IMPROVEMENT THROUGH BIOTECHNOLOGY

"59% of the aroma descriptors, and 79% of the flavor descriptions are either coming directly from or modified by the yeast themselves during fermentation"

American Society of Brewing Chemists

Nutrition Basics

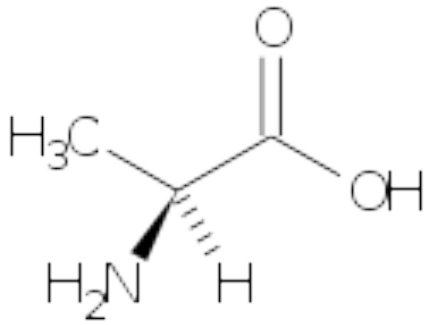
Nutrition directly impacts

Stuck fermentation
Lag-phase
Ethanol tolerance
H_2S production
Aromatic profile

N

Nitrogen that can be utilized by yeast is divided into two distinct categories:

- Ammonia nitrogen: DAP
- amino-acid nitrogen: **α**-amino nitrogenor FAN.



Definition of YAN:

- Ammonium nitrogen plus the yeast utilizable amino acids ("free alpha-amino acid nitrogen," or FAN) are referred to as YAN.

- Ammonia is used by yeasts prior to amino acids.

Nutrition Basics

NH4 salts

Source of non-organic N

Thiamine

Minimizes the production of ketonic compounds and shortens lag-phase length

Micronized cellulose

Favors nucleation

Yeast derivatives

Amino acids (Organic N),
vitamins (B group),
Micro elements (Mg, Mn),
Sterols and fatty acids

Oxygen

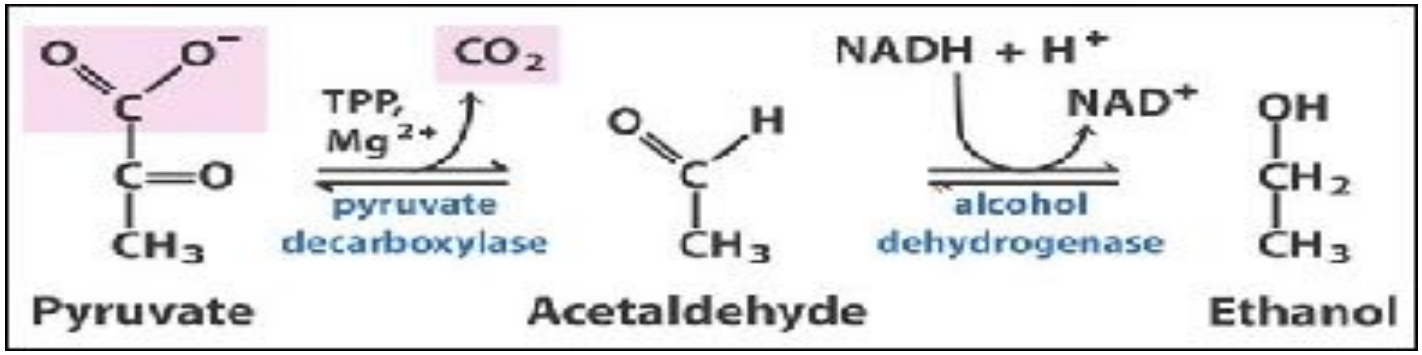
Promotes sterols synthesis but lowers esters concentration

Nutrition Basics

Shocks, Growth	Thiamine, Vit. B1
Multiplication	AA
Presence of inhibitors	Yeast hulls and cellulose
Enzymatic co-factors	Presence of salts (Ca^{2+}, K^{+})
Ethanol Tolerance	Long chain fatty acids and O_2

Thiamine (Vit B1)

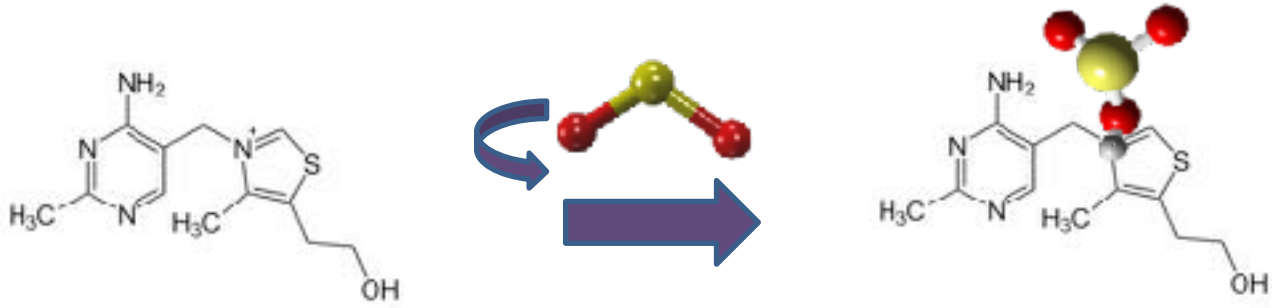
- Thiamine was the first B vitamin to be discovered by scientists, hence the “1”.
- The vitamin thiamine is a co-factor of Pyruvate decarboxylase which is an enzyme part of the fermentation process that occurs in yeast, especially of the *Saccharomyces* genus, to produce ethanol by fermentation.



- It stimulates yeast growth
- speeds up fermentation
- reduces production of SO_2 binding compounds (chetonic acids)
- It allows the yeast to resist various stress situations like osmotic pressure, heat and oxidative.

Timing for Thiamine addition

If SO_2 is added, Thiamine should be dosed three hours apart.



Active

Non active

Factors that conditions Thiamine availability:

- Musts that are rich in indigenous yeast
- Musts affected by *Botrytis Cynerea*
- Cold soaks
- Macerations with high SO_2

Different Nutrition strategies: Enovit P

- Nitrogen salts like DAP bring a large amount of ammonia nitrogen that immediately raises the YAN level. DAP utilized at 30 g/hl (300 ppm) brings 60 ppm of N (about 20%).

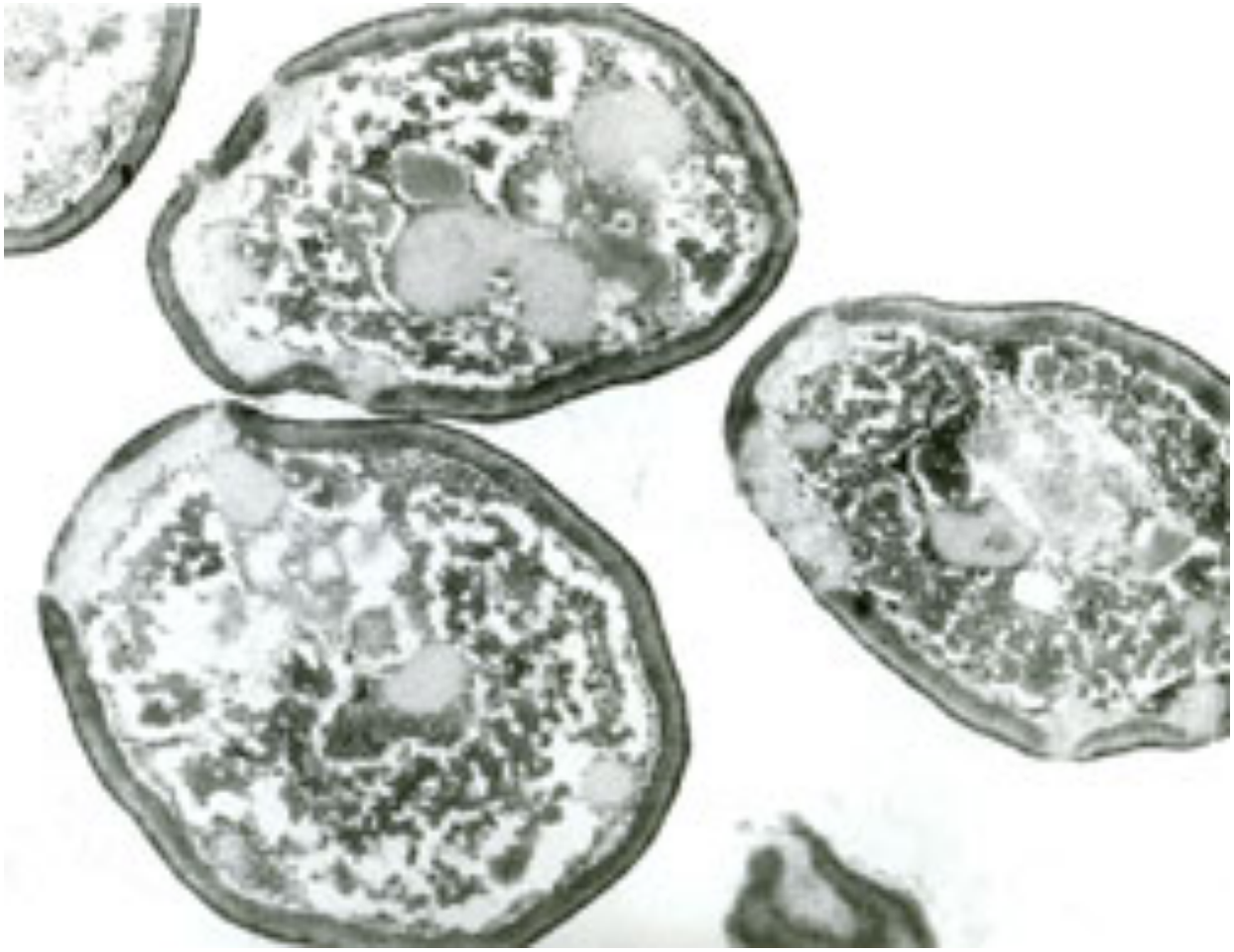
Characteris+cs	Commercial name	Average YAN yield for a 120 ppm (1lb/ 1000 Gallons) addi+on	U+liza+on	Dosage	Shelf life and storage
Fine grade salts of ammonium for aquick boost of the YAN (yeast available nitrogen). It also contains Thiamine wich is a cofactor very important in Saccharomyces because it promotes the ac+vity of the enzyme Pyruvate decarboxylase. Crucial for ethanol forma+on. The Thiamine included in Enovit Ppromotes a quicker lag–phaseand avoids forma+on of ketonic acids that can combine SO2		25 ppm	Dissolve in must and add to thetank. The yeast will be able to metabolize Thiamine early on so it is a product that can be very beneficial in the first step of nutri+on	Standard addi+on is 12–36 g/hl (1–3 pounds 1,000 Gallons)	Stable at room temperatur e for at least two years.

