ESSENTIAL PRE-FERMENTATION PRACTICES IN QUALITY TABLE WINE PRODUCTION

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THANK YOU!

- Kentucky Fruit and Vegetable Conference
  - Kentucky Grape and Wine Short Course
- Initial Contact: Tom Cottrell
- Conference Organizing Committee
- Embassy Suites Hotel (Host Hotel)

OUTLINE

- Fruit Quality:
  - Grape Variety
  - Vineyard (cultural) practices enhancing quality
  - Maturity
  - Fruit condition – percent rot
- Harvest – holding times and temperatures
- Must / juice processing
  - enzymes, skin contact, juice clarification

FRUIT QUALITY

FRUIT QUALITY & OPTIMUM HARVEST PARAMETERS ?

- Season: Good vintage conditions or bad?
- Disease pressure
- Wildlife pressure and damage
- Vineyard cultural practices
  - Cluster thinning, leaf plucking, vine health & vigor
- Varietal characteristics
  - Early, mid, late season maturity
- Grower vintner relationship and agreements
  - A whole other topic worthy of discussion

FACTORS INFLUENCING FRUIT QUALITY

- Grape variety
- Cultural Practices
- Grape maturity
- Fruit condition – Percent rot

GRAPE VARIETY

- Several specific varieties can be related to the production of sound quality wines for certain grape growing regions.

CRITERIA FOR VARIETY SELECTION

Variety Selection

Site Characteristics	*Viticulture Characteristics*	*Market / Profit*
Minimum T & Frequency	Winter Hardiness	Supply / Demand / Trend
Topography	Fruit / Wine Quality	Wineries
Season Length	Ripening Season	Home Winemakers
Growing Degree Days	Others (diseases, yield, growth habit)	Value (Price)

Source: Dr. Imed Dami, 2011 Ohio Grape and Wine Conference

DESIRABLE VARIETIES FOR QUALITY WINE PRODUCTION IN OHIO

- American varieties
- Vidal Blanc
- Traminette
- Chambourcin- (best sites)
- Corot noir (NY-70)
- Noiret (NY-73)
- Valvin Muscat (NY-62)
- White Riesling – (best sites)
- Pinot Gris – (best sites)
- Chardonnay – (best sites)
- Cabernet Franc – (best sites)
- Cabernet Sauv. – (best sites)
- Pinot Noir – (best sites)

OTHER VARIETIES OF INTEREST

- White Varieties
  - Arneis
  - Malvasia Bianca
  - Sauvignon Blanc
  - Siegerrebe
  - Gruner Veltliner
  - Auxerrois
- Red Varieties
  - Dolcetto
  - Gamay Noir
  - Regent
  - Teroldego
  - Syrah

GDD = 2500
FFD = 175
Min T = 21F

GDD = 2700
FFD = 162
Min T = 19F

Vineyard/Varietal Match

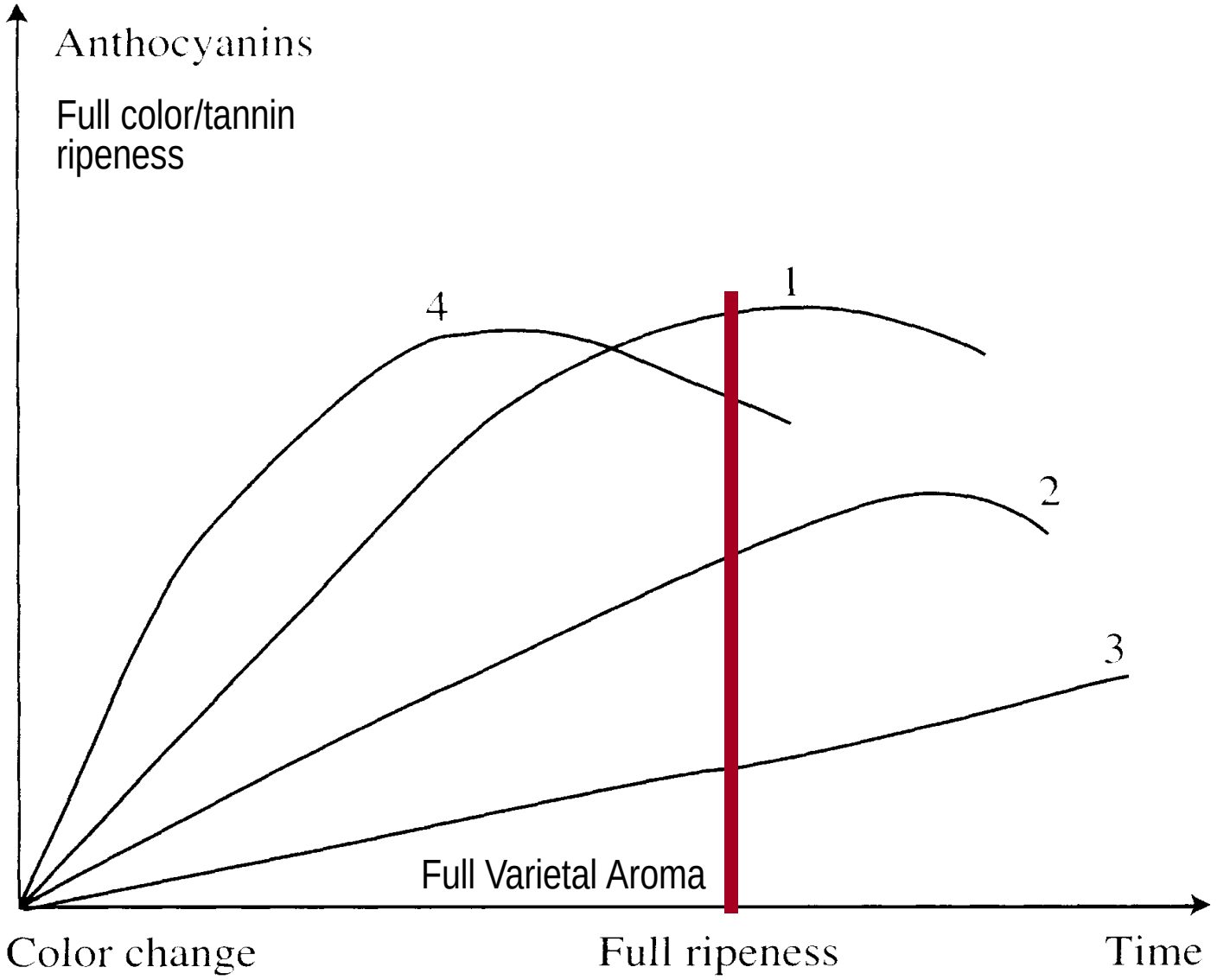


Fig. 6.39. Variations in the accumulation of anthocyanins in grape skins during ripening, according to vintages and vineyards. For the same vintage: 1, ideal situation, good grape–vineyard match; 2, late-ripening vineyard requiring slight overripeness; 3, very late-ripening vineyard, where the grapes are unlikely to produce a high-quality red wine; 4, Vineyard not very well-suited to this grape variety, as phenolic maturity occurs too early (Glories, 1986)

Source: Dr. Christian Butzke, 2009 Ohio Grape and Wine Conference

Y. Glories 1986

CULTURAL PRACTICES

LEAF PLUCKING

- Accomplished just after bloom (fruit set)
  - Below, adjacent and above cluster
- Exposed clusters aid in developing more uniform and increased maturity in addition to lower levels of methoxypyrazine (MP) compounds
  - Helps increase concentration of sugars, anthocyanins, phenolics and tannins etc.
- Promotes wind movement through cluster zone in drying grapes helping to prevent rot

