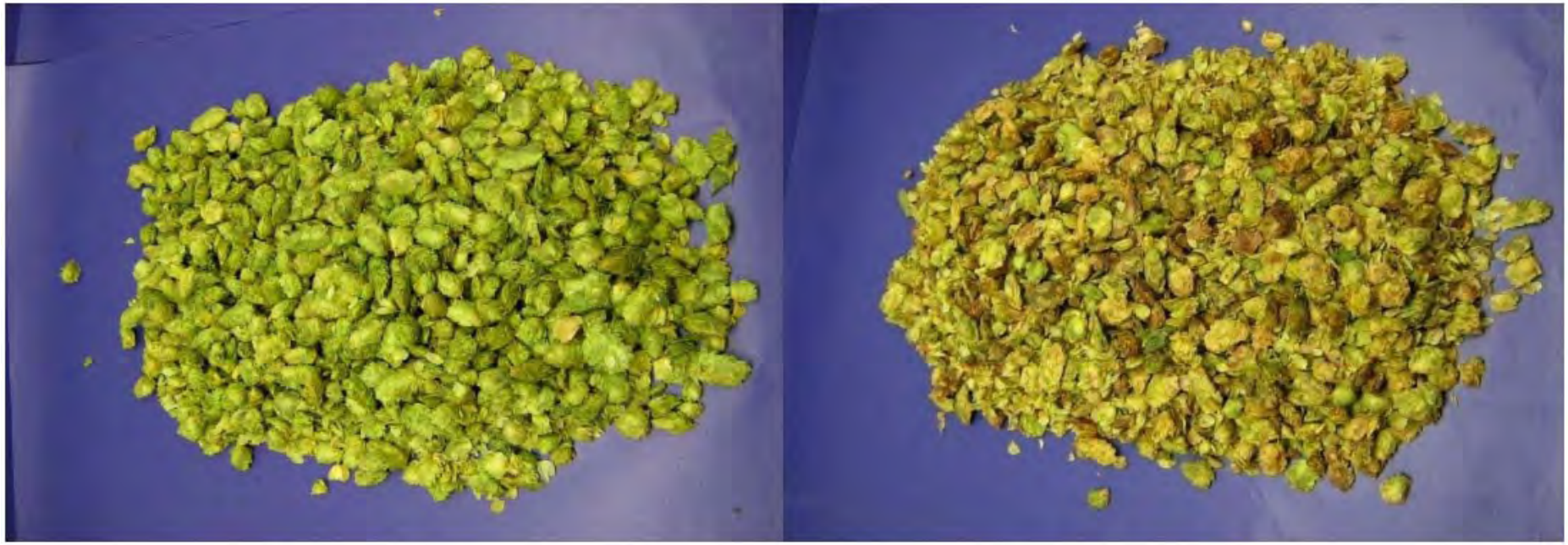


Figure 1: Photography of premium quality (1) and damaged hops (2), both of the variety HTU.

MASTER BREWERS ASSOCIATION OF THE AMERICAS

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- Black and moldy leaf infection
- Fungi growing on aphids excrements
- Species: *Alternaria*, *Cladosporium*, *Curvularia*, *Stemphylium*, and *Stachybotrys* of the *Dematiaceae* family of which some are known to form mycotoxins.

Figure 2: Hop cone infested with hop aphids *(Phorodon humuli)*

# XIV. Further considerations

- Food Safety
- HAACP plan
- Traceability
- Record keeping
  - Yields
  - lot location
  - harvest date
  - quality
  - climatic conditions


- Food grade facility
  - MDARD
  - http://www.gorstvalleyhops.com/Complete%20processing%20Manual.pdf

# Food Safety Plan

- Section 1 General Requirements
  - Food Safety Policy
  - Accountability
  - Documentation
  - Traceability
  - Recall Policy
  - Corrective Action Procedure
  - Record Keeping
- Section 2 Worker Health and Hygiene
  - Toilet Facilities
  - Hand Washing
  - Worker Health and Hygiene Policies
  - Designated Break Areas
  - Worker Illness and Injury
  - Record Keeping
- Section 3 Previous Land Use and Site Selection
  - Previous Land Use
  - Flooding
  - Organic Certification
  - Risk Assessment
- Section 4 Agricultural Water
  - Water Quality
  - Water System Description
  - Water Management Plan
  - Record Keeping
- Section 5 Agricultural Chemicals
  - Usage
  - Agriculture Chemical Policy
  - Proper Chemical Usage and Storage
  - Record Keeping and Training
- Section 6 Animals and Pest Control
  - Animal and Pest Control Risk Assessment
  - Risk Factors-Field/Buildings
  - Pest Control Management-Field/Buildings
  - Record Keeping and Documentation
- Section 7 Soil Amendments and Manure
  - Soil Amendments that do NOT contain Raw or Partially Treated Manure
  - Requirements for Purchased Compost
  - Good Composting Practices
  - Soil Amendments that contain Raw or Partially Treated Manure
  - Record Keeping
- Section 8 Field Harvesting
  - Risk Assessment- Pre-harvest
  - Equipment Policies-Vehicles, Equipment, Tools, etc.
  - Field Equipment Safety Plan and Inspection Procedure
  - Containers, Bins, Packing Materials
  - Harvest Container Maintenance
  - Harvesting Procedures
  - Record Keeping
- Section 9 Transportation (Field to Picking/Processing)
  - Record Keeping
- Section 10 Picking/Processing Design and Activities
  - Design (easy cleaning, lighting, proper location of air intakes, etc)
  - Protocols (eg. food grade lubricants)
  - Materials Sourcing
  - Containers and Bins
- Section 11 Final Product Transport

https://onfarmfoodsafety.org/

# HACCP

- HACCP is an internationally recognized management system focused on the prevention of food related safety problems.
- The philosophy of HACCP is one of a common sense and proactive approach to food safety, where safety issues are addressed during production and not solely through end-product testing.
- In developing a HACCP program, all aspects of production are examined, from raw material acquisition to storage and distribution of the finished product.
- Determinations are made as to whether the food product is liable to a safety threat from a naturally occurring or process-induced hazard. Hazards can be biological (principally microbiological), chemical, and/or physical properties of a food product that have the potential to injure or cause illness when the food product is consumed.
- Through HACCP, existing or potential hazards are identified, and a system is put in place to effectively reduce the risks of hazards in the finished food product.

