WSET Level 4 Diploma Unit 2 - Maturation, Treatments and Bottling

Quizlet

1.	**Maturation**	Post fermentation to consumption Whites: 2-6 months Oak mature Chardonnay: 12+ months Light reds: 1-3 months Full bodied reds: 2-3 years Oak aging allows slow oxygenation - colour - tannin polymerisation - stabilisation Chemical reactions - temperature - humidity - exposure to oxygen
2.	**Effects of maturation**	Reds - ruby red to deeper red or tawny - primary fruit to tertiary flavours - softer, rounder tannin texture Whites - more golden - richer and more complex aromas

3. **Environmental condistions for maturation**

Temperature
- reds (10 - 20 C), optimum at 15 C
- delicate whites and roses (< 10 C)
- min fluctuations

Humidity
- optimum 75 - 85%

Oxidation
- free SO_2 > 20 mg/l
- no ullage in vessels
- blanket of inert gas (nitrogen, CO_2, argon)

Micro-oxygenation
- two chamber device
- porous ceramic material
- reduce herbaceous aromas, better oak integration, better control of reductive characters, cost savings on oak

Oxidative aging
- Oloroso Sherry, tawny Port, Ruthegien liqueur Muscat
- nutty, dried fruits and savoury notes

Biological aging (flor)
- fino sherry, vin jaune (Jura)
- yeasty aroma and flavour

Lees
- MLF, batonnage
- softer, richer, more complex wine
- off-flavours: H_2S, mercaptan odours (cabbage-like)

Inert gases
- reduce oxidation; prevent spoilage
- nitrogen (less soluble, sparge wine to remove oxygen, SO_2, red wine)
- CO_2 (denser than nitrogen, more soluble, flushing, blanket, white wine)
- argon (expensive)

4. **Oak vessels**

225 l barriques (quality red)
228 l Pieces (white)
300 l hogsheads (quality red)
500 l puncheons
20 hl, 50 hl, 100 hl casks in Europe

5. **Barrel maturation**

Clarification and stabilisation
Deepen and stablilise colour
MLF
Complexity of flavours
Soften astringency in reds and whites

6. **3 types of oak in winemaking**

American white oak
- winemakers in Spain, Americas, Australia
- Oregon, Minnesota, Wisconsin
- Auercus alba: low phenols, high aromatics, particularly methy-octalactones (coconut)
- Rioja, Australian Shiraz, warm-climate Cabs

European white oak
- highest quality
- expensive
- French, Hungarian, Russian, Slavonian, Portuguese

Quercus petraea (Quercus sessilliflora)
- tight grains, less extractable tannins, aromatic (lactones, volatile phenols - eugenol (cloves), phenol aldehydes - vanillin (oaky and vanilla odours)
- Troncais, Allier, Nievre, Vosges (tight-grained wood)

Quercus robur
- low aromatics, high extractable polyphenols
- Limousin (looser-grained, more tannic wood)

7. **Barrel-making process**

Cutting
- sawing vs splitting logs
- European oak has to be cut or split along oak grain
- American oak: less porous, can be sawn, max yield

Drying
- air vs kiln
- less aggressively tannic in air-dried wood
- French oak traditionally air-dired (18-36 months)

Assembling
- use heat to bend the wood
- fire vs steam

Shaping and toasting
- shaped by heat
- toasting produces aromatics

Heads

Finishing
- tested for leaks
- bung hole, metal or chestnut hoops

8. **Toasting barrels**

Level of toast
- heat of the fire
- length of time

Light --> Medium --> Heavy
- the lighter the toast, the more "oaky" or "woody"
- the heavier the toast, the more "spicy" and "toasty"

9. **Barrel size**

Gonchihordo - 136 litres
Fuder - 1000 litres
Stuck - 1200 litres
Bordeaux barrique: 225 litres
Burgundy pieces - 228 litres

The smaller the barrels, the larger the surface area of wood contact to accelerate maturation

10. **Barrel age**

New: woody flavours
Replaced after 3rd or 4th use
Saved and re-charred for 10 more years