CROP LOAD

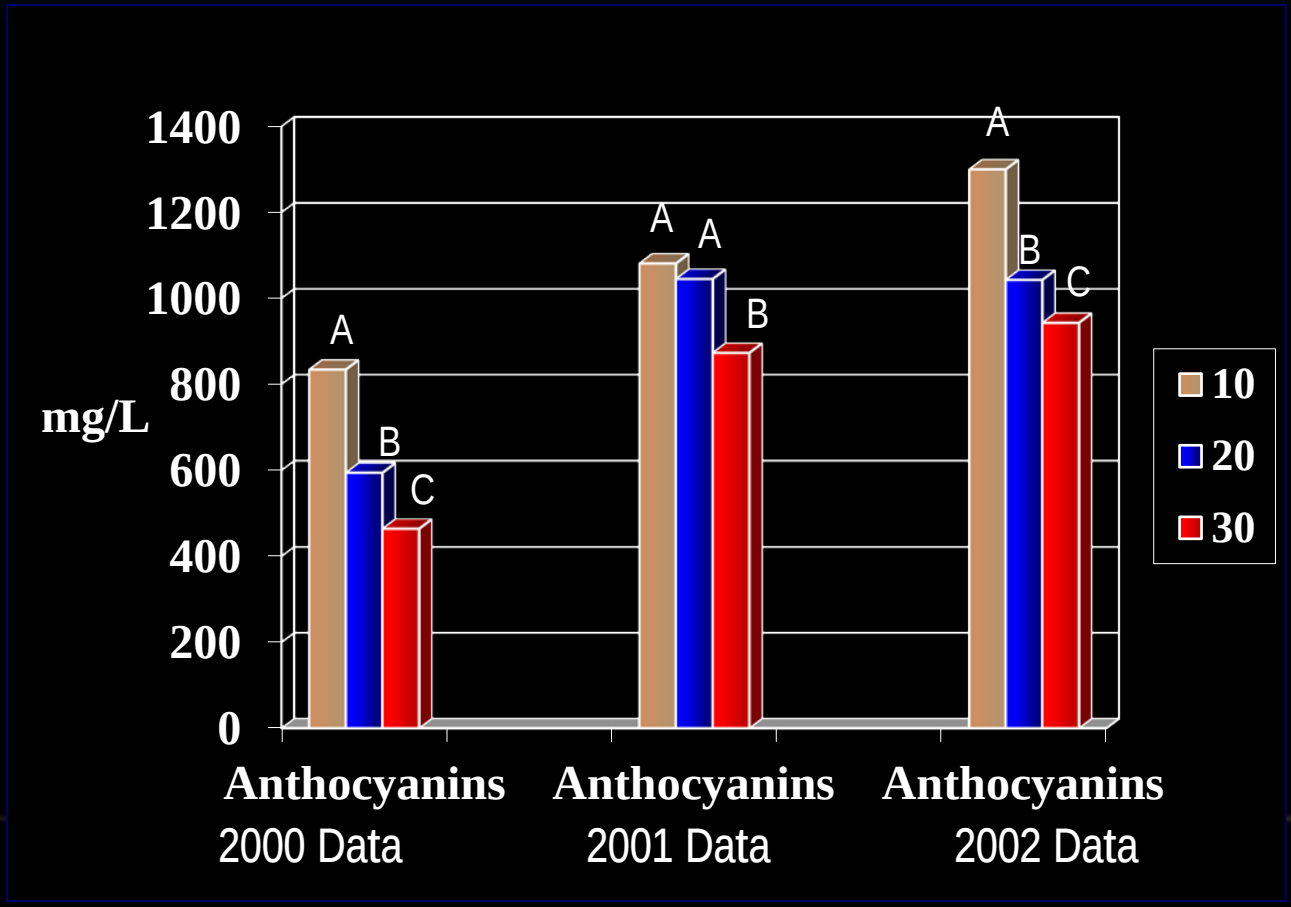
- Extremely important in controlling proper crop loads which directly effect wine quality
- Generally speaking, lower crop levels will ultimately produce higher quality wines
  - Also depends on training system, other cultural practices and vintage conditions
- Also aid in producing lower MP concentrations

THE EFFECT OF CROP LEVEL ON CHAMBOURCIN WINE QUALITY

CHAMBOURCIN MUST ANALYSIS

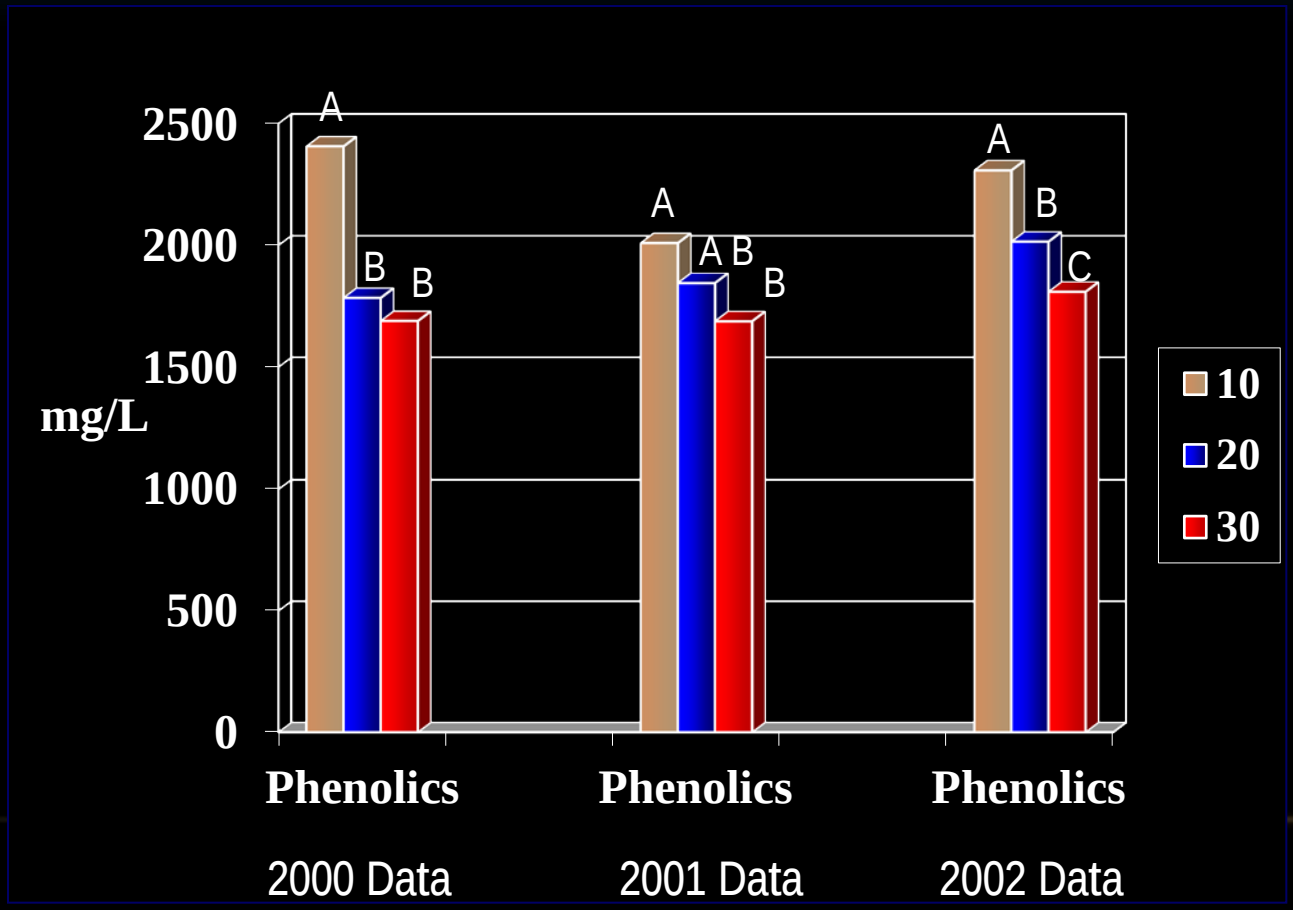
Crop Level	°Brix	pH	% TA (g/L)
2000 Must Analysis			
10	21.6	3.35	11.8
20	20.5	3.25	12.2
30	19.7	3.22	11.4
2001 Must Analysis			
10	23.1	3.23	9.3
20	22.5	3.18	9.3
30	21.5	3.13	9.5
2002 Must Analysis			
10	22.6	3.34	10.3
20	21.6	3.21	10.1
30	20.5	3.13	10.1