# ASSURING PRODUCT SAFETY IN THE HOP INDUSTRY

Reinhold Kugel
Joh. Barth & Sohn GmbH & Co. KG
Hopfengut 22, 88069 Tettnang (Germany)
e-mail: reinhold.kugel@johbarth.de

www.barthhaasgroup.com

1. Product safety begins before the plant even begins to grow through monitoring of:
-plant development
-pest and disease issues
-and later compared to farmers' records

2. Analytical screening of hop leaves in August for pesticide residues
At harvest cones are sampled to assess pesticide degradation rates

3. Farmer pesticide records since 1994.

4. 30% of hops purchased from suppliers around the world are tested for residues. MRLs

5. Traceability- In Germany since 1929 with passage of the Hop Origin Act
Keep a backup sample of each batch as well as pesticide records for 5 years.

BARTH-HAAS GROUP
FOR YOUR SUCCESS

- **Highest standards for the best hops**
- The Barth-Haas Group has established a Quality Management System (QMS) based on ISO 9001:2008 in order to provide goods & services of the very best quality to our customers.

  The Group's QMS also encompasses the international HACCP guidelines to ensure our continuous improvement process with regard to quality and safety. Therefore both systems, QM and HACCP system, play a very important role in our continuous improvement process.

  The Quality Management System is supported by our supply chain model, which monitors the quality of hops from the grower's field to the brewer's final beer and ensures an efficient process flow through our organization.

  We continuously strive to improve our Quality Management System and the quality of our products and services as we realize that customer satisfaction is the key to our success in the market

# ROY FARMS, INC

MOXEE WA USA

Are Roy Farms hops traceable back to field origin and chemical treatment?

**Absolutely!**

Back about 10 years ago it became apparent that brewers wanted to know more about food safety issues related to their hops—what chemicals had been applied, how close to harvest they had been applied and more.

Traceability and food safety concerns (and data gathering) do not end at harvest, our attention to data gathering and reporting are core elements of assigning harvested crop to inventory and logistical planning for sales.

GLOBALG.A.P.

OTCO

USDA ORGANIC

K

SALMON SAFE

ROY FARMS, INC
MOXEE WA USA

# Hop Processing

- Bines cut, transported to picking facility, then to drying kiln
- Kilning from 70% moisture down to 10-12%
- Cooling floor to equalize moisture
- Most commonly then baled for transport to processor/dealer
- Because of the tendency of many hop varieties to rapidly degrade, the time constraint from harvest, picking, kilning and through to baling is kept as short as physically possible.
- Depending upon the variety and crop year this may be as little as 24 hours or as long as 36 hours.

ROY FARMS, INC
MOXEE WA USA

# Aroma Hops

- Brewers seeking the finest in aroma hops are looking for intact hops, deep green in color and possessed of the maximum depth and breadth of the variety-specific “nose”. Past the effort of careful picking and cleaning, the next step to preserve these traits is to slowly dry the hops at lower temperatures than typical for the bittering hops.
- Lower temperatures minimize the potential oxidation of key elements of the aroma profile. Also, the hop cones reach more even moisture distribution during the kilning process rather than waiting to accomplish this at the cooling floor. This allows for raw hops transfer from kiln to cooling and subsequent processes with less shatter, better color and more of the essential oils maintained in “harvest-fresh” condition.

ROY FARMS, INC
MOXEE WA USA

# Harvest Fresh Pellets®

- Our baling units are set up to perform as gentle a “squeeze” on the hops as possible. We have minimized friction at baler walls, perform multiple fills and presses per bale to allow settling of product, and pay careful attention to maximum weight and compression pressure. Despite this, there will always be some disruption to the lupulin glands in the cone which allow for oxidation of brewing resins and essential oils.
- While some brewers prefer a bit of oxidation on their hops as a positive contribution to flavor, a growing part of the aroma market desires as close “green hop” profile as possible. We meet this need by moving the carefully dried aroma hops directly to a pellet mill and bypass baling entirely. This provides for increased preservation of alpha acids and superior aroma profiles.
- The pelletizer is configured with a bore size and compression ratio to allow production of outstanding pellets at temperatures below the limit at which oxidation is a problem. Though the pellets are carefully compressed, they still will fit into standard industry boxes for shipment.

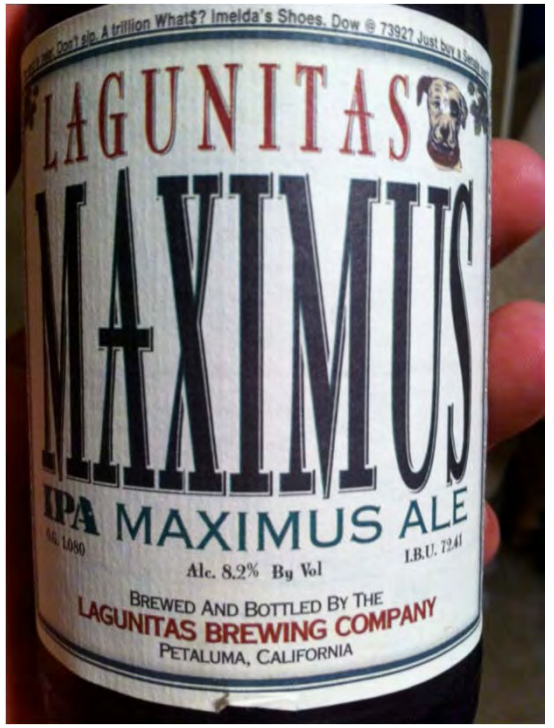
Rybka et al. 2011. Analysis of various implementations of hop strings during hop production. Plant Soil Environment. 57 (9): 441-446.