Different Nutrition strategies: Fermocel P

Nitrogen salts like DAP bring a large amount of ammonia nitrogen that immediately raises the YAN level. Cellulose for Nucleation and adsorption of toxins

It creates the perfect environment for fermenta+on of juices that are extremely clarified, like white musts, fruit wines, cider or mead. The dispersing agents in the mix provide support for the yeast cells to float and be homogeneous in the all fermenta+on vessel		11	Dissolve in must and add to the tank. The yeast will be able to metabolize Thiamine early on so it is a product that works great for restarts but can be beneficial also in the first step of nutri+on.	Standard addi+on is 25–50g/hl (2–4lbs/1,000 Gallons)	Stable at room temperature for at least two years.

Using yeast derivatives as main nutrition strategy



Yeast Hulls

Type of lysis is only thermic with usage of coadjutants

These are the yeast walls without the cytoplasmatic fraction and washed from all the internal part of the membranes. They're treated to make them an adsorbent media.

Inactivated yeast:
Yeast cell that is unable to ferment

Types of inactivation:

- **Thermic at different pressures**
- **Radiations**

To release the content in order to contribute to the wine it needs to sit with the lees for a variable amount of time.

Autolyzed yeast

Yeast cell that went through a lysis (degradation of cell walls)

Types of Lysis

- Thermic: High temperature for short intervals
- Chemical: Salts
- Biochemical: Enzymatic

The choice of the type of lysis depends on the end result and on what we want to obtain

Autolysed yeast contains both the cytoplasmatic fraction of the cell and the cell walls

Yeast Lysate

Yeast cell that went through a lysis (degradation of cell walls) and then separated from the cell-walls.

Types of Lysis

- **Thermic: High temperature for short intervals Chemical: Salts**
- **Biochemical: Enzymatic**

The choice of the type of lysis depends on the end result and on what we want to obtain

Yeast Lysate only contains the cytoplasmatic fraction of the cell

Yeast Lysate and Auto-lysate

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When working on lysate and auto lysate, depending on how the yeast is processed, we can preserve some components from the cell like amino acids, nucleotides of different sizes, etc. In this way we can differentiate different products for different application (ie nutrient Vs body enhancers)

Product Action	Inactivated Yeast	Auto-Lysate yeast	Yeast Hulls	Lysate
Nutrition	X	XXX	O	XXXXX
Detox	XX	XXX	XXXXX	X
Taste	X	XXX	X	XXXXX
Volume	XX	XXX	O	XXXXX
Antiox	X	XXXX	O	XXX

Different Nutrition strategies: Fermoplus Integrateur, Varietal & Premier Cru

DAP brings a large amount of ammonia nitrogen that immediately raises the YAN level. A large fraction of yeast auto-lisate increases the amino-acidic range, sterols and yeast hulls.

Product	PPM of YAN added per 120 ppm of product
Fermoplus Integrateur	18
Fermoplus Blanc Varietal	13
Fermoplus Premier Cru	14
Fermocel P	11
Enovit P	25

Different Nutrition strategies: Fermolus DAP Free (autolisate):

- Products like DAP Free are much more complex ones, they not only contain amino-acids and even if they were, because of the dimensions of their lateral chains their N content would only be less than 20%

Different Strains require different YAN:

Nutrient Requirements of AEB's Fermol Yeast

- YAN (Yeast Available Nitrogen) is measured in parts per million (ppm) or milligrams per liter (mg/L).

Brix	Average YAN Required Fermol Super 16	Average Alcohol produced
21	220	12.8
22	240	13.4
23	255	14.0
24	280	14.6
25	300	15.3

Brix	Average YAN Required Fermol Complete Liter	Average Alcohol produced
21	220	12.8
22	240	13.4
23	250	14.0
24	280	14.6
25	300	15.3

Brix	Average YAN Required Fermol Rouge	Average Alcohol produced
21	225	12.6
22	250	13.2
23	275	13.8
24	300	14.4
25	325	15.0

Brix	Average YAN Required Fermol Mediterranee	Average Alcohol produced
21	170	12.4
22	180	13.0
23	240	13.6
24	240	14.2
25	260	14.8

Brix	Average YAN Required Fermol Premier Cru	Average Alcohol produced
21	230	11.8
22	260	12.3
23	280	12.9
24	300	13.4
25	310	14.0

Brix	Average YAN Required Fermol PB 2033	Average Alcohol produced
21	170	12.6
22	180	13.2
23	200	13.8
24	240	14.4
25	260	15.0

Technological strategies & YAN:

Amino acids are not equally distributed in the grape.
About 10% of the total is in the seeds, 15% in the skins, and 75% in the pulp.

Separation of the pulp juice from the skins, as occurs with bleeding, has a significant qualitative influence and quantitative impact on FAN. This is a very important rosé production consideration.

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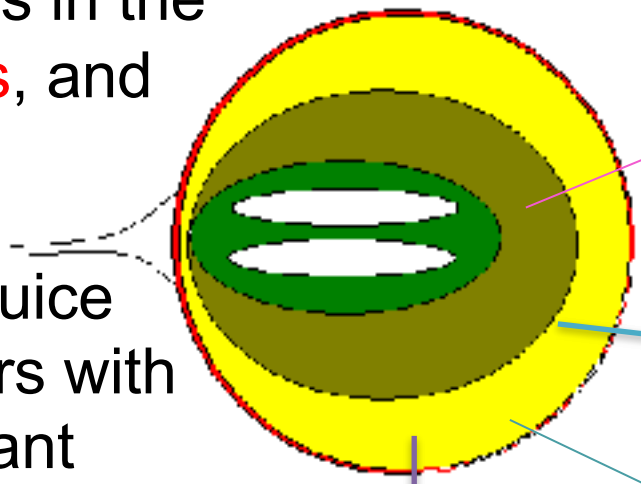


Pruinosity :
Rich in fatty acids
Rich in polyphenols
-AA

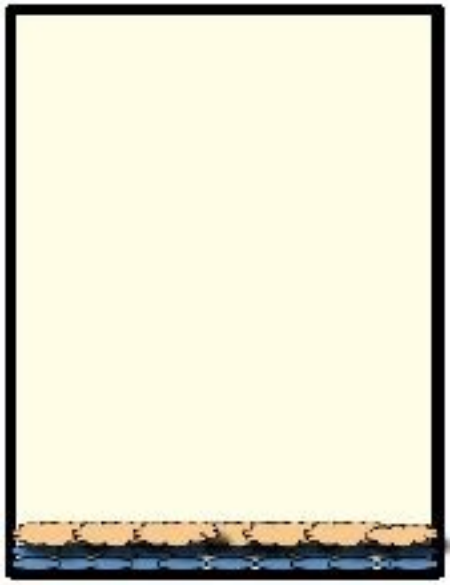
Quality area B:
Moderate acidity
Rich in sugar
+AA

Quality area A:
Rich in Sugar
Balanced acidity
+AA

Central area:
Moderate sugar conc.
Rich in polyphenols and potassium
-AA

Technological strategies & YAN:

- Nitrogen concentrations in white juice can be reduced by 10-15% following cold settling.
- The lower incidence of incomplete fermentation in red musts, compared with white, supports the concept that the slow release of nitrogen from grape skins during fermentation is important.



Timing in FAN consumption:

- Generally the yeast take up amino acids early in fermentation when the ethanol concentration is relatively low, accumulates and stores them in vacuoles and uses them later when needed for metabolic activity.
- This approach also gives the yeast cell a competitive advantage because it depletes nutrients from the medium, and thus deprives other organisms from getting nutrients.

Timing in FAN consumption:

the majority of AA tends to be consumed early on

	inoculation-24h	*24-48h*	*48-72h*	*72-96h*	*96h-end AF*
AsparticAcid					
GlutamicAcid					
Asparagine					
Serine					
Glutamine					
Hystidine					
Glycine					
Treonine					
Arginine					
Alanine					
Tyrosine					
Cysteine					
Valine					
Methionine					
Triptophane					
Fenylalanine					
Isoleucine					
Leucine					
Lisine					
Hydroxiproline					
Proline					

- Most of the nitrogen-containing compounds are transported into the cell by active transport. General amino acid permease (GAP) transports several amino acids. It is inhibited by the ammonium ions. It is, therefore, active in the fermentation when the must is depleted of ammonium ions.

Nutrients Vs Yeast trial

How nutrition with Enovit P, or AA basoo nutrients like Fennoplus OAP Free, affects f e n t a t i o n ofthree AEB strains for white wines

How does nutrition affects yeast? Trial:

Yeast strains used in the trial:

- Fermol Blanc (regular fermentation curve and high alcohol tolerance)
- Fermol Sauvignon (an hybrid conceived to unite a cryophilic attitude and high aromatic expression),
- Fermol Arôme Plus (a short lag-phase high aromas strain).

The strains have been inoculated in the must at $3*10^6$ cells /ml.