EFFECT OF CROP LEVEL ON TOTAL ANTHOCYANINS



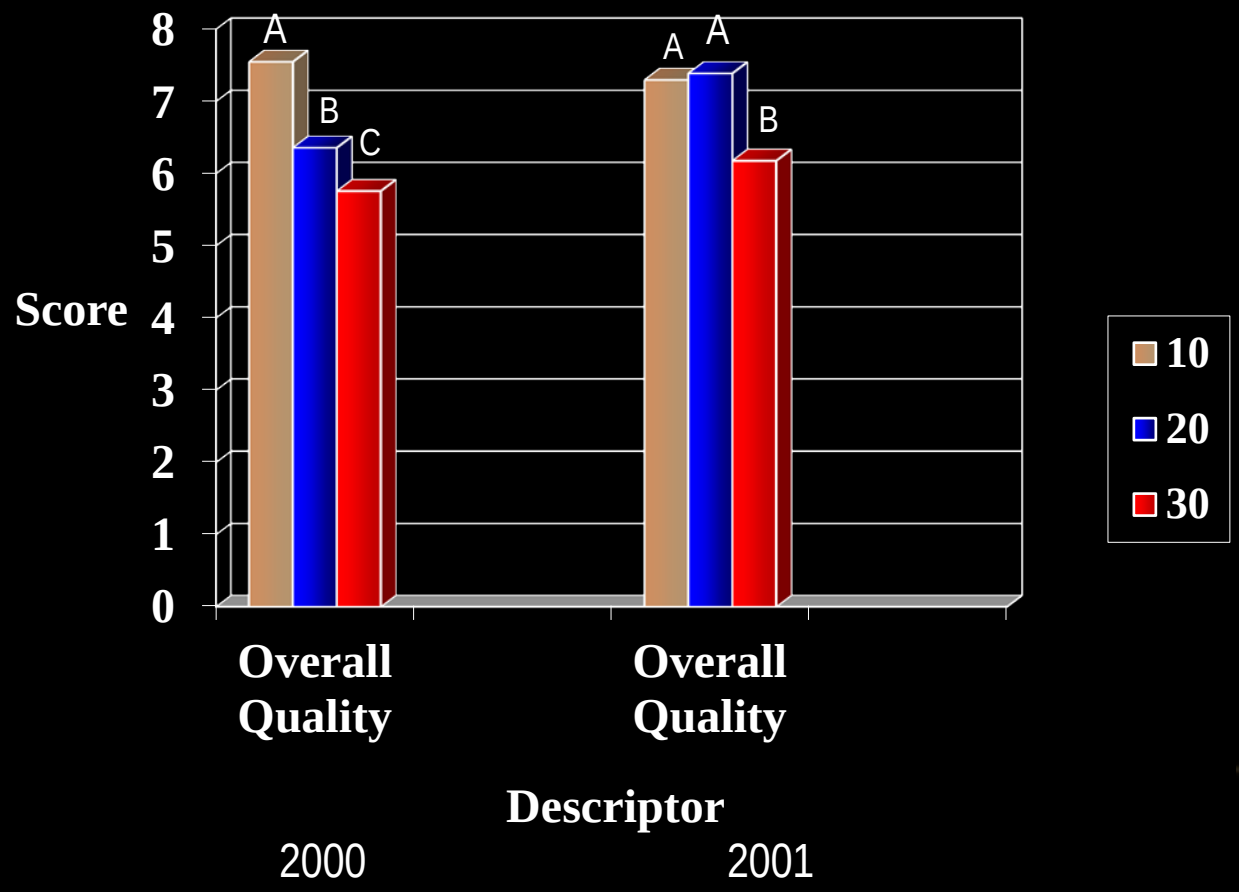
Total Anthocyanins expressed as malvidin-3-5 diglucoside in mg/L

EFFECT OF CROP LEVEL ON TOTAL PHENOLICS



Total Phenols: expressed as gallic acid equivalence in mg/L.

SENSORY PANEL DATA: OVERALL QUALITY



GRAPE MATURITY

“optimum harvest parameters”

GLUCOSE TO FRUCTOSE RATIOS

- Typically reported as a 1:1 ratio
- Glucose is Predominately the major component of unripe grapes in the eastern United States
- Fructose is considered to be a sweeter sugar with a threshold value of .14 g./100 milliliter, whereas glucose has a threshold value of .42 g./100 milliliter

SUGAR VS SOLUBLE SOLIDS

- Unripe to near maturity > 18° Brix, soluble solids are within 1% of actual sugar content
- Just before maturity the actual sugar content may be 4-5% lower then the actual soluble solids
- Factors influencing this are due to non-fermentable soluble solids such as: pectin's, tannins, pigments, acids and their salts

°BRIX AND BERRY SAMPLING

- To be within + 1° Brix with a probability level of .05 two lots of 100 berries should be analyzed
- To be within + .5° Brix five lots of 100 berries should be analyzed

BERRY SAMPLING TECHNIQUE

- Berry sampling should be from the top, middle, and bottom of the cluster
- Begin berry sampling weekly after veraison
- Take samples in the morning to keep track of °Brix, pH and TA progression consistently
- Take samples on both sides of the trellis

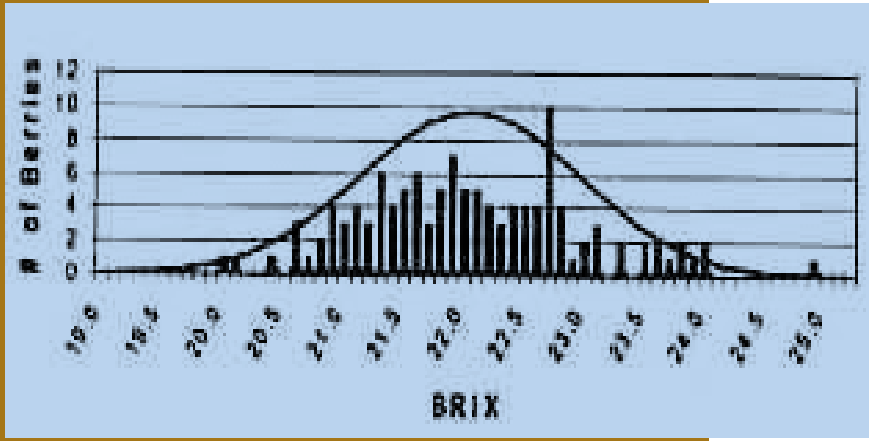
BERRY SAMPLING TECHNIQUE

- Avoid sampling from end rows or vines with physiological or morphological differences.
- Avoid the tendency to sample only mature berries
  - This may result in up to 2° higher Brix measurements then actual at crushing