- Hop purchasers are increasing requirements on quality of final product
- Hops should be without any potential impurities
- One place of concern is hop strings that remain on the trellis post-harvest, loosen in following years, then are found in post-harvest processing stage
- Can negatively influence quality
- Studied different string types
- Results: Tradeoff between complete and easy breakage during harvest vs. spontaneously falling bines prior to harvest.
- Choosing string type and strength should not be an afterthought, depending upon harvesting method.

Reducing plastic twine use in hop farming. 2005/2006. New Zealand Hops Sustainable Farming Fund. Oldham, C. Project Manager.

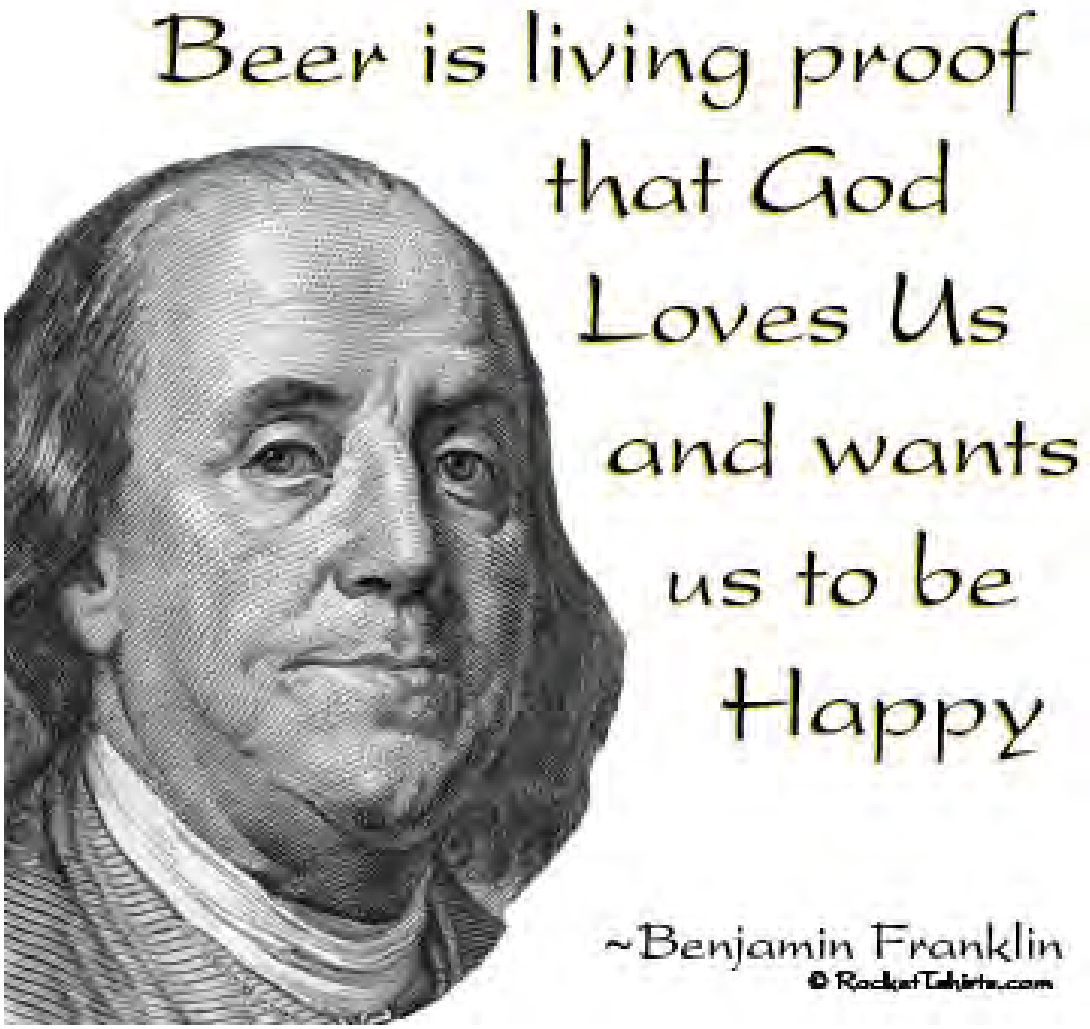
- The purpose: to determine if an environmentally friendly string could be used to replace the non-biodegradable string of polypropylene
- This study has been funded through a government scheme in order to further promote and encourage the use of biodegradable materials being used in stringing process to build on the clean green image which New Zealand strongly promotes.

# Take home messages




1. Post harvest is not an afterthought
    - Think ahead-through the process
        - Drying capacity
        - Harvesting capacity
        - Timing
        - Distance
    - Run the numbers –what will brewers pay? For how long?
2. Variety specific (training, harvest, processing)
3. How will you sell your final product and in what form?
4. Quality and food safety considerations?
5. How will you differentiate your product?


ADD MORE HOPS


Beer is living proof
that God
Loves Us
and wants
us to be
Happy
~Benjamin Franklin
© RockefTshirts.com

# Hops: Cost of Production

Rob Sirrine
MSU Extension
Leelanau County, MI

MSU IPM Academy
February, 2014

MICHIGAN STATE UNIVERSITY | Extension


| | | | | | |
|---|---|---|---|---|---|
| **Post Harvest Costs** | | | | | |
| Picking processing fees **($6/lb.)** (energy, supplies, labor, etc.) | $ 4,500.00 | $ 6,750.00 | $ 9,000.00 | $ 9,000.00 | |
| Transport to processor (variable) | $ 500.00 | $ 500.00 | $ 500.00 | $ 500.00 | |
| Interest on Equipment (picking machine, hammer mill, pelletizer) | | | | | |
| Sales Costs (Commission, transportation, shipping, etc.) | | | | | |
| *Subtotal* | *0* | *$ 5,000.00* | *$ 7,250.00* | *$ 9,500.00* | *$ 9,500.00* |
| | | | | | |
| **Gross Revenue/acre** | | | | | |
| Percent of total yield- (full production 1500 lbs. dried/acre) | 0 | 50% | 75% | 100% | 100% |
| Total yield in pounds dried/acre | 0 | 750 | 1125 | 1500 | 1500 |
| Fresh wholecone wet ($5-6 /lb.) | | | | | |
| Wholecone dried ($10-12/lb) | | | | | |
| Pellitized ($12-14/lb.) | 0 | $ 10,500.00 | $ 15,750.00 | $ 21,000.00 | $ 21,000.00 |
| | | | | | |
| **Net Revenue/acre** | **$ (2,565.00)** | **$ (180.00)** | **$ 2,820.00** | **$ 5,820.00** | **$ 5,820.00** |

