Industrial Microbiology

Food*3260/3270

Answer All 28 Questions

Time Allowed: 50 mins

Name …….

Student Number ……

The exam is closed book. There is no need for a calculator. Pens, pencils and erasers are permitted

Multiple Choice Questions (There is only one correct answer for each question)

1. What was Emile Hansen's contribution to Industrial Microbiology?

   a) First person to brew beer
   b) Introduction of hops into brewing
   c) Introduction of pure strain brewing
   d) Introduction of sanitation in beer making
   e) Discovered fermentation by yeast

2. Chaim Weizmann discovered how to produce glycerol via yeast fermentation. What addition to the media did he find that diverted carbon down the glycerol forming pathway?

   a) Glucose
   b) Diacetyl
   c) Ascorbic acid
   d) Bisulfite
   e) Ethanol

3. *Oenococcus oeni* is important in wine fermentation because?

a) Spoilage organism
b) Aids in the production of ethanol
c) Provides nutrients for yeast growth
d) Undertakes malolactic fermentation
e) More than one of the above

4. Single cell protein was developed in the 1960's as a potential meat replacement. However, in 1970's the concept of SCP fades, why ?

a) Health risks derived from microbial protein
b) Low consumer acceptance
c) Price of meat decreased
d) Oil prices increased
e) More than one of the above

7) Glutamic acid is a major product of industrial microbiology. What is the amino acid mainly used for?

a) Nutritional supplement
b) Flavor enhancer
c) Precursor or aspartame
d) Animal feed
e) All of the above

8) What is Reinheitsgebot?

a) Type of yeast used in beer production
b) First definition of beer
c) City where lager was first brewed
d) Taxation law for beer
e) None of the above

9) Hops were introduced into brewing in the 1500's but for what purpose?

a) Add bitterness to beer
b) To increase yeast growth
c) Provide enzymes to assist starch degradation
d) As a preservative
e) More than one of the above but not all

10) What was Balling's contribution to brewing?

a) Introduce thermometer
b) Invented the hydrometer
c) Developed a scale to estimate sugars in wort
d) Introduced Pasteurization
e) None of the above

11) What was Pasteur's contribution to industrial microbiology?

a) Discovery of the Kreb's cycle
b) Fermentative metabolism of yeast
c) Pasteurization of wine
d) Discovered enzymes
e) Some of the above but not all

12) Which grape variety is commonly used in Canadian vineyards?

a) *Vitis vinifera*
b) *Vitis labrusca*
c) *Vitis riparia*
d) American hybrids
e) None of the above

13) Which of the following are common spoilage yeasts encountered in wine production?

a) *Brettanomyces*
b) *Hanseniaspora*
c) *Schizsaccharomyces*
d) *Zygosaccharomyces*
e) All of the above

14) What are the characteristics of ice wine?

a) Grapes harvested with high acidity low sugar
b) Grapes can be harvested at 0°C
c) High attenuation (no residual sugar)
d) Wine has relatively high acetic acid and glycerol
e) All of the above

15) If a wine is referred to as “Brett” or “Bretty” what is the spoilage characteristic?

a) Sour
b) Oxidized
c) Band-aid
d) Nail varnish
e) fruity

16) On occasion sugar juice is added to wine to increase sweetness of wine. What is the process referred to?

a) Amelioration
b) Chaptalization
c) Edulcoration
d) Sugatization
e) None, illegal to add sugar to wine

17) What factors should be considered when selecting a yeast for wine production?

a) Sensory profile
b) Acid tolerance
c) Resistance to sulphur dioxide
d) Bacteriophage resistance
e) All of the above

18) Which metabolite is associated with cork taint?

a) 2,4,5-trichloroanisole
b) Guiacols
c) Volatile acids
d) 2,3 pentanedione
e) Ethyl acetate

	ppm		
Water	**Ca**	**Bicarbonate**	**SO_4**
A	5	5	3
B	350	350	750
C	120	340	180

Which of the above water types would be suitable for the following beer types?

19) Stout …C……

20) Pilsener …A….

21) Indian Pale Ale …B…

Short Answer Questions

22) Why is 2 row barley, as opposed to 6 row barely, preferred in brewing (5 marks)?

Even kernels to aid milling

Lower protein

Lower DMS precursor

High endosperm to husk

High starch extraction yield

High endosperm to husk ratio

23) What are adjuncts used for in brewing? Provide two examples of adjuncts used in brewing? (3 marks)

Provide additional starch (sugars) without significantly contributing to the color or flavour of the beer. Also permit high gravity brewing and beer stability (ie do not significantly contribute to protein)

Examples, corn, rice, sucrose

24) In wine production, how would the fermentation of a must be affected if there is a low Yeast Available Nitrogen (YAN)? (3 marks)

Stuck fermentation
Production of mostly undesirable flavour compounds
Generation of hydrogen sulfide

25) Which are common acids encountered in wine? (3 marks)

Malic

Citric

Tartaric

26) What is the purpose of the malolactic fermentation of wine? (2 marks)

Conversion of malic acid into lactic acid to soften the flavour of the wine

Performed by lactic acid bacteria with *Oenococcus oeni* being mainly applied.