Brix

- 20.0 - 21.1
- 21.1 - 22.1
- 22.1 - 23.0
- 23.0 - 24.9

Range: 20.0 - 24.9



Ripeness Variation

R. Boulton, UC Davis

FORMULAS TO MONITOR HARVEST MATURITY (SUGAR / BERRY)

Calculation Formula

a/100 x b/100 = sugar concentration/berry

Where: a = °Brix

b = 100 berry weight in grams

Helps take berry to berry variation out and provides efficient monitoring of optimum harvest maturity

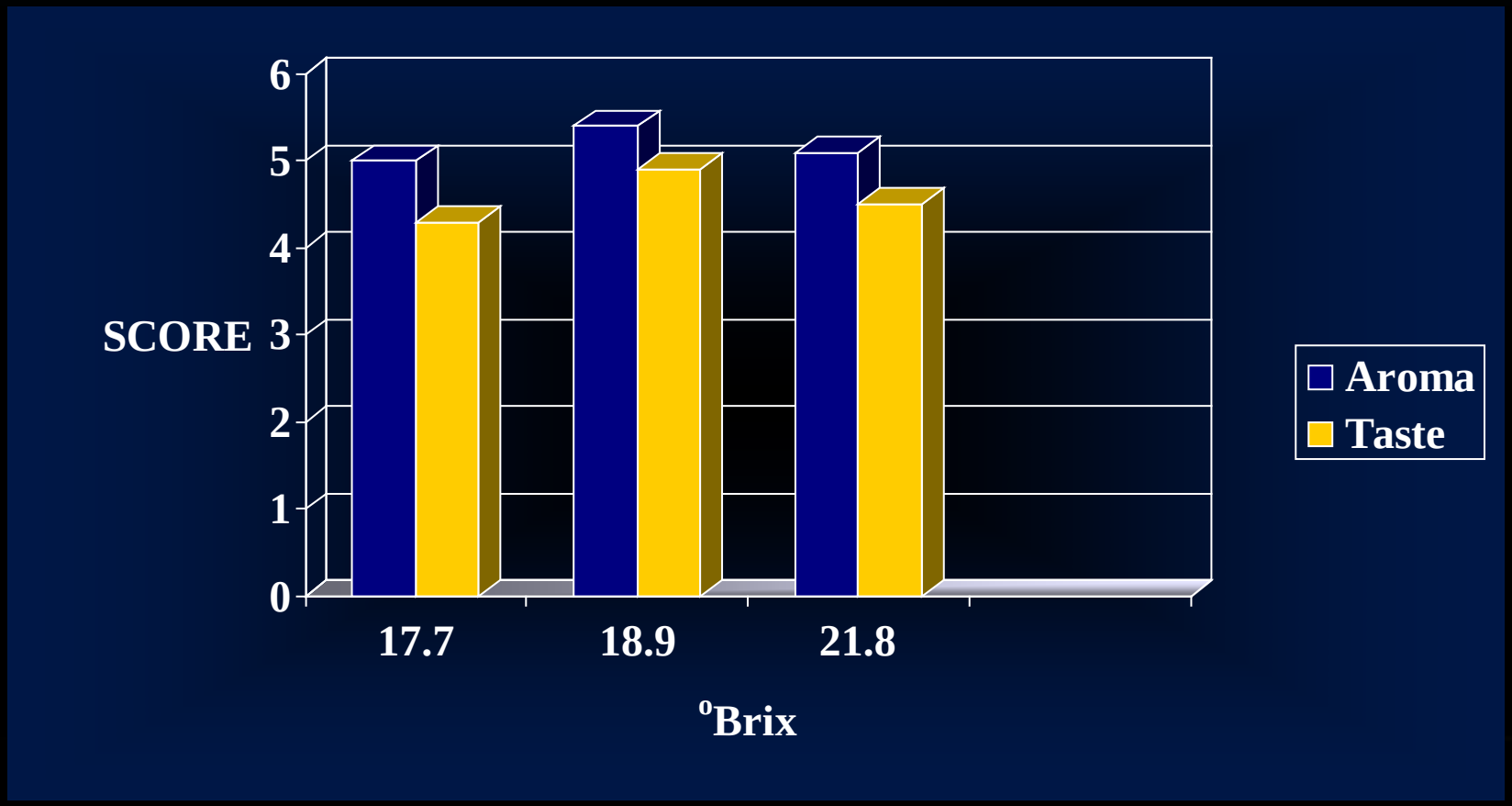
FORMULAS TO MONITOR HARVEST MATURITY (°BRIX / TA)

- Divide °Brix by %TA
  - 21/0.90 = 23
  - 22/0.80 = 28
- Higher values represent increased maturity
- Keep variety, pH and grape condition in mind
- A decent way to tract variety & site over the years
- One of the formulas we examine at OARDC

MATURITY DECISIONS

- Don’t judge maturity by sugar, pH and TA alone
- Sensorial monitoring is an important aspect in addition to chemical analysis for determining optimum maturity
  - Follow development of varietal character and intensity in the vineyard with a goal of maximizing flavor and aroma development while minimizing rot

VIDAL BLANC STUDY EVALUATING FRUIT MATURITY AND SENSORY SCORE



Gallander (1979)

FRUIT QUALITY AND MICROBIOLOGY CONCERNS

FRUIT CONDITION - ROT

- “You can’t make a silk purse out of a sows ear!”

FRUIT CONDITION - ROT

- Produces enzymes called tyrosinase and laccase which causes browning and oxidation.
- Increases levels of glucan which make wine hard to filter.
- Damage fruit leads to secondary spoilage by microorganisms producing off odors and flavors.

FRUIT CONDITION - ROT

- Acetic and lactic acid bacteria can be problematic in rot scenarios
  - May play important roles in the production of off aromas and flavors before, during and after fermentation
- Native yeast originating in the vineyard
  - Hanseniaspora and Kloeckera can produce high levels of ethyl acetate during pre-fermentation processing mainly during cold soak and/or low-temperature fermentation

FRUIT CONDITION - ROT

- High density populations on fruit arriving at the winery represent a contamination threat to subsequent operations and the winery
- Development of population densities of native species in the winery depends upon microbial load arriving on fruit and subsequently, upon sanitation conditions in the winery
- Rapidly growing microbial populations are spread throughout winery on worker's boots/clothing as well as by insect vectors resulting in a generalized contamination

FRUIT CONDITION – ROT AND WINERY MICROBIOLOGY CONCERNS

- Increased microbial properties can lead to a depletion of nitrogen (YANC) needed for a successful primary fermentation
- An increase in rot elevates must pH (> 3.5)
  - Greater chance for both chemical and microbial instabilities
  - Also, tartrate, protein, color and SO_2 effectiveness

SPOILAGE PRODUCTS PRODUCED BY MICROORGANISMS FROM ROT

- Yeast: hydrogen sulfide, acetic acid, ethyl acetate, higher alcohols, etc..
- Molds: glycerol, gluconic acid, ethanol, etc..
- Bacteria: acetic acid, ethyl acetate, butyric acid, acetaldehyde, hydrogen sulfide, etc..