- UVM-$1.60/lb for picking only
- A couple of MI processors- ~$5.50/lb (including a 10% sales commission)
- Ontario $4.50/lb (no sales or marketing)
- Quebec and BC- (they charge 35% of sales amount) or currently $5.50/lb since they are selling for close to $16/lb (including access to mechanized harvester + dryer) and post-harvest services (including pelletization, packaging, commercialization)
- A group in Wisconsin was charging $4/lb just for pelletizing, packaging, and selling.
- **Depends on your assumptions (lbs per acre, cost of labor, payment on debt, etc.), but it looks like things are shaking out at around $5/lb for the process of picking through selling.**


# TAKE HOME MESSAGES

- Quality is crucial
- Do not skimp on establishment
- You will not get rich growing hops
- Hi initial and annual costs with questionable returns in the future

| | |
|---|---|
| • Wolf (picker) | $50,000+ |
| • Hammermill & Pelletizer | $15,000-$60,000 |
| • Vacuum Sealer | $2500-$10,000 |
| • Dryer | $12,000 + |
| • Energy (wet hop to pellet) | $1.50 / lb |
| • Cold Storage | $ ????? |
| • Annual labor for 14 acres | $600/day |

Crew of six (2 months working 10 hour + days)

- Don’t underestimate the amount of labor required
- Need for picking and processing equipment if you plant >1/2 acre
- Line up supplies well in advance
- How will you sell your hops?
- Will most likely need a price premium to do organic

# Hops: Markets

Rob Sirrine
MSU Extension
Leelanau County, MI

MSU IPM Academy
February, 2014

MICHIGAN STATE UNIVERSITY | Extension


## *U.S. HOP ACREAGE BY STATE (10 YEARS - IN ACRES)*

| YEAR | WASHINGTON | OREGON | IDAHO | TOTAL |
|---|---|---|---|---|
| 2003 | 19,492 | 5,748 | 3,429 | 28,669 |
| 2004 | 19,382 | 5,107 | 3,253 | 27,742 |
| 2005 | 21,013 | 5,163 | 3,287 | 29,463 |
| 2006 | 21,532 | 5,036 | 2,797 | 29,365 |
| 2007 | 22,745 | 5,270 | 2,896 | 30,911 |
| 2008 | 30,595 | 6,370 | 3,933 | 40,898 |
| 2009 | 29,686 | 6,108 | 4,030 | 39,824 |
| 2010 | 24,336 | 4,622 | 2,331 | 31,289 |
| 2011 | 23,320 | 4,202 | 2,265 | 29,787 |
| 2012 | 25,040 | 4,470 | 2,423 | 31,933 |

SOURCE: USDA-NASS. Prepared by HGA.

## *U.S. AVERAGE HOP YIELD (TEN YEARS)*

| | POUNDS PER ACRE | | | |
|---|---|---|---|---|
| YEAR | WASHINGTON | OREGON | IDAHO | TOTAL U.S. |
| 2003 | 2,050 | 1,626 | 1,536 | 1,903 |
| 2004 | 2,137 | 1,686 | 1,588 | 1,990 |
| 2005 | 1,878 | 1,560 | 1,640 | 1,796 |
| 2006 | 2,058 | 1,757 | 1,613 | 1,964 |
| 2007 | 2,049 | 1,811 | 1,417 | 1,949 |
| 2008 | 2,072 | 1,569 | 1,841 | 1,971 |
| 2009 | 2,528 | 1,948 | 1,943 | 2,383 |
| 2010 | 2,147 | 1,791 | 2,129 | 2,093 |
| 2011 | 2,200 | 1,908 | 2,408 | 2,175 |
| 2012 | 1,941 | 1,885 | 1,745 | 1,918 |

SOURCE: USDA-NASS. Prepared by HGA.


## *IHGC AROMA ACREAGE (FIVE YEARS)*

| COUNTRY | AROMA ACREAGE (IN ACRES) | | | | | 2011-12 |
|---|---|---|---|---|---|---|
| | 2008 | 2009 | 2010 | 2011 | 2012 | % +/- |
| Australia | 82 | 67 | 79 | 119 | 128 | 8.33% |
| Austria | 479 | 474 | 460 | 479 | 477 | -0.52% |
| Belgium | 126 | 126 | 126 | 148 | 175 | 18.33% |
| China | 1,433 | 1,433 | 1,433 | 946 | 853 | -9.92% |
| Czech Rep. | 12,486 | 12,316 | 12,215 | 10,791 | 10,413 | -3.50% |
| France | 1,814 | 1,068 | 983 | 892 | 922 | 3.32% |
| Germany | 25,386 | 23,673 | 23,844 | 23,569 | 22,489 | -4.58% |
| New Zealand | 531 | 568 | 568 | 655 | 655 | 0.00% |
| Poland* | 1,905 | 1,905 | 1,008 | 1,008 | 988 | -1.96% |
| Romania | | 183 | 158 | 151 | 151 | 0.00% |
| Russia* | 376 | 376 | 855 | 208 | 208 | 0.00% |
| Serbia* | 84 | 84 | 84 | 84 | 84 | 0.00% |
| Slovakia | 531 | 581 | 566 | 549 | 529 | -3.60% |
| Slovenia | 3,615 | 3,581 | 3,210 | 3,168 | 2,634 | -16.85% |
| South Africa* | 0 | 0 | 0 | 0 | 0 | 0.00% |
| Spain* | 0 | 0 | 0 | 0 | 0 | 0.00% |
| Ukraine | 1,606 | 1,589 | 1,663 | 1,268 | 853 | -32.75% |
| UK - England | 1,977 | 2,002 | 2,019 | 1,984 | 1,965 | -1.00% |
| USA | 15,182 | 13,425 | 10,811 | 11,921 | 15,558 | 30.51% |
| IHGC Total | 67,614 | 63,450 | 60,082 | 57,940 | 59,082 | 1.97% |

*Countries with partial provided report updates for the IHGC. Missing figures were used from previous reports or from IHGC estimates.