11. **Barrel maintenance and hygiene**

Check for leaks
Store wine at 18-24 C (MLF) or 10-18 C (maturing), 75% humidity
Cleaning with water under high pressure or steam
Storing empty barrels (rinsed, dried, SO_2, bunged up)

12. **Oak alternatives**

Oak chips (6.35 mm to 2 cm)
Inner staves
Barrel inserts
Toasted oak powder (legal issues)
Stainless steel tanks (aromatic wines, reduction problems)
Cement tanks (lined by epoxy resin or glass)
Fibre-glass or resin tanks
Bottle aging

13. **Blending**

Objectives
- style
- standardization
- balance & complexity
- hide faults

Between fermentation and bottling
Stabilized before bottling

The final wine should always be better than its components

14. **Components of a blend**

Wines of different quality --> large volume brand
Different vintages for consistency (Champagne, Sherry)
Different grapes e.g. Cabernet Sauvignon + Merlot
Different barrels or wines subject to different vinification processes (MLF + non-MLF; press + free-run; different yeasts)

15. **Examples of blends**

Champagne (Pinot Noir, Pinot Meunier, Chardonnay)
Bordeaux reds (Cabernet Sauvignon, Cabernet Franc, Merlot, Petit Verdot, Malbec)
Jacob's Creek Shiraz-Cabernet
Sherry (fractional blending, solera system)
European table wine (cheap wine from France, Italy, Spain)

16. **Clarification**

Remove "unwanted" suspended particles to make the wine clear

Suspended particles
- dead yeasts
- grape skins, stems, seeds and pulp
- bacteria
- tartrates
- colloids (large organic molecules, polysaccharides, tannins, phenolics, pigmented tannins, heat un-stable proteins)

Methods
- sedimentation and racking
- fining
- filtration
- centrifugation
- floatation

17. **Sedimentation**

Speed of sedimentation
- density of particles
- viscosity of wine
- temperature
- convection

Advantages
- gentle, natural process
- minimal equipment (hose and pump)

Disadvantages
- slow
- several stages
- volume of lees

18. **Racking**

Gross lees are usually racked off after fermentation
White in tank: every 2 months
Red in barrel: every 3-4 months
Check SO_2
"Top off" or blanket with inert gases to avoid oxidation
CO_2 not used coz soluble

19. **Centrigugation**

Very high speeds (10,000 rpm)
High flow-rate
Expensive

Advantages
- rapid
- removal of dense particles

Disadvantages
- expensive
- noise
- oxidation

20. **Fining**

Addition of an agent to remove something
Usually added after fermentation and one or two rackings

Fining agents
- natural or synthetic
- electrostatically charged

Colloids
- -ve (tannins, pectins, dextrans, glucans)
- +ve (coloured pigments, proteins)
- 2 - 1000 nm (too small for filtration)
- cause cloudiness or deposit

Effects of fining
- remove colloids and stabilize wine
- clarify wine
- change appearance, aroma and flavour

21. **Fining agents**

Bentonite (-ve)
Gelatin (+ve)
Casein (+ve)
Isinglass (+ve)
PVPP (Polyvinylpolypyrrolidone) (+ve)
Carbon (charcoal)
Silica sol (-ve)
Tannin (-ve)
Egg albumen (+ve)

22.	**Bentonite**	Montmorillonite clay, swells in water Strong -ve charge Reduce enzymes (oxidases), vitamins, amino acids Increase microbial and heat stability of wine Non-selective (reduce flavour) Uses - protein stability in whites and roses - eliminate colloidal colouring matter in young red Commercial bentonites - powder or granule form - sodium bentonite
23.	**Gelatin**	Protein extracted from pig skins and animal bones by boiling +ve charge Odourless and colourless Remove off tastes, but reduce the "body" Best used at 16 - 25 C Uses - remove astringency and off-flavours in whites - remove harsh tannins in reds, but also reduce colour Over-fining a white wine - protein-unstable - counter-fined with tannin or silca sol
24.	**Casein**	Milk +ve charge Applied in conjunction with tannin Sodium or potassium caseinate Whole milk not permitted in EU Skimmed milk has better clarifying abilities Uses - white fines with excess colour or oxidative taints - reduce iron content of wine
25.	**Isinglass**	swim bladder of fish (sturgeon) +ve charge Uses - reduce phenolics - improve colour vibrancy and clarify of whites Disadvantages - fishy nose and palate - can clog filters - expensive - difficult to prepare
26.	**PVPP**	Synthetic polymer Strong +ve charge Uses - reduce bitterness and browning in whites - reduce astringency and soften tannins in reds