EFFECT OF GRAPE CLUSTER ROT ON WINE QUALITY

% Rot	pH	% TA	Sensory Score
0	3.74	.56	13.9
5	3.79	.49	11.7
10	3.79	.53	11.0
20	3.72	.56	8.2
40	3.74	.61	6.1

Loinger (1977)

FRUIT CONDITION – ROT PREVENTATIVE MEASURES

- Continually pick out rot in the vineyard
- Sorting tables prior to destemming and crushing worth extra effort in preventing rotten grapes to be fermented
- Increased amounts of rot require an increase in sulfur dioxide to the must
  - 50 to 75 ppm recommended for higher percentages of rot coming into the cellar

FRUIT CONDITION – ROT PREVENTATIVE MEASURES

- Whole cluster pressing recommended to white varieties and Thermovinification to reds high in rot
- Lysozyme can be added to must and wine to protect against gram positive bacteria (LAB)
  - Do not add to must of grapes known for low color extraction such as Pinot Noir
- Tannin addition as an antioxidant and lower O_2 availability to microbes and inhibit laccase

FRUIT CONDITION – ROT PREVENTATIVE MEASURES

- Follow wine movement from crushing to bottling in evaluating for off aroma's and flavors
- Monitor and maintain sulfur dioxide levels based on wine pH at .8ppm molecular SO_2
- Practice good sanitation and sterilization protocols in winery
- Practice sterile bottling techniques

HARVEST – HOLDING TIMES AND TEMPERATURES

HARVEST – HOLDING TIMES AND TEMPERATURES

- Hand harvesting ultimately provides better overall grape quality with less maceration
- Harvest at cooler temperatures at night or early morning to minimize microbial activity
- Use sulfur dioxide at rates of 75 to 100 ppm to bins for higher temperatures of grapes at harvest in addition to increased percentages of rot
- Minimize time from harvest to cellar

HARVEST – HOLDING TIMES AND TEMPERATURES

- Grapes should be cooled immediately after harvesting.
- Unless skin contact is desirable crushing should occur shortly after cooling of the grapes.
- Skin contact should be performed below 50° F if possible

MUST AND JUICE PROCESSING

Enzyme use, skin contact and juice clarification

SKIN CONTACT & ENZYME USE - WHITES

- Excellent choice for aromatic white varieties
  - Vidal, Traminette, Riesling, Gewurztraminer, Muscat
- Desire of extracting the free volatile terpene fractions (Monoterpenes) and other flavorants present in grape juice and skins
- Use of pectolytic enzyme with Beta-glucosidase activity beneficial in releasing free volatile terpenes Ex.(Cinn Free)

SKIN CONTACT & ENZYME USE - WHITES

- Preferably accomplished at temperatures below 50 ºF in preventing microbial issues
- Depending on variety, contact time from 6 to 24 hrs. common

IMPACT OF THE USE OF CINN-FREE ON MUST MONOTERPENES (MG/L)

Treatment	FVT	PVT	Total monoterpenes
Control	2.0	3.6	5.6
Cinn-Free	2.5	3.7	6.2
Significance	**	ns	**
**: Significant at $p \leq 0.01$			

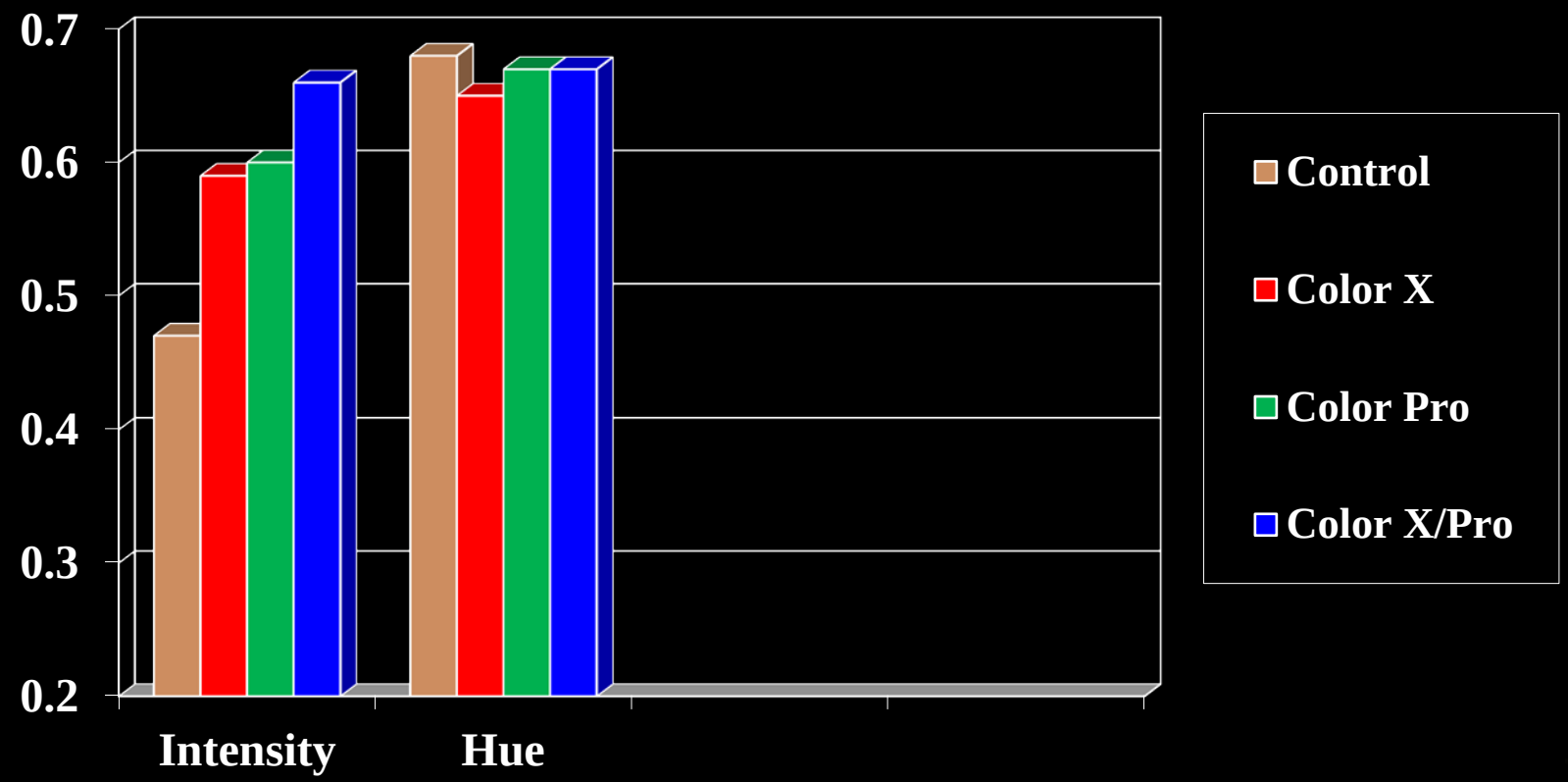
Source: Dr. Andy Reynolds, Flavor Development in the Winery, Proceedings of the 2002 Ohio Grape-Wine Short Course