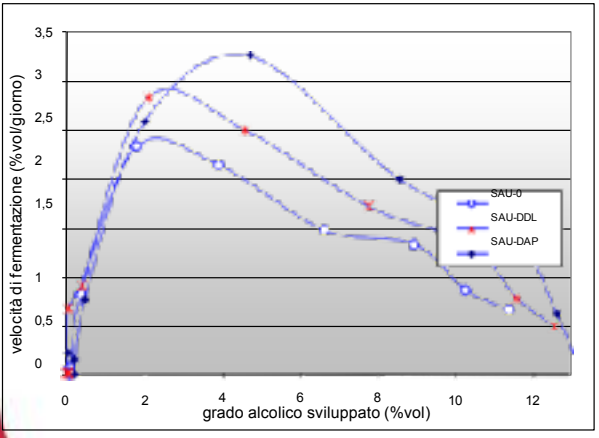
For the nutrition:

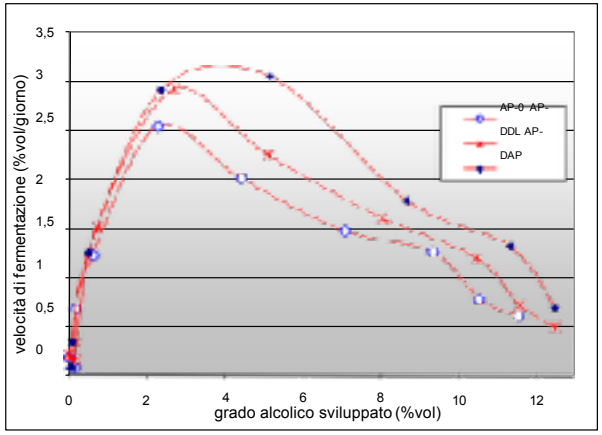
Enovit P = DAP + Thiamine clorohydrate

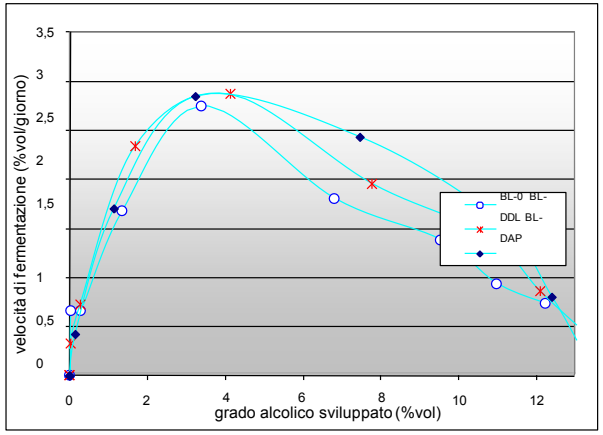
Fermolus DAP Free = Yeast derived nutrient

Fermentation Speed Vs Yeast strain & Nutrition

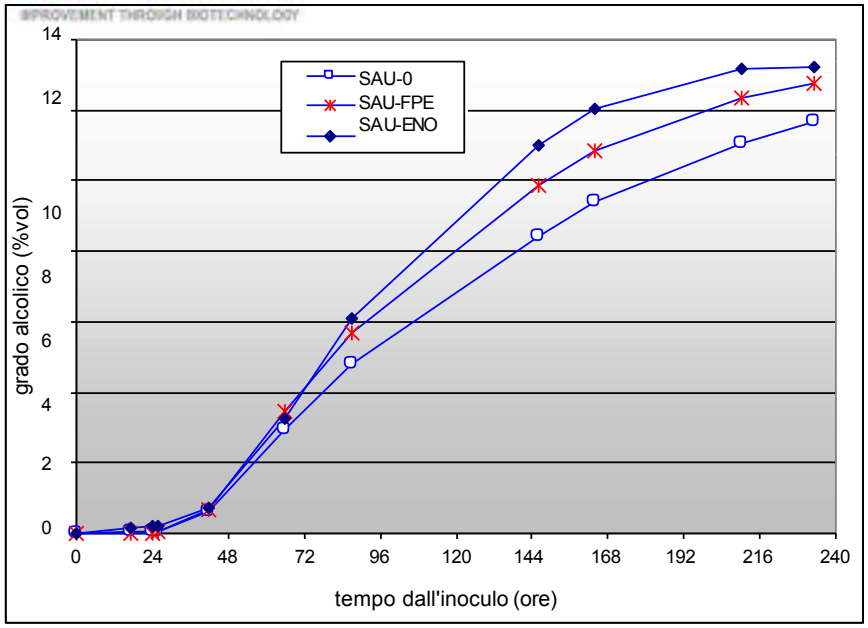
For Fermol Sauvignon, and up to 2% alcohol, DAP free nutrition is the one that grants the highest speed, even if the peak is reached at around 5% in the must where DAP was added.
A similar pattern is observed for Fermol Arôme Plus, while Fermol Blanc seems to be pretty unique as the different nutrition don't seem to have a significant impact on the fermentation curve, other than the positive impact of DAP in speed after the 5% alcohol mark.
Fermol Blanc fermentation speed is less affected by the type of nutrient.