27. **Carbon (charcoal)**	Burnt animal or plant Used in conjunction with 50 mg/l ascorbic acid to prevent oxidation Uses - remove off-odours and colour - treat final pressings (low doses)
28. **Silica sol**	Colloidal suspension of silicon oxide -ve charge Used in association with gelatin/isinglass Uses - accelerate clarification - produce compact lees to minimize wine loss - remove gelatin - improve filterability of fined wine
29. **Tannin**	-ve charge Blood products not permitted in EU since 1987 Uses - stabilize new wines by precipitating excess proteins - aid fining process (in conjunction with gelatin)
30. **Egg albumen**	whites of chicken's eggs +ve charge Remove less colour or flavour Uses - absorb harshest, "greenest" tannins in reds - premium quality red wines
31. **Filtration**	Flow rate of filter - surface area - pressure - permeability - viscosity - thickness of filter Filterability index (clogging power) of a wine - percentage of solids - size of particles and their nature - MLF wine more difficult to filter
32. **Filtration mechanisms**	Depth filtration (adsorption) Surface filtration

33.	**Depth filtration (adsorption)**	unwanted particles trapped in filter medium Earth filtration - diatomaceous earth (DE) or Kieselguh - perlite (musts and cloudy wines) Sheet or pad filtration - pads made of cellulose - papery taste unless rinsed with 1% citric acid Advantages - high solids content - simple to operate - inexpensive Disadvantages - need to control filtration rate - not absolute filtration
34.	**Surface filtration**	simple sieving mechanism Membrane with uniformly-sized holes/pores - 0.65 micron (yeast) - 0.45 micron (yeast and bacteria) - 0.2 micron Membrane filters - sterilize wine before bottling Cross-flow filtration - prevent clogging - can filter dirty wines - expensive Ultra-filtration - cross-flow filtration - illegal in EU - can filter out individual components (tannins, sugars, acids) Advantages - absolute Disadvantages - flow rate decrease with volume of liquid - clogging - expensive
35.	**Reverse osmosis**	Specialise cross-flow filtration Membrane allows only small molecules Uses - concentrate grape musts - de-alcoholise a finished wine - decrease high levels of acetic acid Advantages - efficient, quiet and automated - total inert gas blanketing and low temperature Disadvantages - expensive

36.	**Osmotic distillation**	Specialised membrane filtration process PTFE or Telflon membrane with brine on the other side Uses - high quality grape juice concentration - selective removal of a single volatile, e.g. ethanol
37.	**Stabilisation**	Prevent hazes, clouds, bubbles or deposits Stability tests - proteins (bentonite fining) - tartrates (chilling)
38.	**Wine stability**	Causes of instability - aeration (e.g. bottling) - light (e.g. shop window displays) - low or high temperatures (e.g. transport or storage)
39.	**3 main instability problems**	Tartrate instability Oxidation and reduction Microbial spoliage Others: proteins, phenolics, copper, iron