ENZYME ADDITION - REDS

- The addition of pectinase enzymes help aid in both color extraction and stability
  - Formulated to have cellular and protease side activities that break down cellular structures helping increase extraction of anthocyanins, polymeric phenols and tannins
- Follow manufactures directions and addition rates for specific enzymes
- Recommend addition of enzymes to crushed grapes just prior or shortly after fermentation starts

EFFECT OF PECTINASE ENZYMES ON THE COLOR OF CABERNET FRANC

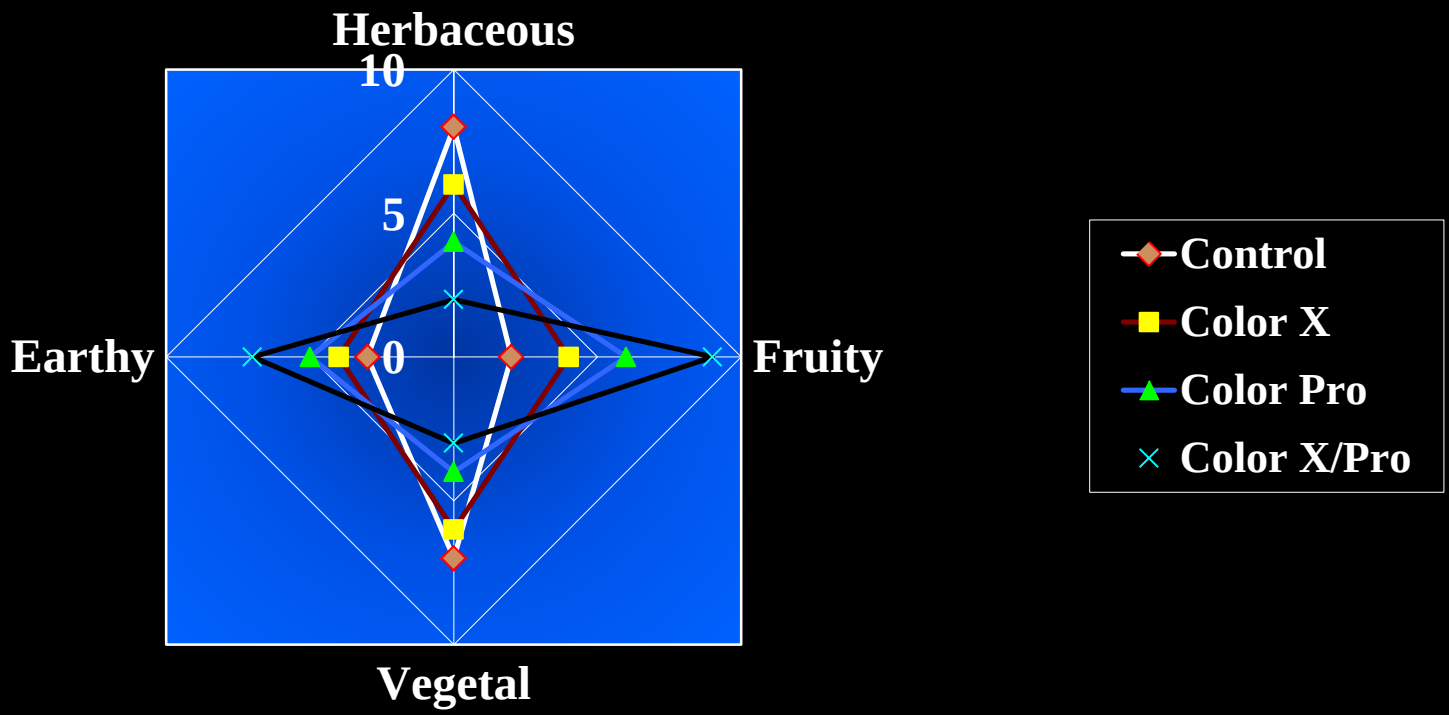
EFFECT OF PECTINASE ENZYMES ON THE COLOR OF CABERNET FRANC WINES FOR THREE SEASONS, 1998-2000, MEAN VALUES



Intensity: sum of Abs. at 420nm and 520nm

Hue: ratio of Abs. At 420nm and 520nm

EFFECT OF PECTINASE ENZYMES ON THE OVERALL SENSORY ATTRIBUTES OF CABERNET FRANC WINES FOR THE 1998 SEASON



JUICE CLARIFICATION - WHITES

- Juice clarification prior to fermentation is a very important aspect in producing a premium white table wine high in both aroma and flavor varietal attributes

ADVANTAGES OF JUICE CLARIFICATION

- Produce clean, fruity and delicate wines
- Production of less higher alcohols with better varietal characteristics
- Less off odors, particularly hydrogen sulfide
- Produces wines with less harsh and rough characteristics

DISADVANTAGES OF JUICE CLARIFICATION

- Must with excess juice clarification of less then .2% insoluble solids may lead to lengthened fermentations

FACTORS INFLUENCING AMOUNT OF JUICE INSOLUBLE SOLIDS

- Fruit condition - sound fruit yields less solids
- Maturity - over ripe grapes tend to produce higher insoluble solids
- Variety - certain varieties are recognized for producing high insoluble solids
- Fruit temperature - high temperature grapes produce higher insoluble solids