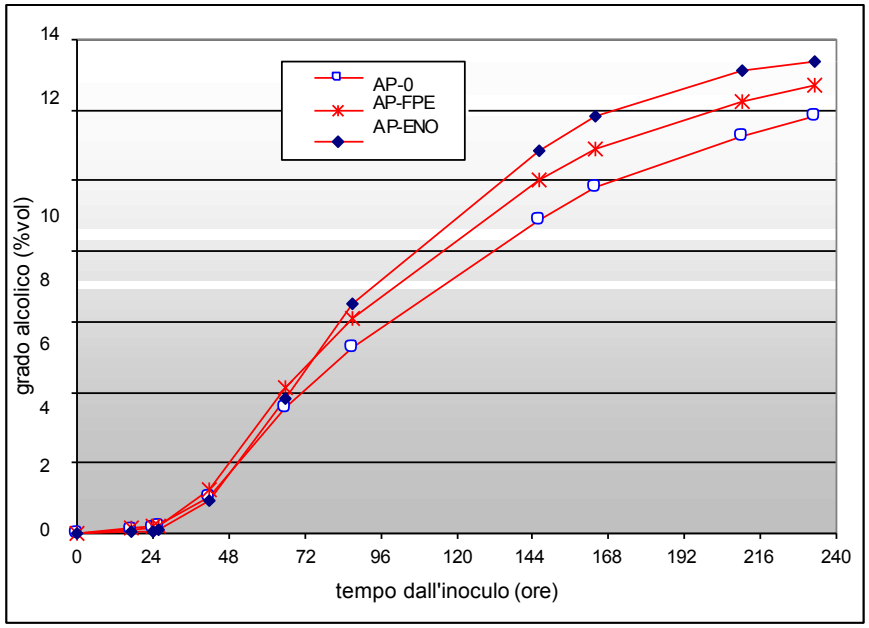


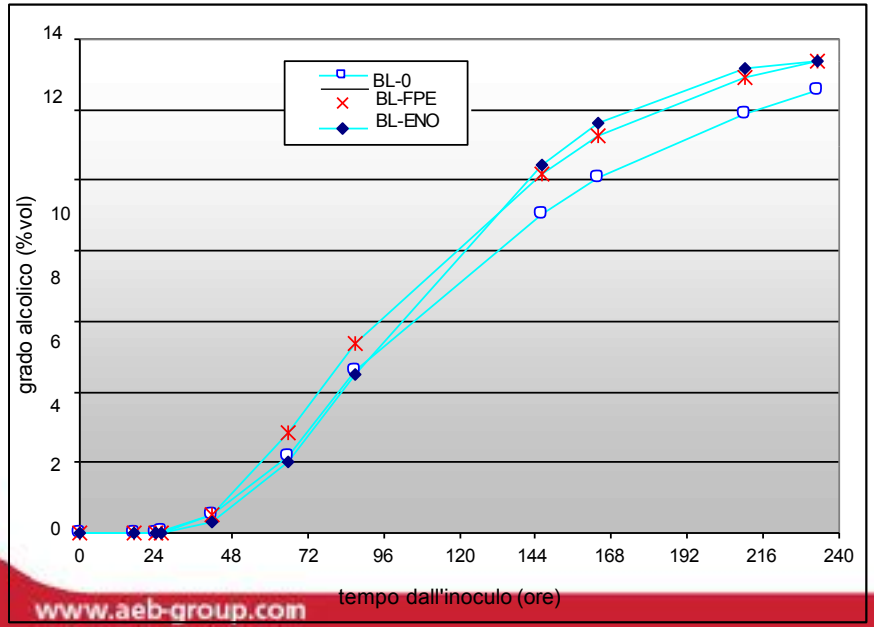




Effects of Nutrition on Fermentation Kinetics

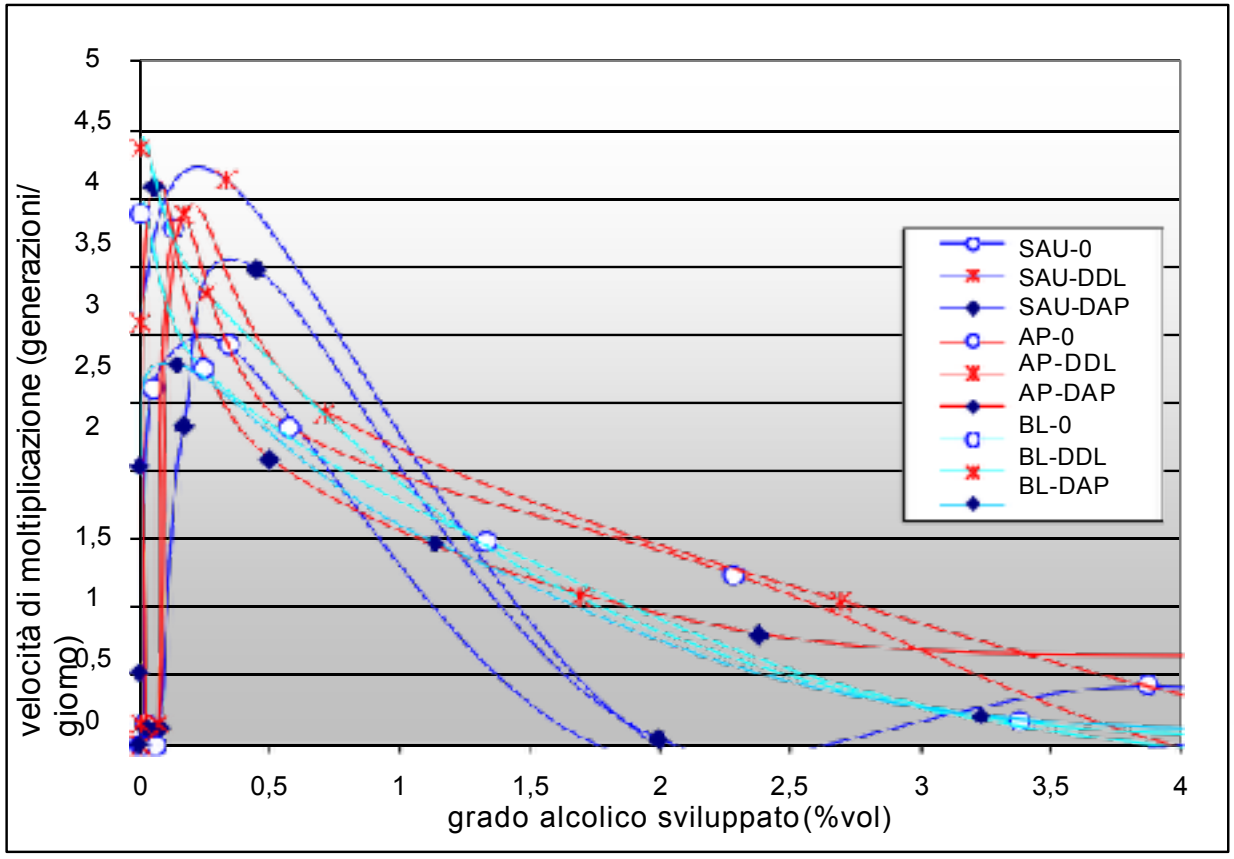






- As showed in the graphs, the different yeast strains significantly conditioned the fermentation kinetics in the first 3 days.
- AP shows short lag-phase
- In all the trials no nutrition gave the worst yeast performance.

Generations/Day Vs. Et-Oh



Fermol Blanc reaches the maximum multiplication speed at the minimum alcohol level.

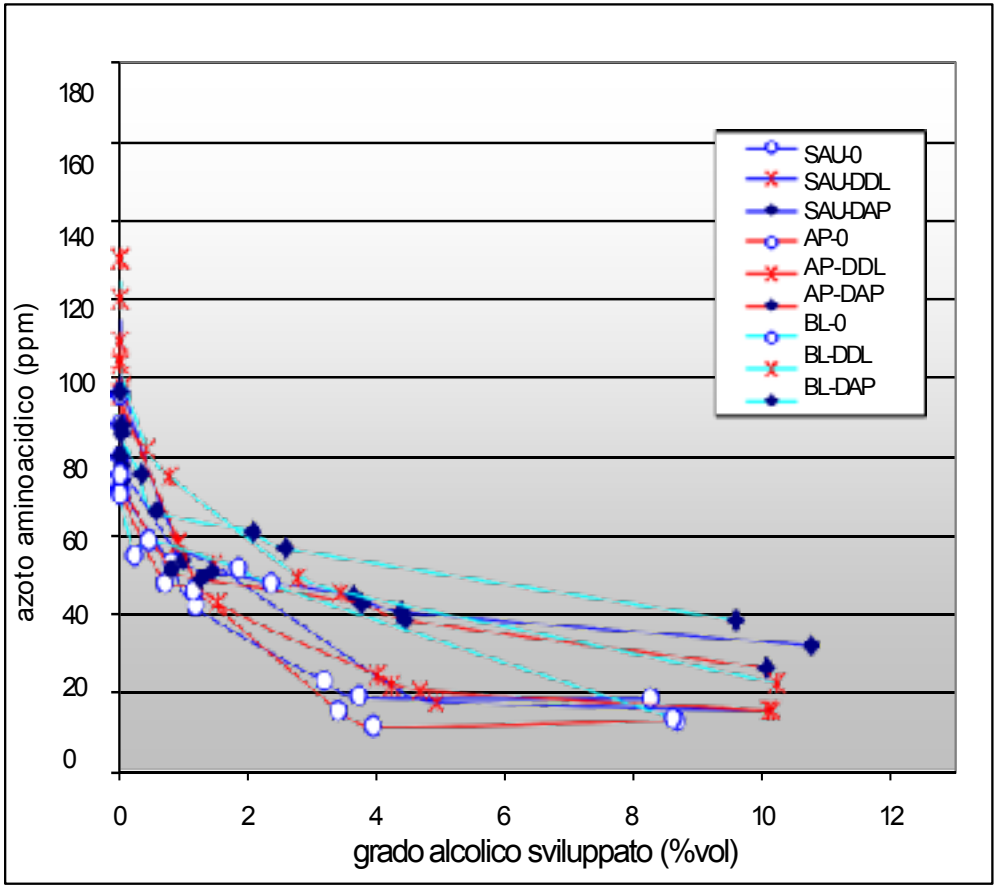
Fermol Sauvignon reaches the highest speed of growth much later and at the same time is the strain that slows down the earliest.

All yeast multiply faster with DAP Free

Fermol Arome Plus, which reaches the maximum multiplication speed when half % of alcohol has been developed, is the fastest in multiplying at 3% alcohol.

For the strain Fermol Sauvignon the maximum generation speed really varies in function of nutrition, while the Blanc seems less affected by this parameter.

Residual AA



In the final stages of the fermentation it is possible to notice an influence of both the variables considered:

- Musts adjusted with DAP have higher residual amino-acidic N at the end of the fermentation compared to the other two nutrition trials.
- The SAU strain leaves behind the least amino-acids and BL leaves behind the highest amount.

Conclusions:

Musts adjusted with DAP have higher residual amino-acidic N at the end of the fermentation

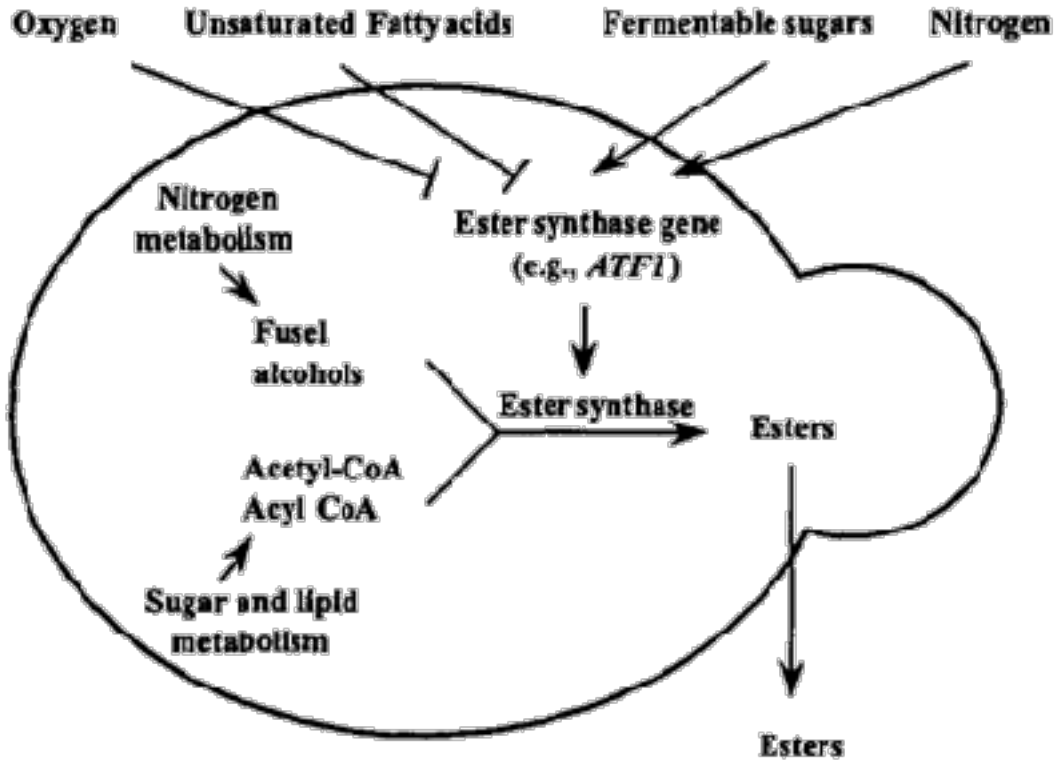
(More ketonic compounds, less esters)

Volatile ketones that are typically seen include β-damascenone, and diacetyl.

- Consumption of AA has been associated with esters formation.