40. **Tartrate instability - Potassium bitartrate**	Cold stabilisation prior to bottling - chill wine to -4 (12% abv) to -8 C (fortified) - stored in insulated tanks for up to 8 days - expensive equipment - results not reliable - more dissolved oxygen at low temp Contact process - chill wine to 0 C and add potassium bitartrate crystals (4g/l) - quicker, cheaper, more effective Gum arabic (Acacia) - colloid that prevents tartrate crystal formation - short-lived, about 12 months - 50 - 200 mg/l Metatartaric acid - anti-crystallising properties - short-lived, about 12 months - longer than gum arabic at cooler temp (10 C) - 100 mg/l Mannoproteins - enzymatic hydrolysis of yeast - soluble, no colour, flavour nor taste - long-lasting - 200 to 250 mg/l Ion exchange - not permitted in EU due to health concerns - resin containing sodium ions - sodium bitartrate more soluable - alter aroma and taste Electrodialysis - special selective membranes - passage of potassium, calcium and tartrates ions - high capital cost - low energy costs, reliable result
41. **Tartrate instability - Calcium tartrate**	Calcium carbonate (de-acidification) Calcium bentonite (clarification) Highly soluble, forms crystals only very slowly Stabillised by - metatartaric acid - ion exchange - electrodialysis

42.	**Oxidation**	Effects - change colour (brown and dull) - change aromas and flavours (sherry-like) - increase bitterness Factors - polyphenol oxidase & lacasse ennzymes (grey rot) - yeast & acetic acid bacteria - phenolics - dissolved oxygen - pH - SO2 - temperature - catalysts (e.g. copper ions) Stabilisation - pasteurisation (laccase) - storage at low temperature, SO2 (browning)
43.	**Reduction**	H2S (rotten eggs), mercaptans, organic sulphides, thiols (garlic or onion) Removal - aeration - copper sulphate; silver chloride
44.	**Microbial spoliage**	Microorganisms - lactic acid bacteria - acetic acid bacteria - yeast - moulds Factors - pH (high) - alcohol (< 15%) - temperature (20-35 C) - SO2 (free 20 mg/l) - residual sugar - nutrients - air (for acetic bacteria) - winery hygiene
45.	**Lactic acid bacteria**	useful for MLF not for light, fruity whites Wines with low acidity - breakdown of tartaric acid - slimy and "ropy" texture Prevention - SO2 (20 mg/l) - clarification - goog winery hygiene
46.	**Acetic acid bacteria**	Converts alcohol to acetic acid (vinegar) Form ethyl acetate (ethyl ethanoate) - acetone (nail polish remover) Prevention - minimize air - SO2 (20 mg/l) - good winery hygiene

47.	**Spoilage yeasts**	Sterile filtration at bottling Surface "film" spoilage yeasts (Candida) - flor on surface of wine that is in contact with air - oxidise ethanol to produce acetaldehyde (ethanal) - yeasty taint - prevention - barrels fully "topped up" or blanketed with inert gas - SO_2 (20 mg/l) - good winery hygiene Brettanomyces - 4-ethyl-phenol and 4-ethylguaiacol - brett taint (farmyard and sticking-plaster flavours) - high pH Syrah and Cabernet Sauvignon - prevention - sterile filtration - DMDC (dimethy dicarbonate) - SO_2 Re- fermentation - cloudiness and gasiness - prevention - sterile filtration - sorbic acid (potassium sorbate; 100 - 200 mg/l; strange, rancid flavour; metabolised by lactic acid bacteria to create an aromatic compound that smells of geraniums)
48.	**Protein instability**	Hot or cold temperature Whites: haze, cloudiness or deposit Reds: deposit of pigmented tannins and protein Removal by bentonite fining
49.	**Phenolic instability**	Fined with albumen (egg whites) or gelatin
50.	**Excess copper**	Max in EU - 1 mg/l Causes - contact with copper, tin or bronze equipment - use of copper sulphate to eliminate H_2S and mercaptans - use of copper sulphate to combat powdery mildew Gas chromatography - direct sunlight for 7 days Effects - copper casse in whites (reddish-brown haze and deposit) Prevention - bentonite fining - gum arabic - potassium ferrocyanide (blue fining) - highly toxic