SOURCE: IHGC Economic Commission annual reports.
Numbers may not total exactly due to rounding and standard/metric conversions.

Srecec et al. 2009. Hop pellets type 90: Influence of manufacture and storage on losses of alpha –acids. Acta Alimentaria 38(1): 141-147.

The glandular trichomes (peltate and bulbous) are placed on the epidermis of hop cone bracts in which the hop metabolites are accumulating (Saito et al., 1995; Hi rosawa et al., 1995). Higher temperature speeds up the oxidation reactions which cause degradation of bitter and aromatic hop substances and consequently decrease the brewing value of hop pellets. The basic principle of hop chemical compounds degradation primarily means the oxidation of α-acids when they are exposed to air, particularly at high temperatures during kilning, conditioning, pressing, temporary storage, pelletization, transportation to a brewery and storage in brewery warehouse (Weber et al., 1979; Forster, 1999; 2001a; b; 2002; 2003a; b; Rossbauer & Münsterer, 2003; Virant & Majer, 2003; Srečec et al., 2009). Hop pellets type 90 are still the most frequent hop products used in brewing and their quality is diminished during harvesting and processing to hop pellets (Forster, 2001a; Srečec et al., 2009). Depending on exposure to the high temperatures during the different phases of hop processing and storage the losses of hop bitter and aromatic substances could increase (Forster, 1999; 2001a; b; 2002; 2003a; b; Rossbauer & Münsterer, 2003; Virant & Majer, 2003; Srečec et al., 2009). In order to reduce the time of hop exposure to high temperatures the integrated pelletization of hop cones into hop pellets type 90 was developed (Srečec et al., 2004b; Marić & Srečec, 2006). It means that all well-known technical solutions are linked into an integrated system which covers harvesting, kilning and conditioning or just cooling of dried hop cones with grounding, pelletization and packing in 3-ply Al-folium bags under inert N2 atmosphere. Nevertheless, it is well known that even this kind of packing does not prevent degradation of α-acids when exposed to high temperatures during transportation and storage (Marić & Srečec, 2006; Srečec et al., 2009). Changes of α-acids content during the integrated procedure of hop pellets production confirm that integrated procedure considerably decrease loss of α-acids in comparison to the usual procedure (Srečec et al., 2004b; 2009). Nevertheless, time, temperature and hop damage have significant impact on losses of α-acids. However, there are no such optimal conditions, in which the losses of hop bitter compounds could be completely avoided. One of the most possible reasons is damage of lupulin glands or hop glandular trichomes during the drying and pelletizing (Forster, 2001a; b; 2002; 2003a; b; Rossbauer & Münsterer, 2003; Virant & Majer, 2003; Marić & Srečec, 2006; Srečec et al., 2009). On the basis of previous considerations the main goal of this study is to consider the morphological and structural changes or damage of hop glandular trichomes during the different phases of hop processing in order to find the causes of α-acids losses.

# Climate change and hops

A B S T R A C T
The impact of climate change on the production and quality of hops Humulus lupulus will depend on future weather conditions in the growing season. Our simulations suggest that hops will be particularly vulnerable to a change in climate. Even with the modest warming so far experienced yields have stagnated and quality declined. Recorded observations show an increase in air temperature which is associated with an earlier onset of hop phenological phases and a shortening of the vegetation period. Simulations using future climate predict a decline in both yields, of up to 7–10%, and a-acid content, of up to 13–32%, the latter a major determinant of quality. The concentration of hop cultivation in a comparatively small region in the Czech Republic makes it more vulnerable than if the crop were grown in more areas with different climates. Thus climate change may gradually lead to changes in the regionalization of hop production. Policy assistance may be necessary for the adaptation of the Czech hop growing industry to changed climatic conditions.

The impact of climate change on the yield and quality of Saaz hops in the Czech Republic. 2009.
Martin Mozny a,*, Radim Tolasz a, Jiri Nekovar a, Tim Sparks b, Mirek Trnka c, Zdenek Zalud c
Agricultural and Forest Meteorology 149 (2009) 913–919