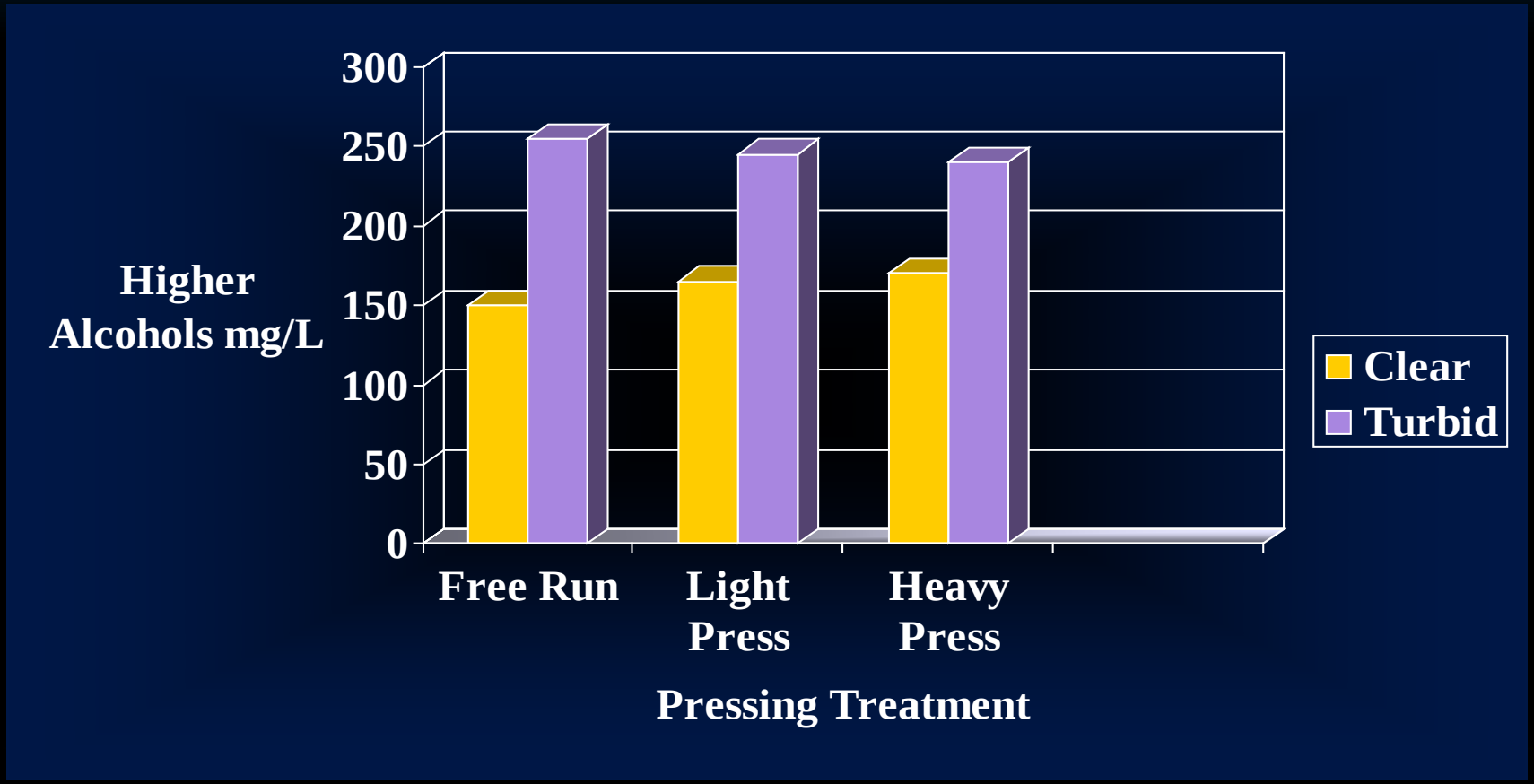
JUICE CLARIFICATION PRACTICES

- Natural settling and racking
- Addition of pectic enzymes with natural settling and racking
- Addition of fining materials with natural settling and racking. (ex. bentonite)
- Centrifugation

JUICE CLARIFICATION PRACTICES

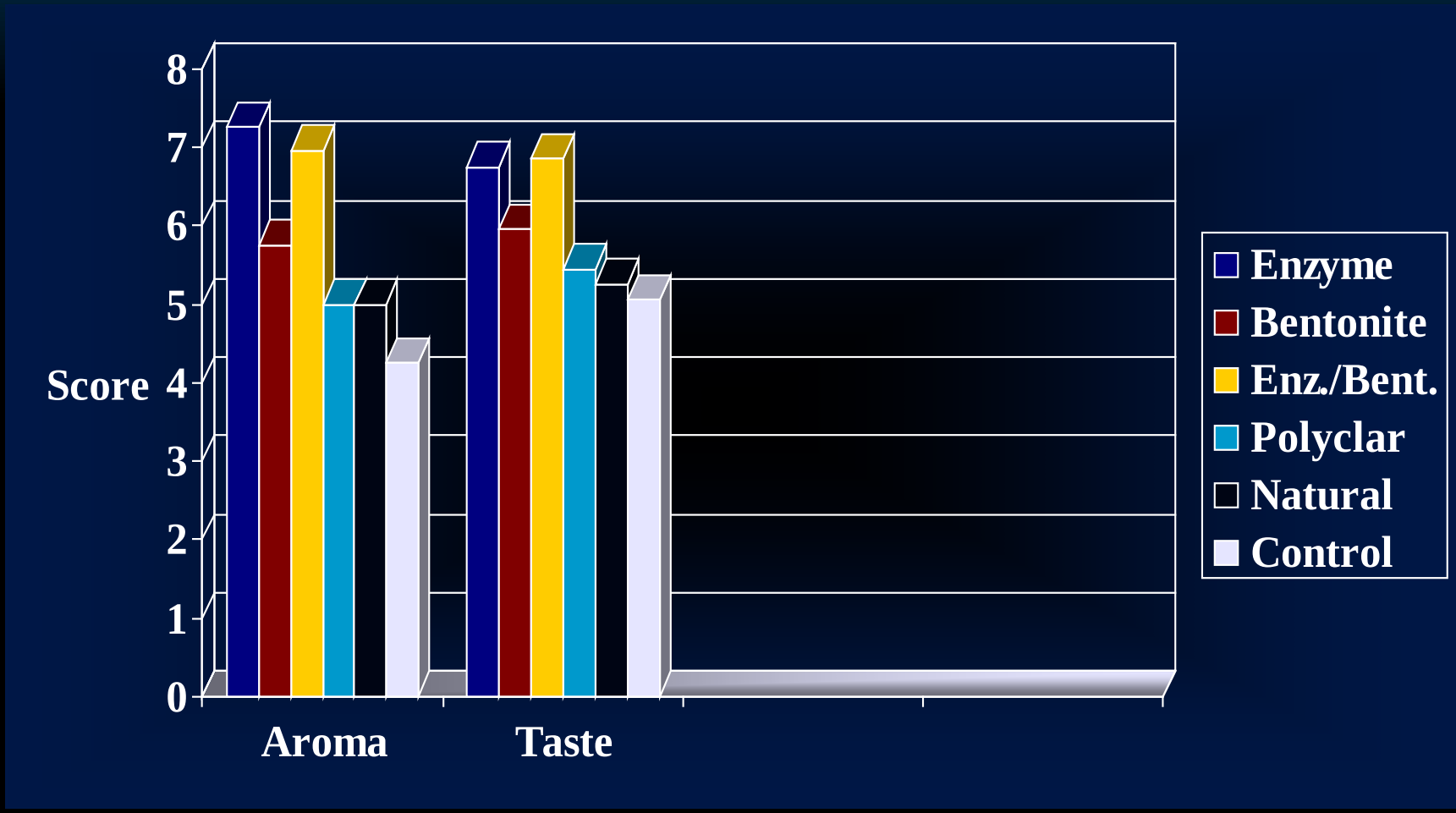
- Juice clarification should take place at 50 - 55ºF to provide a more efficient separation
- Add pectic enzymes based on manufactures instructions, settle for 12 hours and rack off
  - CinnFree, Pec 5L, KS etc…
- Addition of bentonite (250 mg./L.) or other fining agent while mixing slightly, settle for appropriate time and rack off