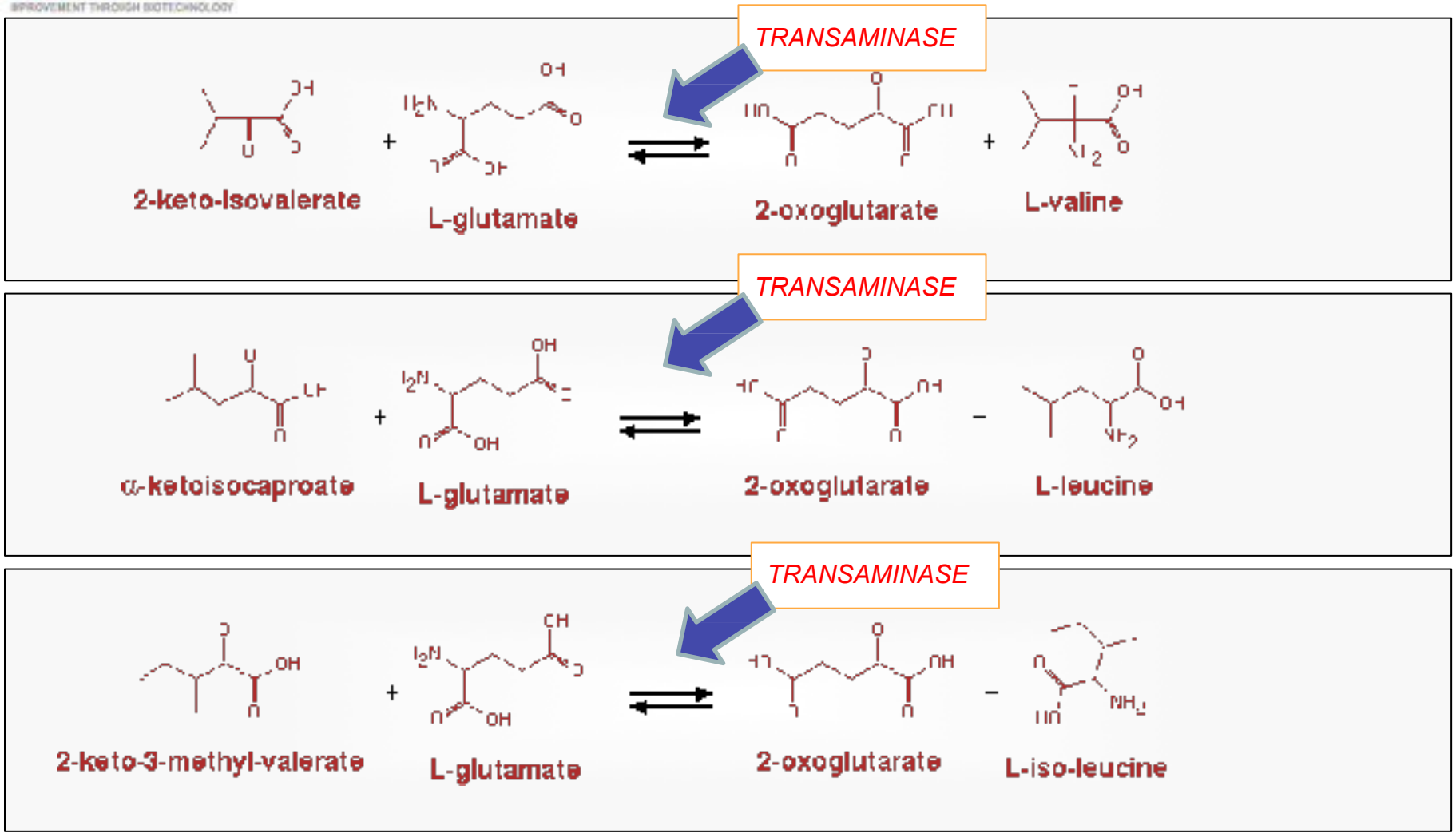
AA→ Esters

Excessive AA can be deaminated by the yeast and originate esters through the Ehrlich's Mechanism



- The amino group can be removed from the amino acid and converted to ammonia. The rest of the amino acid is made up of mostly carbon and hydrogen

Amino Acids Synthesis starting from α-keto acids

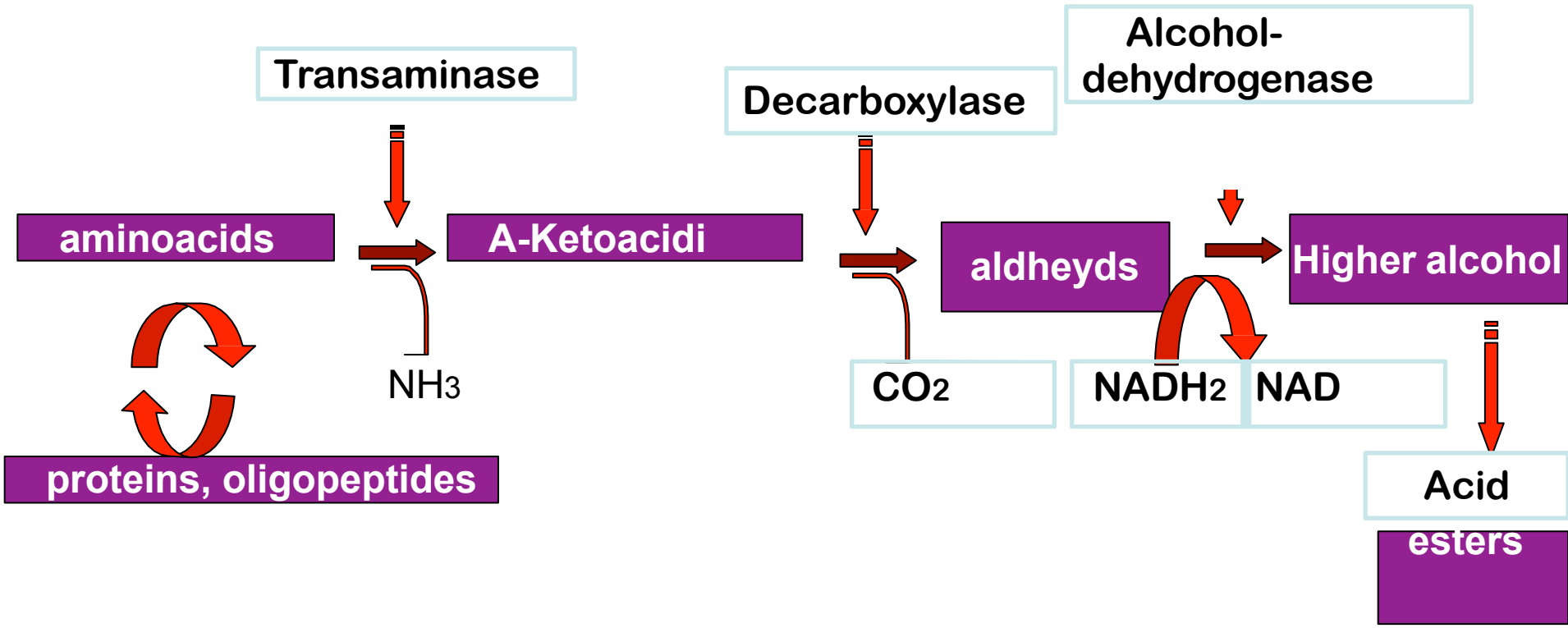


The synthesis of all amino acids happens through the transfer of one amine group from the glutamate to an alpha-keto acid that will then become an amino acid. Enzymes that operate this mechanism are called transaminases.

Or….Deamination of AA leads to more esters

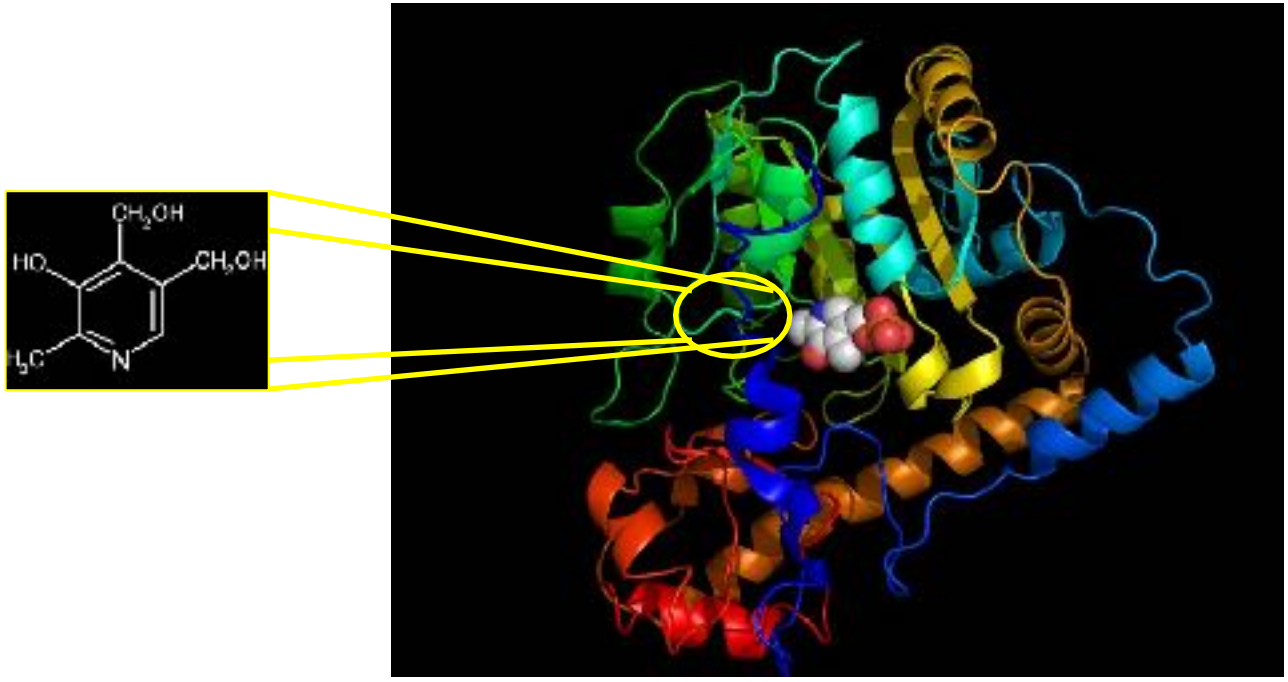
Ehrlich's Mechanism

transaminase, decarboxylase, and alcohol dehydrogenase



B6 important for AA synthesis & Esters

The prosthetic group of the transaminase enzyme is pyridoxal phosphate (PLP), a derivative of vitamin B6 (Pyridoxine) which is naturally present in Fermoplus DAP Free and Integrateur