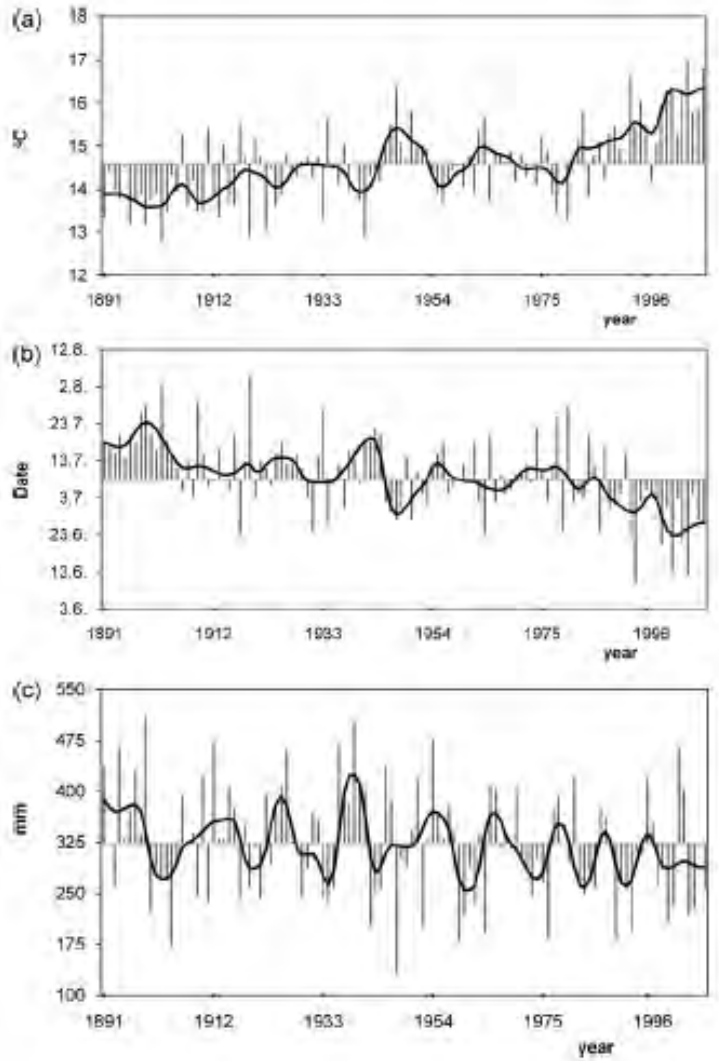



**Fig. 2.** (a) Average air temperature of the Czech hop cultivation area for the summer half-year (April–September) in the period 1891–2006. Bars indicate deviations from the average value and 4253H filter has been used to show the underlying trend. (b) The beginning of flowering of Saaz hops in the Czech hop cultivation area in the period 1891–2006. Bars indicate deviations from the average value and 4253H filter has been used to show the underlying trend. (c) Seasonal (April–September) precipitation totals in the Czech hop cultivation area in the period 1891–2006. Bars indicate deviations from the average value and 4253H filter has been used to show the underlying trend.

# Hop Extracts

**Hop Extracts**

- Hop extracts are the liquid bittering essences of hops and are used for convenience in the brewing industry. Some liquid hops extracts are processed with a wide variety of chemical solvents that dissolve the hop resins into solution and chemically “isomerize” alpha acids (to isomerize, means to chemically rearrange the molecular structure of alpha acids so that they are soluble in water and thus impart their bitter qualities.) There are also hop extracts available that are not isomerized.
- The non-isomerized hop extracts also do not come into conflict with any German beer purity laws if this is a particular concern of yours. The chief advantage of using the hop extracts, especially for large breweries or where storage space is limited, is that they occupy considerably less space. All hop extracts must be used sparingly and care must be taken that they are well mixed to ensure that they are dissolved.

# Hop Extracts

- At its simplest, hop extraction involves milling, pelleting and re-milling the hops to spread the lupulin, passing a solvent through a packed column to collect the resin components and finally, removal of the solvent to yield a whole or "pure" resin extract.
- The predominant extracts are "organic" solvent extracts (hexane) and CO2 extracts (supercritical and liquid).
- Following extraction there is the process of solvent removal which for organic solvents involves heating to cause volatilization. Despite this, trace amounts of solvents do remain in the extract. The removal of CO2, however, simply involves a release of pressure to volatilize the CO2.
- Solvent extracts are increasingly falling out of favour worldwide due to perceived problems with the residues. CO2 extracts on the other hand are gaining favour as they are seen to be produced with a "natural" solvent.
- Disadvantages: Solvent residues are the main problem with the organic solvent extracts. Further, the heating of the extract to remove solvent markedly modifies the aroma profile.

# The evaluation of the quality of hop purchased from growers

The purchase of hop of the growers is governed in Czechoslovakia by two special state standards (CSN 46 2510 - Hop and CSN 46 2520 - Hop tests). Both standards were innovated and their last modification is valid since the 1st August 1986. There are two categories of characteristics used for evaluation of hop purchased from growers:

1. *objective characteristics* investigated by objective methods in laboratories, among which it has to be mentioned: damage to cones by harmful factors, the rate of knocks (damages to the colour of cones), the rate of disintegrated cones, the rate of biological adulterants, the moisture content of cones and the content of a-bitter acids (conductometrical value)

2. *subjective characteristic* evaluated by senses - biological growth, the structure of spindle, the scent, the presence of seeds (negative characteristic), the colour of cones, the colour of lupuline.

There are four c l a s s e s of q u a l i t y . The State Inspection of Quality of crops and products of food industry establishes for every quality class the samples of typical quality. These samples are made known to every purchasing centre before the purchase starts. The representatives of the grower and of the purchasing centre decide about the quality class of the hop which is purchased. The results of laboratory analyses of the purchased hop as well as the typical samples are available to the experts which decide about the quality class given to the purchased hop.

Generally, three levels of quality are distinguished

First level, the deviations from the ideal parameters can be tolerated.

Second level, these are over limits and the price should be reduced.

Third level-some corrective measures are required to make the product acceptable for commerce. These measures are naturally to the account of the grower. So the rate of biological adulterants is limited to 3 %. When their quantity ranges from 3 to 7 % the price is reduced, when it exceeds this limit, the product has to be recleaned on the grower's costs. The content of alpha bitter acids is limited with 4 %. Every 0.5 % over or below this value are reflected by positive or negative charges respectively.

2 ply Sisal twine

Coir Twine

non biodegradable *string* of *polypropylene 9000 baling twine*

bio-degradable twisted paper strings

On the trial were 5 types of strings trialed these were:

- Coir 50, in ball form with a breaking strain of 50 lbs
- Coir 75, bundle form of 5 meter lengths with a 75lb breaking strain
- Paper, also cut to length and made of recycled paper
- Sisal, original hop twine previously used in the industry
- Sisal Light, white thin twine
- Synthetic string currently being used in the industry

5 farms participating

http://maxa.maf.govt.nz/sff/about-projects/search/L04-007/l04-007-final-report.pdf

## *STRINGING*

The following findings are those which were completed during the stringing process of the hops.

| STRING TYPE | FINDINGS |
|---|---|
| Coir 50 | This string took twice the time to string and was moderately hard on the stringers hands, the string did not run well through the ball. |
| Coir 75 | More than twice the time to string with the string been moderately hard on hands. This string was a lot more difficult to handle due to its thickness. The string was not used in a ball so if produced in a ball I imagine this would be even more difficult to use. |
| Paper | Also more than twice the time to string. The main difficulty with this string was that it is less pliable than others; this creates problems with tightening the knot on itself and tensioning it. This string was however easier on the stringers hands. |
| Sisal | This string was the fastest of all the trial strings to tie. The string ran well off the ball however was very harsh and left splinters on the stringers hands. |
| Sisal Light | Quality of this string was extremely low with all vines falling well below the top of the garden. |

## *TRAINING*

The following findings are those which were completed during the training process of the hops.