51.	**Excess iron**	Max in EU - 10 mg/l Causes - soil with high levels of iron - mild steel or cast iron containers or crusher rollers Gas chromatography - excess oxygen in cool, dark place for 48 hours Effects - ferric casse in whites (haze and white deposit) - blue-black deposit in reds Prevention - citric acid (1 g/l) - gum arabic - ascorbic acid - potassium ferrocyanide (whites) and calcium phytate (reds)
52.	**Quality control**	Series of anlyses and tests - compliance with regulations - stability - faults and other contaminants Carried out at - bulk storage of wine - transportation - bottling
53.	**QC - bulk storage**	Vessels topped off or blanketed with inert gas Stable cool temperature (< 15 C) No exposure to sunlight SO_2 (25-30 mg/l for dry reds; 35 mg/l for dry whites)
54.	**QC - transportation**	Cool storage temperatures (avoid shipping in summer; refrigerated containers and lined containers) SO_2 Inert gas in headspace of vessels No exposure to sunlight Sweet wines imported in bulk into the EU cannot be shipped as dry wines and sweetened at bottling.

55.	**QC - bottling**	Prevent - oxygen - microbial contamination - bottle dirt, cork dust, grease, insects HACCP (Hazard Analysis and Critical Control Point) - food safety procedure to reduce hazards to acceptable - compulsory in EU - hazards (physical, chemical, microbiological) - Remove or monitor CCPs (Critical Control Points) - preventative action plan - minimize likelihood of something serious - identify most likely reasons for errors CCPs in bottling - check bottles - control fill - no contamination - check corks ISO 9001 - quality managment system - set of procedure - records - review
56.	**Bottling operation**	Pre-bottling analysis
57.	**Pre-bottling analysis**	Equipment - gas chromatograph - atomic absorption spectrometer
58.	**SO2**	- titration with iodine - alkaline to release bound SO2 before titration - aspiration method (EU)
59.	**Volatile acidity (VA)**	- acetic acid - glass still to distill VA - titration with sodium hydroxide - enzymatic assay - HPLC (high performance liquid chromatography)
60.	**Titratable acidity (total acidity)**	- de-gassed sample to an end point of pH 7.0 - sodium hydroxide - g/l tartaric acid (sulphuric acid in France x 5/3) - table wines (> 4.5 g/l), avg 5-7 g/l, high 8 g/l
61.	**Malic acid and lactic acid**	- paper chromatographic procedure - HPLC
62.	**Other acids**	Sorbic acid - colorimetric procedure - wines for Japan Ascorbic acid - simple titration or HPLC Metatartaric acid - HPLC Citric acid - HPLC

63. **Alcohol**	- distillation and hydrometrics - ebulliometer
64. **Residual sugar**	- Fehlings titration with copper salts - enzymatic assay or HPLC
65. **pH**	- pH meter - most wines: 2.8 to 4.0 - cool-climate whites: 3.0 to 3.2 - hot-climate reds: 3.4 to 3.6 - softer, ripe reds: > 3.7
66. **CO2**	- measured enzymatically or by titration - 600-1000 mg/l is common
67. **Total dry extract (TDE)**	- measures all things non-volatile - detection of fraudulent practices - dry whites: 16 - 20 g/l
68. **Stability analysis**	Tartrate stability (cold stability) - -4 C liquid bath for 72 hours Protein stability (heat stability) - heated to 90 C for 6 hours
69. **Trace metals**	Metal analysis - copper, iron, potassium, calcium, sodium - flame atomic absorption spectrophotometer Anion analysis - choride and sulphate - HPLC
70. **Dissolved oxygen (DO)**	- oxygen meter - < 0.3 mg/l to minimize oxidation - "sparged" with nitrogen or CO2
71. **Microbial populations**	Yeast, bacteria - petri dish - microscope
72. **Taint analysis**	3 main halo-anisoles (musty odours) - TCA (2,4,6-tricholoranisole) - TeCA (2,3,4,6-tetrachloroanisole) - TBA (2,4,6-tribromonoanisole) Causes - cellar atmosphere - tanks, barrels, oak chips, filter pads, closures, bentonite GC-MS (gas chromatography-mass spectrometry)
73. **Bottling equipment**	Membrane filter (0.45 micron for sterile filtration) Bottle rinser (filtered water and acidified SO2 solution) Filler (siphoning, gravity, differential pressure) Corker (capper) Labeller
74. **Bottling options**	Traditional bottling (dry wines) Aseptic bottling - filtration (e.g. cold sterile filtration) - heat treatment (e.g. flash pasteurisation, tunnel pasterurisation, thermotic bottling)