Vitamin content in Fermoplus DAP Free in mg/Kg

B1	THIAMINE	48.9
B2	RIBOFLAVIN	23.5
B3	NIACIN	141.04
B5	PANTOTHENTIC ACID	87.08
B6	PYRIDOXINE	15.256
B8	BIOTIN	4.096
B9	FOLIC ACID	11.246
B12	CYANOCOBALAMIN (µg/kg)	0.0010168

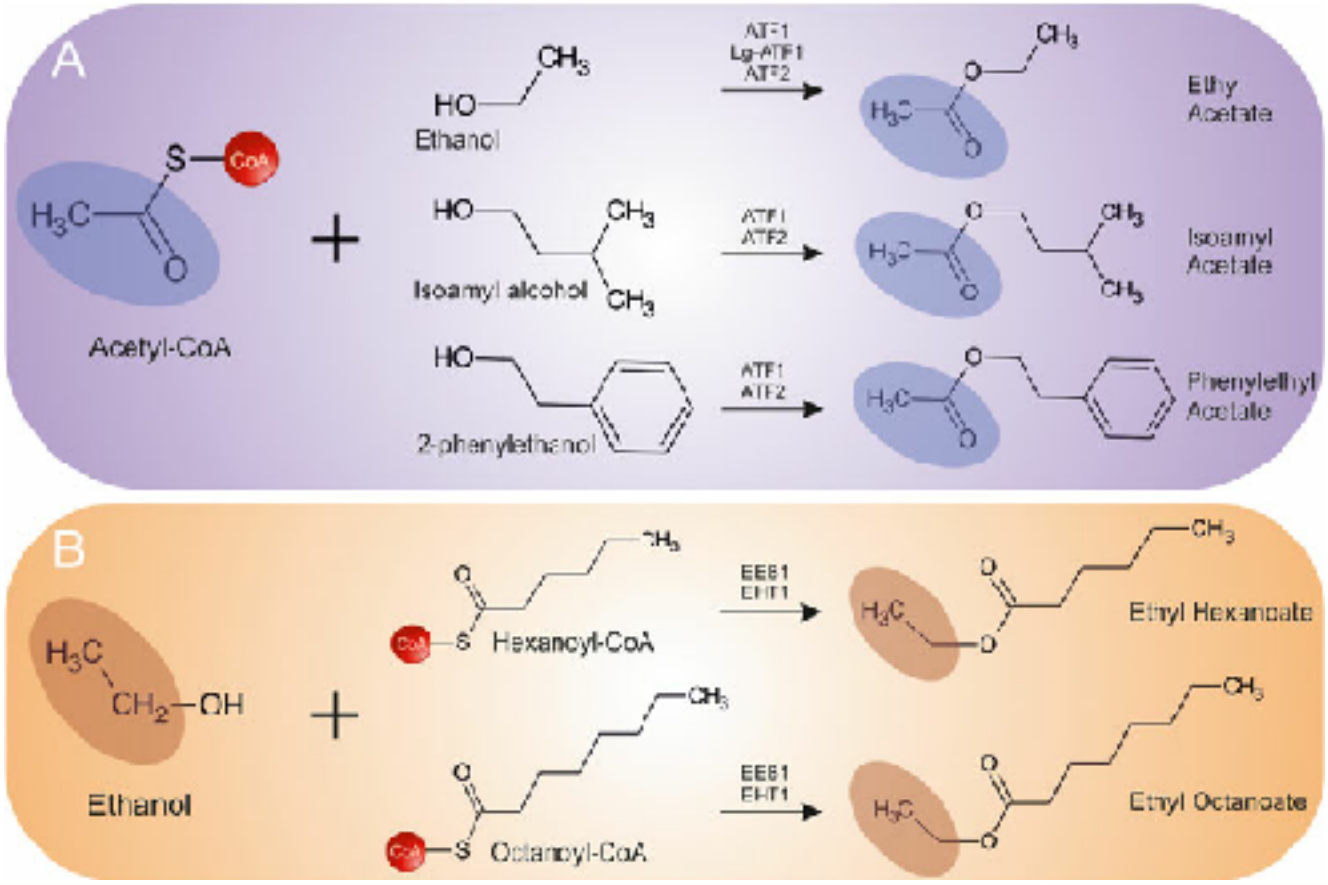
Why esters?

Esters are formed by the yeast for 2 main survival reasons.
1) Detoxification mechanism. Esters are less toxic than their alcohol or acidic precursors.
2) Esters attract insects that are vector for spreading the yeast.

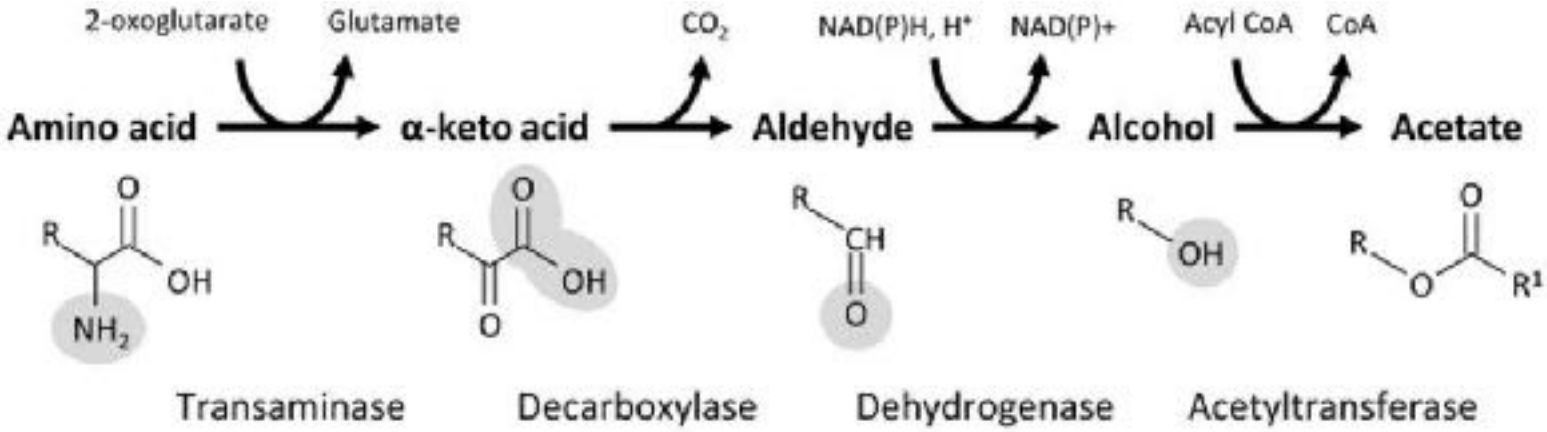
There are two main categories of flavor−active esters in fermented beverages.

1. **Acetate esters:** the acid group is acetate, the alcohol group is ethanol or a complex alcohol derived from amino acid metabolism. Formation of acetate esters essentially comes from two substrates: an alcohol and acetyl−CoA.
2. **Medium−chain fatty acid (MCFA) ethyl esters:** the alcohol group is ethanol, the acid group is a medium−chain fatty acid precursors of CoA.

The most important thing for the rate of acetate ester formation is the concentration of the two substrates, acetyl−CoA and a fusel alcohol…… We can increase the Fusel alcohol part.



From AA to Esters



Amino acid	α-Keto acid	Fusel aldehyde	Fusel alcohol	Fusel acetate
Leu	4-Methyl-2-oxo-pentanoate	**3-Methylbutanal***	**Isoamyl alcohol***	Isoamyl acetate**
Val	3-Methyl-2-oxo-butanoate	**2-Methylpropanal***	**Isobutanol***	Isobutyl acetate**
Ile	3-Methyl-2-oxo-pentanoate	**2-Methylbutanal***	2-Methylbutanol	Ethyl pentanoate
Phe	3-Phenyl-2-oxo-propanoate	2-Phenylethanal	**2-Phenyl ethanol***	2-Phenylacetate**

Esters derived from AA degradation Vs Fatty Acids degradation

Compound	Aroma Description	Source	Concentration in Wine (μg/L)	Putative Thresholda (μg/L)
Ethyl acetate	Glue, solvent, nail polish, vinegar	Cell carbon metabolism	2-150	7.5
Ethyl butanoate	Floral, fruity	Amino acid and fatty acid degradation	70-2200	20
Ethyl hexanoate	Green apple, unripe fruit	Fatty acid degradation, grape acids	150-2800	5/14
Ethyl octanoate	Soapy, floral	Fatty acid degradation, grape acids	130-2700	2,5
Ethyl decanoate	Soapy, floral	Fatty acid degradation	14-850	200
Ethyl propanoate	Fruity	Amino acid degradation		1800
Ethyl-2-methyl propanoate (ethyl isobutyrate)	Fruity, pineapple	Amino acid degradation	30-480	15
Ethyl-2-methyl butanoate	Fruity	Amino acid degradation	1-30	1/18
Ethyl 3-methyl butanoate (ethyl isovalerate)	Fruity, berry, blackberry	Amino acid degradation	2-36	3
Ethyl lactate	Strawberry, fruity	Cell carbon metabolism	0.2-390	150
Isoamyl acetate	Banana, tropical fruit	Amino acid degradation	115-7400	30