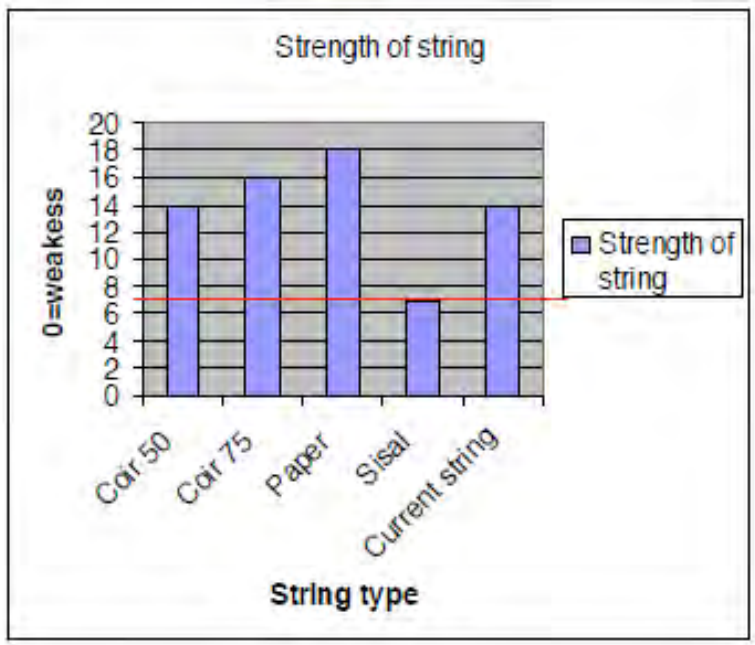
- Coir 75 was the most unfavorable string to train due to its thickness and husks protruding out.
- Coir 50 and Sisal were more favorable, on the basis that they were thinner than the Coir 75.
- Paper was trained easily and more in line with the current string /polypro.

## *VINE CLING*

All strings performed satisfactory with the Coir 50, Coir 75 and Sisal all having the best vine cling this is due to the fact that they all have husks on them. These strings would also be useful for hop varieties of a smoother vine texture, in order to assist them clinging onto the string with more ease.

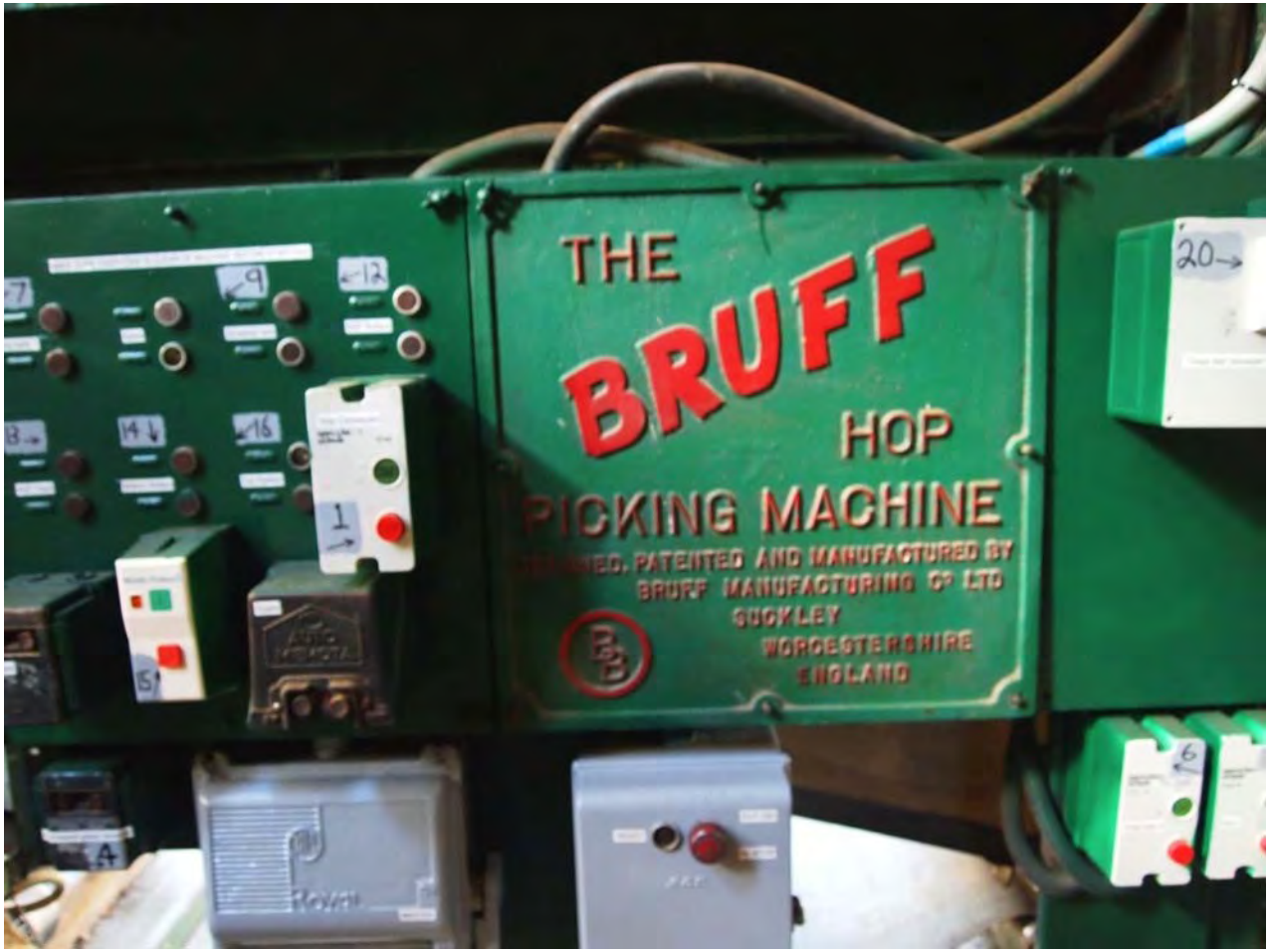
- String deterioration after 5 months

Currently composting of the strings is being carried out at Hort Research on all of the strings involved in the study.
At this stage the Paper and Sisal are showing good signs of breaking down.