75. **Cold "sterile" (aseptic) filtration**

Sterilise bottling line equipment
- hot most steam at 115 C
- hot water for 20 minutes

Wine to pass through sterile membrane into bottle
- aromatic whites with residual sugar (no MLF)
- fruity red wines

Advantages
- simple, cheap, reliable
- no risk of re-contaminiation or re-fermentation in bottle

Disadvantages
- training of staff
- costs (hot water, membrane filters)

76. **Bottling using heat**

Wines of moderate quality

Flash pasteurisation
- high temp for short period of time
- 80 - 90 C for few second, then rapid cooling
- pros: simple equipment, min damage to wine
- cons: re-infection, operator training
- low end reds and whites

Tunnel pasteurisation
- high temp for medium length of time
- bottles pass through heated tunnel, sprayed by hot water
- over 80 C for 15 minutes
- cold water sprays
- pros: no need for sterile bottling
- cons: expensive equipment, heat damage
- low end sparklings

Thermotic bottling
- medium temp for a long time
- heat to > 55 C
- fill bottle with warm wine, sealed and cooled
- pros: no need for sterile bottling; advance maturity of young reds
- cons: filling levels
- bulk, low end wines

77. **Packaging**

Contain the wine (transport, store, serve)
Protect wine against contamination and degradation
Provide information
Appeal to consumers

78.	**Containers**	Glass bottles - inert, impermeable, cheap to produce - coloured to reduce UV - shrink-wrapped while still hot - 3 shapes (Bordeaux, Burgundy, German/Alsace Flute) Bag-in-box - polyester film coated with aluminium foil, between two layers of high density polyethylene - 2, 3, 5, 10, 20 litres - prone to oxidation, high SO_2 dosage - tartrates can clog tap - not for wines with high level CO_2 - not for wines requiring bottle maturation - limited shelf life (12 months) Plastic containers - little protection against oxygen transfer - short shelf life - negative image - PVC (no protection against light, oxygen): few week life - PET (ligh, robust, recyclable), short life Other composite cartons - paper laminate, foodgrade polyethylene, aluminium foil - Tetra pak (1 and 2 litres) - low cost "sterile" packaging - image problems Aluminium cans - plastic liner - light, fully recyclable
79.	**Closures**	Reliable seal Inert Easy to remove

80. **Closures for glass bottles**

Natural cork
- Quercus suber
- elastic, resilient, compressible, impermeable to liquids
- 44 x 24
- cock taint (TCA, TBA, TeCA)
- gas chromatography with mass spectrometry
- solid phase micor-extraction
- Steam distillation
- Oeneo: supercritical CO2

Technical cork-based closures
- Agglomerated cork stopper
- cork bits stuck together by resin-based glue
- Diam and Neutrocork
- Colmated cork stopper
- natural cock covered with cork dust and latex
- types of technical corks
- 1 + 1/2 + 2 (cork discs at either ends) e.g. TwinTop by Amorin
- DIAM by Oeneo (agglomerated, supercritical CO2)

Synthetic closures
- foodgrade plastics
- ethylene vinyl acetate, silicone oil coating
- inexpensive
- 5 yrs shelf life
- negative consumer perception & non-recyclabiilty
- Nomacorc, Supremecorq, Neocork, Intega

Screwcaps
- aluminium alloy cap
- polyethylene / tin liner
- cheaper, easy to remove, inert, long life, tight seal
- costs of bottling equipment, special bottles, reduction

Crown caps
- Champagne aging
- cheap, easy to apply, tight seal, long life
- consumer preception

Vinolok
- Germany
- glass/plastic bottles
- no TCA, easy to open, no odour, stylish
- questionable for long-term storage