27) What are the 3 methods for producing sparkling wine? (3 marks)

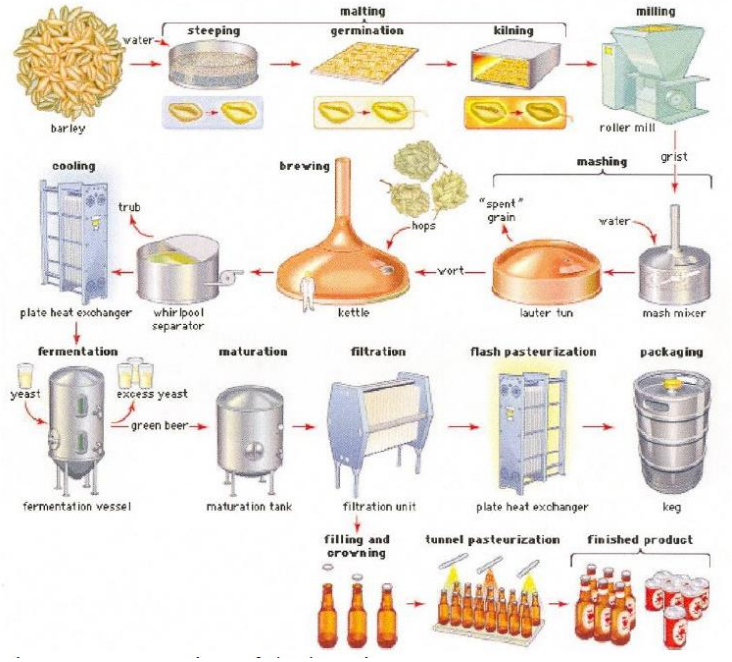
Within bottle

Barrel or tank

Carbon dioxide injection.

Long Answer Question

28) By using a diagram, provide an overview of the different steps of the brewing process and provide a brief explain the purpose of each unit operation (10 marks).



Milling

The grain is processed through a roller mill (2, 4, or 6 roller), designed to leave the husk intact.

Mashing

The crushed grain is mixed with water in a mash tun at proper volume and temperature;

Protein degradation- reduction of high molecular weight proteins to simpler amino acids (proteinase- reduce large proteins to medium sized proteins; peptidase- degrade medium sized proteins to amino acids for yeast growth)

Starch degradation- conversion of starch molecules to fermentable sugars (alpha amylase - rapidly reduces starch to shorter chains; beta amylase - reduces starch and short chains to maltose)

Mashing is affected by: temperature (rise in temperature controls amount of fermentable extract), time (influences yield and fermentability), mash pH (optimum range is 5.1-5.6), mash water (calcium is required), mash viscosity (thin mash favour the conversion of starch to sugars)

Fermentability and final concentration of alcohol are regulated by mash time and temperature

Lautering (Wort separation)

The separation of wort from the converted mash, tun is predominant separation device (produces clear wort, obtain good extract recovery)

o Mash is pumped to the false bottom of lauter tun which acts as a filtration system, rakes assist in leveling of grain bed and facilitates the filtration process

Separated wort continues to return to lauter tun until the bed is established and the wort is clear; once clear, wort is transferred to kettle; spent grain used as animal feed

Kettle (wort boiling)

Functions to: inactivate enzymes, sterilize the wort, isomerize the hop components, remove un-wanted volatiles, precipitate proteins, concentrate wort by evaporation, form colour from Maillard reactions

Sterilization- destroys residual microorganisms

Protein precipitation- removes high molecular weight proteins, isomerization- produces alpha acid (hop flavour)

Dissipation of volatile constituents- dimethyl sulphide (DMS)

Isomerization of alpha-acids in hops

Hot wort tank (whirlpool, tangential entry, protein precipitate spun into centre of tank, clear wort sent to wort cooler)

Fermentation

Depends on 3 parameters: wort composition (nutrients, oxygenation level, °P), yeast (proper pitching rate, viability), process conditions (temperature)

Yeast pitching: Depends on ale or lager brewing

End of fermentation: Diacetyl rest

High fermentation temperature leads to diacetyl formation

Diacetyl rest is when fermenter is held at a higher temperature to allow for yeast to reduce the diacetyl

11 °C for 2-10 days towards the end of the fermentation

Transfer to storage

Separate yeast – mature beer at 0 °C – precipitate proteins, remove oxalate

Chillproofing agents added before filtration (silica gels, stabilizes/removes haze forming elements (proteins))

Differing packaging processes (Pasteurization - 60 °C for 5 minutes; sterile filtration; bottle fermentation- Belgian styles, wheat beers)