Fermoplus Tropical

First Yeast Nutrition Trial - August 2017

Competition Nutrient (yeast extract based nutrient)
Vs
Fermoplus Tropical

Winemaking Notes:

- Lodi Chardonnay, grapes picked at 23.5 Brix; pH = 3.40; TA = 6.5
- Whole cluster grapes to the presses with 5 ml per truck Endozyme Micro.
- Adjusted juice temp to 60 F,
- Ran juice through E-flot with 0.84#/1000Gal of E-Gel.
- Ctrl Nutrient 2.5 lb/1,000 Gallons Vs Fermoplus Tropical at 2.5 lb/1,000 Gallons

Wine Analyses:

pH=3.6
TA=6.5 g/l
VA=0.3 g/l
Alc=13.2 %
ML=3.18 g/l

Analyses of the Esters

Component	*u.m.*	***test***	***FTropical***	***Descriptors***
Isoamyl acetate	**µg/L**	154325	144804	banana
Hexyl-acetate	**µg/L**	11733	11217	fruity
etilic ester of 3-*hydroxybutanoic* acid	**µg/L**	3067	2468	kiwi
***ethyl* ester of decanoic acid**	**µg/L**	11041	12424	fruity/pear
Total		170,229	170,913	

Both wines have a solid fruity bouquet

Analyses of the Esters

Component	*u.m.*	*Ctrl*	*FTropical*	*Descriptors*
***Ethyl* ester of 2-hydroxypropanoic acid**	**µg/L**	96640	11435	Fruity

More of the same fruit aromas derived from the degradation of fatty acids

Component	*u.m.*	*Ctrl*	*FTropical*	*Descriptors*
4 *hydroxy* ethyl butanoate	**µg/L**	37273	59385	Pineapple

New component derived from amino acid degradation

Analyses of the Esters

Component	*u.m.*	*Ctrl*	*FTropical*	*Descriptors*
2-3-butandiolo	**µg/L**	473995	233545	odorless-bitter
esanale	**µg/L**	296	33	grassy
1-butanolo	**µg/L**	8938	2355	medicinal
guaiacolo	**µg/L**	779	317	Phenolic/Medicinal/ Leathery
1-esanolo	**µg/L**	18272	15332	resiny/grassy
Acido propanoico	**µg/L**	3767	1344	rancid butter
Total		506,047	252,926	

AA from Fermoplus Tropical diminished the formation of unpleasant odors

Fermoplus Tropical

Second Yeast Nutrition Trial - Sept 2017

Competition Nutrient (yeast extract based nutrient)
Vs
Fermoplus Tropical

Winemaking Notes:

- Rose' of Zinfandel, Fresno State Vineyard fruit. 28 brix.
- 2 days cold settle then rack to neutral barrels.
- DAP add was 125ppm
- 250ppm Fermoplus Tropical went in (vs x) 1 day after inoculation
- Ferment took 2 weeks and peak temp was 66F.

Analyses of the Esters

Ethyl propionate is a compound derived from amino acid degradation with formula $C_2H_5(C_2H_5COO)$. It is the ethyl ester of propionic acid. It has a pineapple-like odor. Ethyl propionate is used in "spiced rum" flavor compositions. Ethyl propionate is falso found in apple. Some fruits like kiwis and strawberries naturally contain ethyl propionate in small amounts.

Compound	descriptors	Rose' with Fermoplus Tropical	Rose' with Nutristart
		Peakarea	Peak area
Ethyl propionate	Pineapple, Apple	77384	54144

Analyses of the Esters

Isoamyl alcohol is an ester derived from amino acid degradation found in nature and also produced as a flavoring in industry. It is a main ingredient in the production of banana oil,

Compound	descriptors	Rose' with Fermoplus Tropical	Rose' with Nutristart
		Peakarea	Peak area
3-methyl-1butano (Isoamyl alcohol)	banana	16392443	9873928

Analyses of the Esters

Ethyl butyrate, is an ester derived from amino acid and fatty acid degradation with the chemical formula $CH_3CH_2CH_2COOCH_2CH_3$. with a fruity odor, similar to citrus (orange) and pineapple.
It occurs naturally in many fruits and is commonly used as artificial flavoring resembling orange juice in alcoholic beverages (e.g. martinis, daiquiris etc.). In addition, ethyl butyrate is often also added to orange juice, as most associate its odor with that of fresh orange juice.

Compound	descriptors	rosato con Tropical	rosato con Nutristart
Ethyl butyrate	Orange	90531	75038

Analyses of the Esters

Phenethyl alcohol, is an ester derived from amino acid degradation that occurs widely in nature, being found in a variety of essential oils. It has a pleasant floral odor. Used in the formulation of skin care products, shampoos and perfumes and colognes.

Compound	descriptors	Rose' with Fermoplus Tropical	Rose' with Nutristart
Phenyl ethylalcol	Floral	90224	62922

Analyses of the Esters

Ethyl octanoate and decanoate, are esters derived from the degradation of fatty acids. These esters are a frequent product of fermentation during winemaking, especially at temperatures above 15°C.

Compound	descriptors	Rose' with Fermoplus Tropical	Rose' with Nutristart
Ethyl octanoate	Fruity, winey	2597173	2799212
Ethyl decanoate	Soapy Floreal	1155834	1693050

Conclusion:

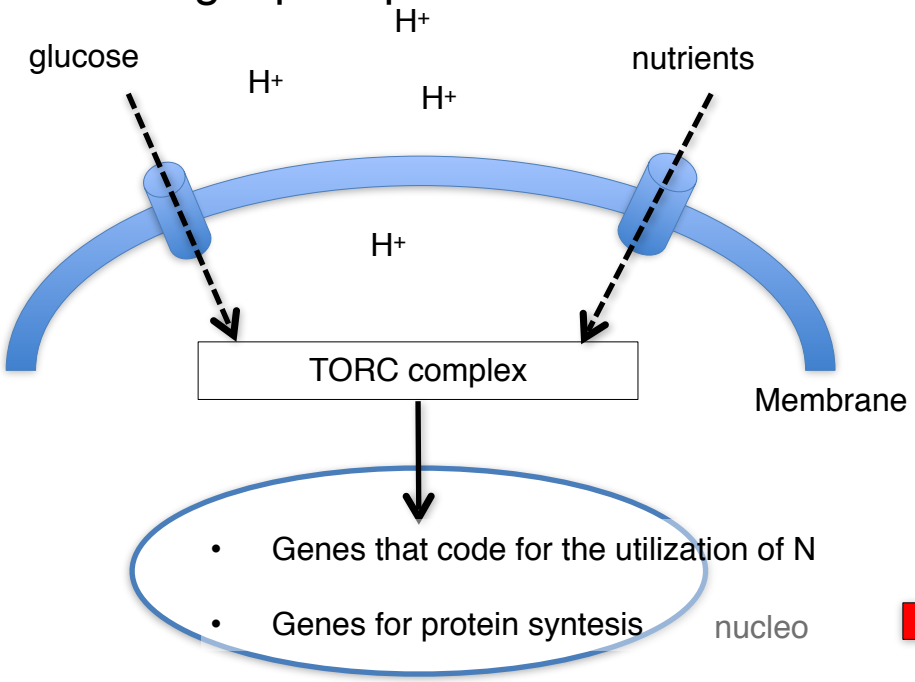
- In both trials Fermoplus Tropical resulted in more complex aromas and a bouquet that was enriched by the esters directly derived from AA degradation.

- In the Chardonnay trial these AA derived aromas also prevailed on the negative bouquet that this wine developed.

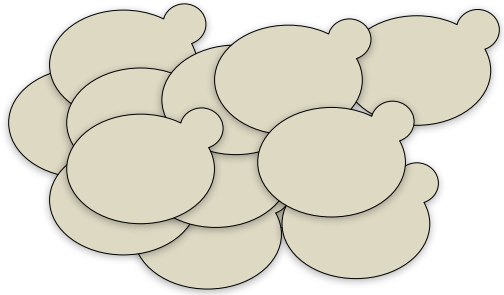
Rehydration: the beginning of a clean fermentation

The yeast membrane is the “sensor” that regulates the behavior of the cell during fermentation by analyzing the conditions of the media.