CLARIFICATION IN RELATION TO HIGHER ALCOHOL CONCENTRATION



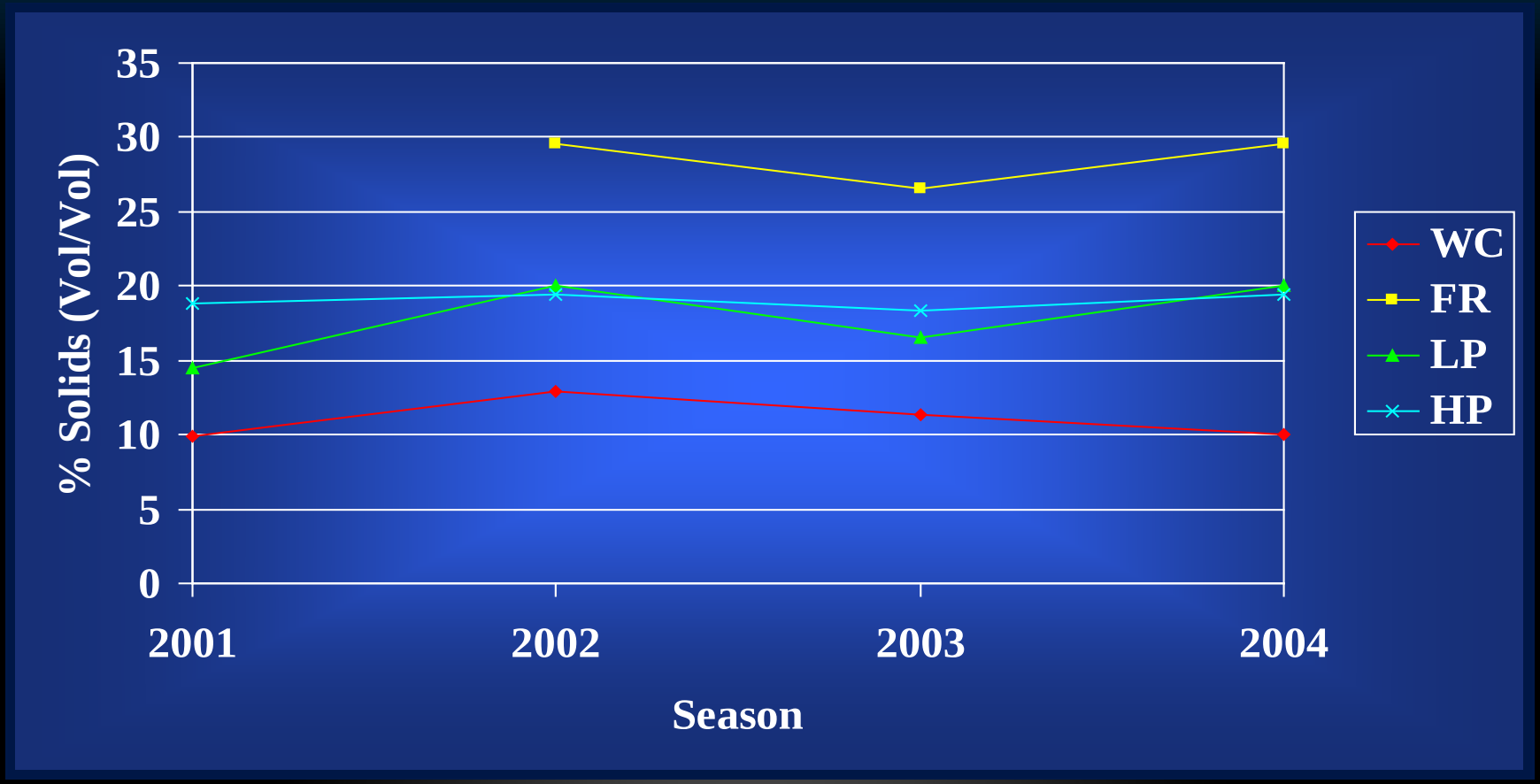
Gallander et al, (1983)

SEYVAL BLANC - SETTLING STUDY



Gallander et al, (1991)

PERCENT SOLIDS (VOL/VOL) IN RELATION TO PRESSING FRACTIONS



OARDC Pinot Gris Pressing Study

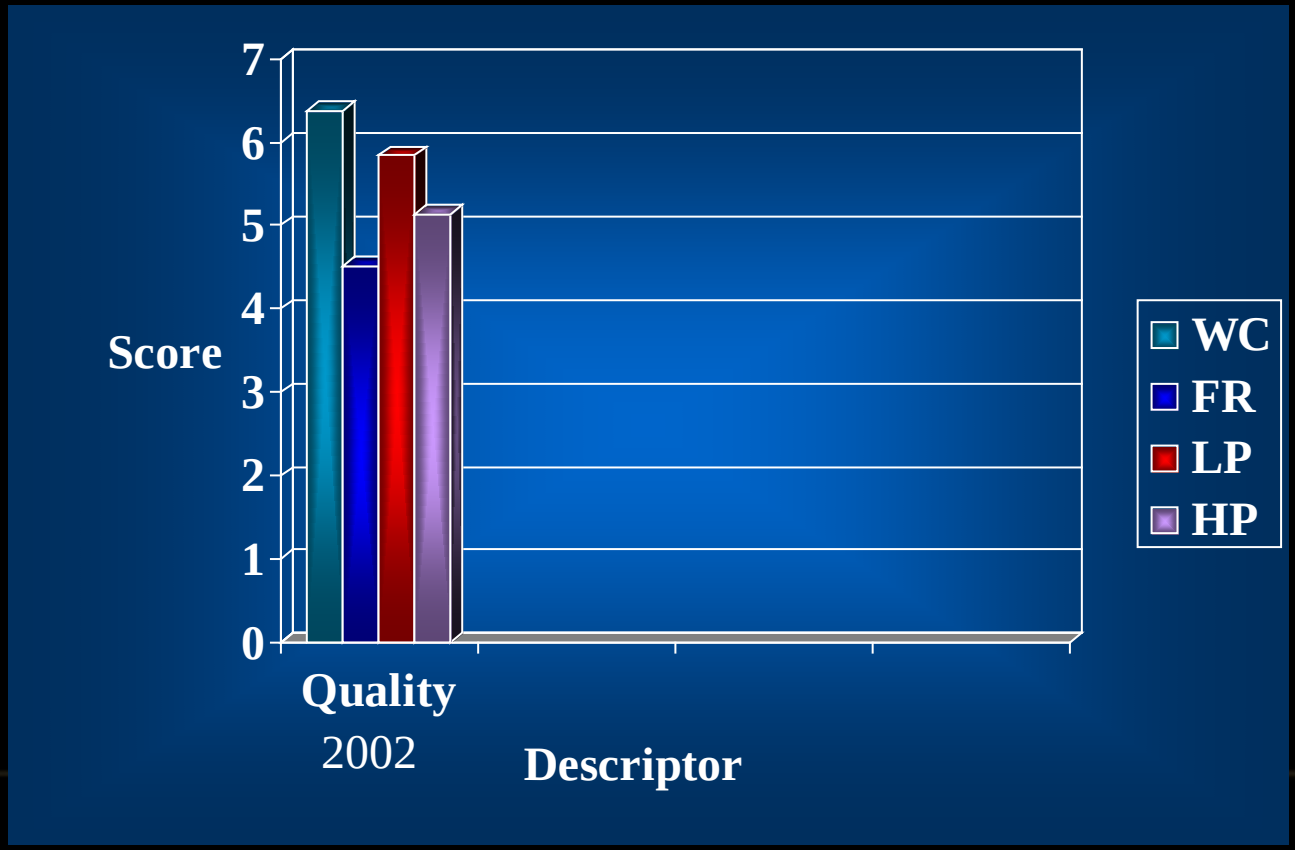

LIGHT PRESS
HEAVY PRESS


WHOLE
CLUSTER
FREE
RUN

INFLUENCE OF PRESSING FRACTIONS ON PINOT GRIS WINE QUALITY

Press Trt.	pH	Total Acidity	% ETOH	% VA	Total phenols
Across Seasons					
WC	3.12a	0.81a	13.2a	0.04a	196.7c
FR	3.12a	0.76b	13.0b	0.04a	231.3a
Light	3.12a	0.78b	13.2a	0.04a	219.7ab
Heavy	3.12a	0.76b	13.3a	0.04a	211.3bc

SENSORY PANEL DATA: (OVERALL QUALITY)



OTHER ESSENTIAL CELLAR PROCEDURES

- Certainly other must / juice cellar practices such as: fining, acid adjustments, tannin additions and pomace handling regimes have a place in our winemaking portfolio but due to time constraints will not be discussed today

THANK YOU!

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