"It is my recommendation that we select Coir 50 and Paper for further larger scale trials."


NEW
HOPLANDS
EST. 1951
DANGER


THE
BRUFF
HOP
PICKING MACHINE
PATENTED AND MANUFACTURED BY
BRUFF MANUFACTURING Co LTD
SUCKLEY
WORCESTERSHIRE
ENGLAND


**PELLETS**

- A superior alternative to other hop forms, pellets have wide commercial acceptance. Made by pulverising the hop to hop powder then extruding the powder through the die of the Amandus Kahl hop press at New Zealand Hops Ltd, designed to keep the product as cool as possible at all times, even before the final cooling process, the fresh hop flavour and aromatics are retained very well. Finally back flushed with inert gas and vacuum packed, New Zealand hop pellets have readily gained international acceptance, and are sold to many breweries in different countries overseas.
- 5, 20 or 25kg Cartons of New Zealand hop pellets Type 90, are vacuum packed with alu-foil liner and backflushed with Nitrogen to produce a free-flow effect.
- **5kg Cartons**
- Dimensions: 36 cm x 23 cm x 14 cm
  Net Weight: 5 KG
  Gross Weight: 6 KG
  Volume: 0.01 m3
  Available in all varieties.
- **20kg Cartons**
- Dimensions: 53.5 cm x 36.6 cm x 20.2 cm
  Net Weight: 20kg
  Gross Weight: 21.5kg
  Volume: 0.04 m3
  Available in all varieties.
- **25kg Cartons**
- Dimensions: 53.5 cm x 36.6 cm x 25.3 cm
  Net Weight: 25kg
  Gross Weight: 26.5kg
  Volume: 0.05 m3
  Available in all varieties.

- **100 Gram Pellet Sachets**
- Developed for the homebrew market these sachets are also ideal as samples of our New Zealand hop varieties.
  Dimensions: 15 cm x 20 cm
  Net Weight: 100 grams
  Gross Weight: 105 grams
  Available in all varieties


# • Cone Hops

**Baled Hops**

Hops are received into New Zealand Hops Ltd's store straight from the farm during harvest time, packaged in this form. After checking for moisture content and sampling for colour, aroma, general appearance, broken cones, and leaf and stalk content, the hops are placed into coolstores ready for either the pelleting plant or for general sale to those breweries who prefer brewing the traditional way using cone hops.

To save on freight cost these bales can be recompressed to about half their size using a hydraulic pres
Baled dried cone hops, kiln dried on farm and pressed into a standard hop pack.
Dimensions: 150 cm x 75 cm x 75 cm
Net Weight: Approx. 135kg
Gross Weight: Approx. 136.5kg
Volume: 0.84 m3 (This can be reduced to half its size by recompressing the bale)
Available in all varieties.

**MiniVac Pockets**

This pack type was developed to protect cone hops from oxidation, which is an inevitable occurrence atmosphere. Ideal for those breweries that use cone hops in smaller quantities.
15kg vacuum packed compressed cone hops in alu-foil liner with a cardboard outer.
Dimensions: 53 cm x 32 cm x 30 cm
Net Weight: 15kg or 3 x 5kg
Gross Weight: 16.5kg
Volume: 0.05 m3
Available in all varieties.


- **$CO_2$ Hop Extract**
- Supercritical $CO_2$ hop extract made from our New Zealand varieties by Nutrizeal Ltd.
  $CO_2$ hop extract is a golden to tan, thick honey-like paste with all the natural hop variety specific brewing characteristics. As a pure resin, the alpha acids concentration is variety specific, typically between 25% and 60%.$CO_2$ Hop Extract Typically contains between 3% to 12% hop oils, depending on variety.
- **Packaging**
- Available in drums, pails or cans for the varieties Super Alpha, Green Bullet, Pacific Gem, Southern Cross, and others upon request. New Zealand $C0_2$ Hop Extract can be packed according to a set amount of alpha acid by weight in partially-filled containers (for example 300 gram alpha in a can. At 50% alpha concentration in the extract can will contain 600 grams of extract.)


- **HARVESTED FOR PERFECTION**
- New Zealand hops are harvested in late February and March of each year. During drying, hot water radiators are the source of heat, thereby ensuring the hops stay free from any contamination by exhaust gases. The dried hops are pelleted at our own facility near Nelson and hop extracts are produced at our modern supercritical $CO_2$ extraction facility, Extract Solutions Ltd, situated adjacent to the hop pelleting plant.


HOPS
HOP PELLETS
(Humulus Lupulus)
Sticklebract
Alpha 14.1 %
Batch: 11086-03
100g net
3.52 oz net
PACKAGED BY:
NEW ZEALAND HOPS LIMITED
Store in a cool place.
Re-seal after use.
HOPS
HOP PELLETS
(Humulus Lupulus)
Nelson Sauvin
Alpha 12.3 %
Batch 11179-04
100g net
PACKAGED BY:
Store in a cool place.
Re-seal after use.


CERTIFIED
ORGANIC
IFOAM
ACCREDITED
USDA
ORGANIC
NEW ZEALAND
SINCE 1842
HOPS
LIMITED
VARIETY
CROP YEAR
BATCH NO.
PACIFIC GEM ORGANIC
2011
11086-02
NET WEIGHT
WHEN PACKED 20 kg
ALPHA:
16.7
PELLETS


NEW ZEALAND
HOPS
LIMITED
NEW ZEALAND
HOPS LTD.
OFFICE


VARIETY
CROP YEAR
BATCH NO.
PACIFIC GEM
2011
11284-03
NET WEIGHT
WHEN PACKED 20 kg
ALPHA:
HOPS
LIMITED
NEW ZEALAND