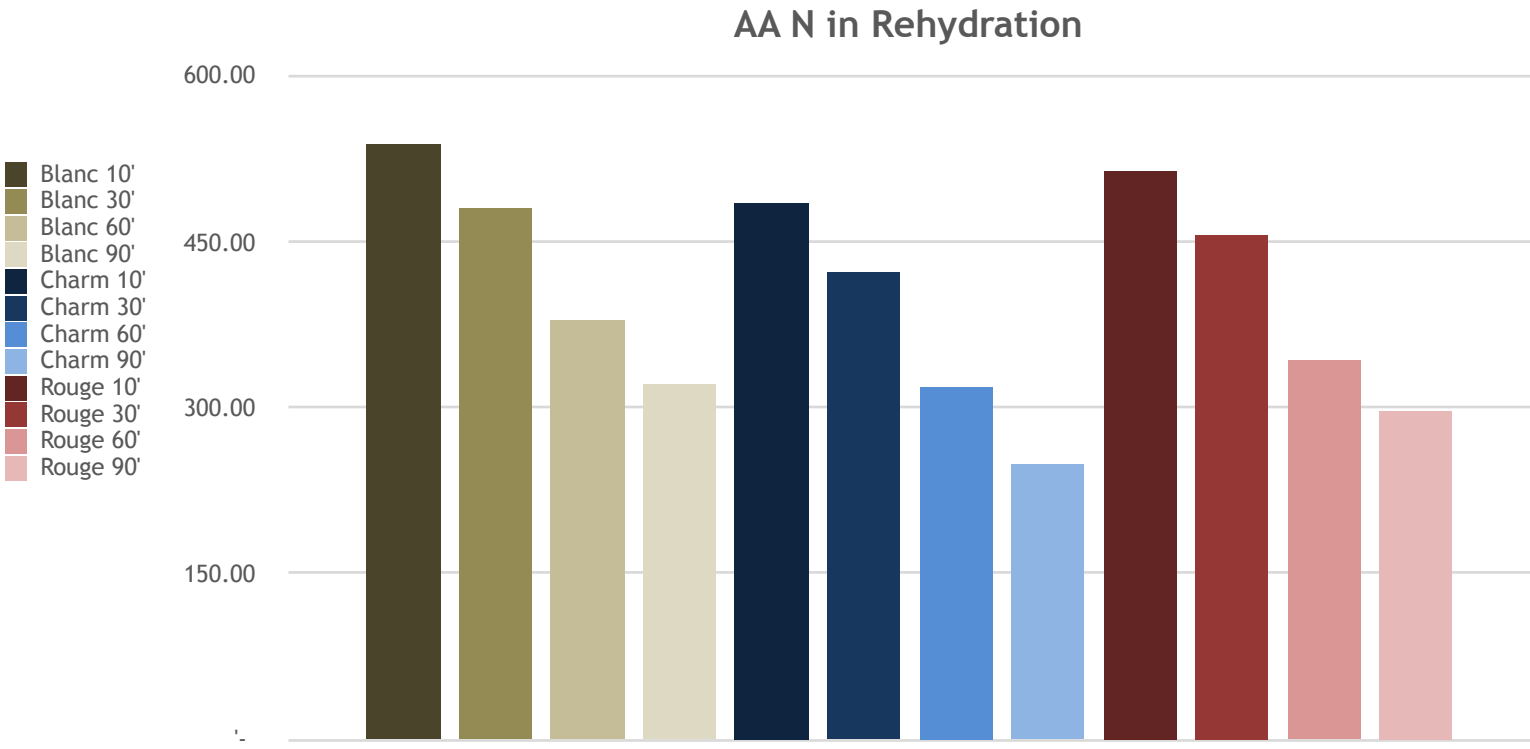
A good acclimation that gradually puts the yeast in contact with the must to be fermented, stimulates the growth from the early stages, shortening the lag phase and favoring a prompt start of the fermentation.



Multiplication



Rehydration: The beginning of the acclimation

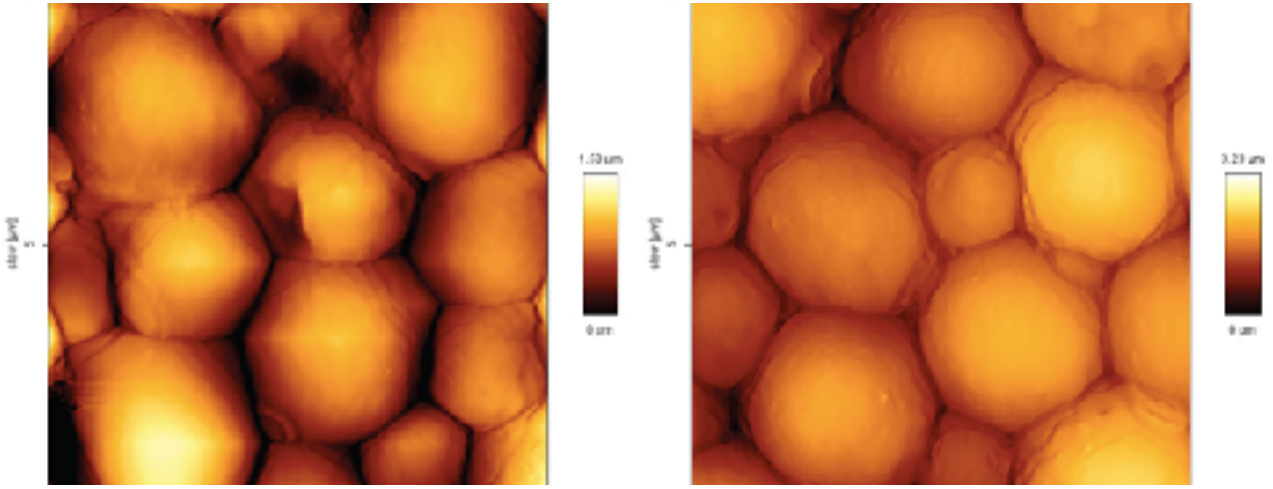


In rehydration when the media is enriched with an AA based nutrient, we can see a quick depletion of the FAN in time. This demonstrates that the yeast can assimilate AA from the very early stages.

Fill the spill

• When active dry yeast (ADY) rehydrates, both the cell wall and the internal organs of the yeast cell swell with water. However, before the cell wall is completely reformed and sealed (it goes from a dry, crystaline-like state to a smooth skin during hydration), it is possible to have a fraction of the internal nutrients leak out of the cell (up to 20-30% of the dry weight of the yeast).
• This loss of nutrients needs to be made up if the yeast cell is to get off to a great start and be able to create healthy offspring.

Sterols make 5% of membrane structure

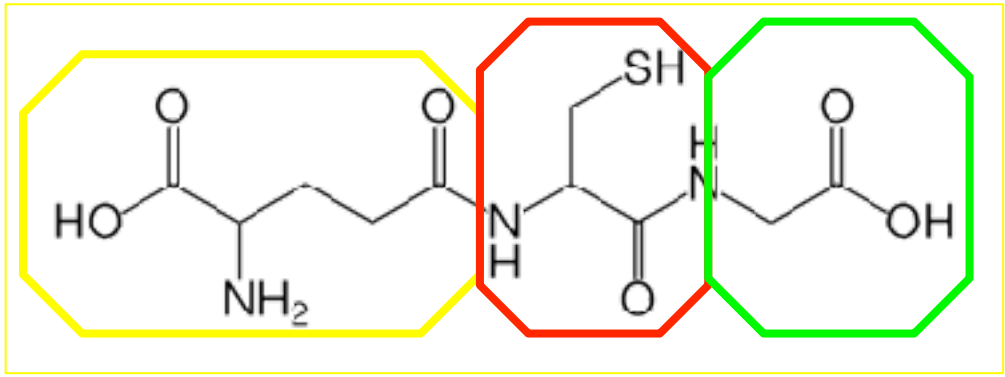


w/o sterols

with sterols

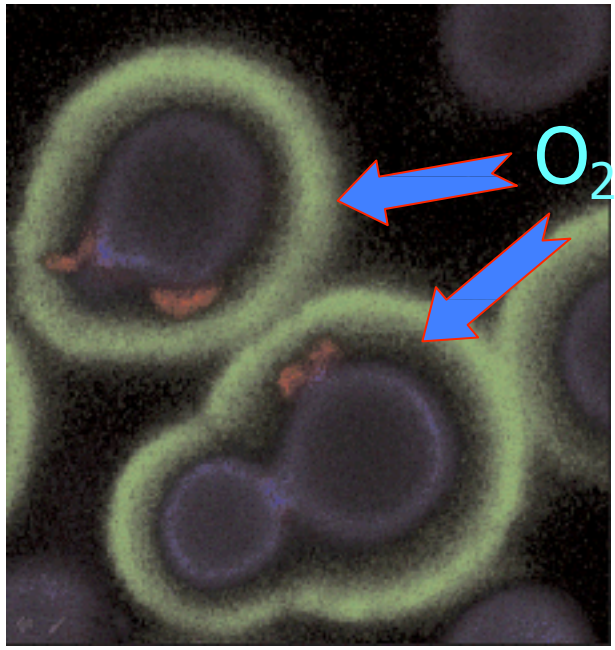
Yeast Rehydration & Glutathione

Atypical tripeptide: γ-Glutamyl-Cisteil-glycine is an important antioxidant in plants, animals and fungi. It prevents damages to important cellular components caused by reactive oxygen species such as free radical and, peroxides



Glutathione in re-hydration

During re-hydration, the cells import oxygen for their multiplication, but they still do not have the ability to synthesize glutathione.



Utilization: dissolve directly in the rehydration water along with the yeast.
Dosage: 1:4 compared to yeast inoculum.
i.e. 25 grams/Hl of yeast will need 6 grams/Hl of Fermoplus Energy Glu
2lb/1000 Gallons of yeast will need ½ lb of Fermoplus Energy Glu.

Nutrition for Cidermaking

Cider apple juices contain much less nitrogen than grape juices or beer worts - typically five or ten times less.

A traditional British or French cider fermentation takes four or five months for completion, from November or December through to March or April. As a result, it is now common practice for modern commercial cider makers to add extra nitrogen.

Endozym Alphamyl FJ:

Is utilized directly on the fresh juice or in pre-concentrated fruit juices in order to enable starch degradation. Starch degradation takes place in 1-2 hours depending on dosage and temperature

It facilitates:

1. Clarification with fining agents
2. Ultra-filtration
3. Avoids clouding in concentration

- Optimal pH: 4-5
- Optimal temperature: 45-50 C, contact time 60 minutes. At lower temperatures use 2-3 times the dosage and double contact time

Endozym Pectofruit PR

Endozym Pectofruit PR is an ultra-concentrated enzymatic preparation specifically designed for the treatment of macerated apples before pressing.

1. Yield increases significantly.
2. Viscosity is diminished.

- Use at 30 ml for 100 kg of fruit at 45-50 C with 1/2 hour contact time If colder (but always >15) use 2.5 the dosage and allow 2 hours contact time.
- Optimal pH 3.5-5.

Ale yeast are used in modern craft cider fermentation for their ability to leave a smoother body to the final beverage

Champagne of Bayanus yeast will give a dryer product