COLLEGE OF PHARMACY

Pharmaceutical Quality Control & Biochemistry Laboratory

Experiment 6 Examination: Determination of Fixed Oils (British Pharmacopoeia)

INSTRUCTIONS: Select the single best answer for each of the following 15 multiple-choice questions.

1. According to the British Pharmacopoeia (BP) definition, what is the core chemical structure of a fixed oil extracted from botanical sources?

A) An ester derived from spherical proteins and fatty aldehydes

B) A triglyceride consisting of glycerol esterified with three fatty acids

C) A free carboxylic acid polymer with aromatic side chains

D) A carbohydrate derivative combined with inorganic alkali salts

2. How do carbon chain length and double bond frequency influence the physical properties of fixed oils?

A) Larger number of carbon atoms increases MP; larger number of double bonds lowers MP

B) Larger number of carbon atoms lowers MP; larger number of double bonds increases MP

C) Both chain length and double bonds increase the melting point proportionally

D) Double bonds increase viscosity while carbon chain length has no effect on melting point

3. Acid Value (AV) is specifically defined as the number of milligrams of potassium hydroxide (KOH) required to neutralize free fatty acids in:

A) 100 grams of fixed oil

B) 1.0 gram of fixed oil

C) 10.0 grams of fixed oil

D) 1.0 milliliter of pure triglyceride solvent

4. What type of rancidity is directly evaluated by determining the Acid Value (AV) of a pharmaceutical oil sample?

A) Oxidative rancidity

B) Ketonic rancidity

C) Hydrolytic rancidity

D) Thermal degradation rancidity

5. Which parameter is used to calculate the Acid Value (AV) using the standard formula $AV = (M \times M_w \times V) / W$?

A) M_w = 40.00 (NaOH); M = Molarity of Iodine

B) M_w = 56.11 (KOH); V = Titrant end-point volume in mL

C) M_w = 158.1 ($Na_2S_2O_3$); W = Weight of alkali in mg

D) M_w = 100.0 (Glycerol); V = Indicator volume in drops

6. Why must pharmaceutical grade oils possess negligible or ultra-low acidity (low Acid Value)?

A) Acidic oils degrade active ingredients and indicate lipid breakdown due to hydrolysis

B) High acidity prevents the oil from reacting with iodine during stability testing

C) High acid values lower the boiling point of the oil below room temperature

D) Hydrolyzed free fatty acids convert the oil into volatile essential aromatic oils

7. During the oxidative deterioration of fixed oils, which compounds represent the primary oxidation products?

A) Short-chain volatile aldehydes and ketones

B) Peroxides, conjugated dienes, and initial free radicals

C) Tertiary polymers and cyclic alkanes

D) Glycerol molecules and inorganic oxide salts

8. Peroxide Value (POV) measures the amount of peroxide oxygen per kilogram of oil, traditionally expressed in:

A) Grams of KOH per 100g

B) Milliequivalents (mEq) of peroxide oxygen

C) Percentage of unreacted glycerol

D) Micromoles of free iodine per liter

9. In the chemical determination of Peroxide Value, liberated iodine (I_2) is titrated against which standard volumetric titrant?

A) 0.1 M Potassium Hydroxide (KOH)

B) Standard Sodium Thiosulfate ($Na_2S_2O_3$)

C) Hydrochloric Acid (HCl) with Phenolphthalein

D) Potassium Iodide (KI) in concentrated ethanol

10. What color transition marks the exact end-point in the Peroxide Value titration using starch as an indicator?

A) Colorless to deep pink

B) Deep blue / purple to completely colorless

C) Bright yellow to dark brown precipitate

D) Light green to intense violet

11. A sample of vegetable oil exhibits a Peroxide Value (POV) between 30 and 40 mEq/kg. What organoleptic quality does this indicate?

A) Fresh, high-grade oil with zero oxidation

B) A noticeable rancid taste and advanced oxidative spoilage

C) Complete saponification into pure sodium soap

D) Extreme purity suitable for immediate parenteral injection

12. How is the Saponification Value (SV) mathematically and chemically related to the average molecular weight of triglycerides in an oil sample?

A) Inversely related: Long-chain fatty acids (high MW) yield a lower Saponification Value

B) Directly proportional: Higher molecular weight always results in higher Saponification Value

C) Independent: SV depends solely on the number of double bonds present

D) Exponentially related: SV increases as fatty acid chain length extends

13. Saponification is defined as the chemical reaction between a neutral fat (triglyceride) and a strong base to produce:

A) Peroxides and volatile fatty aldehydes

B) Glycerol and salts of fatty acids (soap)

C) Hydrocarbons and halogenated derivatives

D) Synthetic ester waxes and water

14. What fundamental chemical feature of a lipid sample is measured by its Iodine Value (IV)?

A) The exact concentration of free carboxylic acid groups

B) The degree of unsaturation (number of carbon-carbon double bonds)

C) The total quantity of primary hydroperoxides formed during storage

D) The average specific gravity and relative density

15. Why does a fixed oil with a high Iodine Value (IV) exhibit a greater susceptibility to oxidative rancidity?

A) High IV oils contain more unsaturated double bonds that readily react with oxygen

B) High IV oils contain saturated fatty acids that attract atmospheric water vapor

C) High IV oils have short carbon chains that evaporate rapidly at room temperature

D) High IV oils spontaneously hydrolyze into glycerol and potassium hydroxide

OFFICIAL ANSWER KEY & RATIONALE

BP Experiment (6): Determination of Fixed Oils

Q#	Correct Answer	Pharmacopoeial Rationale & Explanation
1	B	**Triglyceride structure:** A fixed oil is chemically defined as a triglyceride (triacylglycerol), which is an ester derived from one glycerol backbone and three fatty acid chains.
2	A	**Structure-property relationship:** Melting point increases with longer aliphatic carbon chains (greater intermolecular forces) and decreases with higher degree of unsaturation (double bonds create kinks in chains).
3	B	**Acid Value Definition:** Acid Value is defined specifically as the milligrams of KOH required to neutralize free fatty acids present in **1.0 gram** of fat/oil.
4	C	**Hydrolytic Rancidity:** Acid value measures free fatty acids liberated by moisture and temperature cleavage of triglyceride ester bonds (hydrolysis).
5	B	**AV Calculation Parameters:** In $AV = (M \times M_w \times V) / W$, M_w represents the molecular weight of potassium hydroxide (56.11 g/mol) and V is the end-point volume in mL.
6	A	**Pharmaceutical Quality:** Pharmaceutical oils must have minimal acidity because free fatty acids indicate hydrolysis, cause active ingredient degradation, and cause tissue irritation.
7	B	**Oxidation Stages:** Primary oxidation products formed during autoxidation include peroxides, hydroperoxides, and conjugated dienes. Secondary products are aldehydes and carbonyls.
8	B	**POV Units:** Peroxide Value specifies the content of peroxide oxygen per 1 kg of fat, traditionally expressed in milliequivalents (mEq/kg).
9	B	**POV Titration:** Peroxides react with iodide (KI) to liberate free iodine (I_2), which is quantitatively titrated using standardized sodium thiosulfate ($Na_2S_2O_3$).
10	B	**Starch Indicator Endpoint:** Iodine forms a dark blue complex with starch (amylose). As $Na_2S_2O_3$ reduces I_2 to iodide (I^-), the blue complex turns completely colorless.
11	B	**Organoleptic Thresholds:** Fresh oils have POV < 10 mEq/kg. A POV between 30 and 40 mEq/kg imparts a clear, noticeable rancid taste and smell due to advanced oxidation.
12	A	**Inverse SV-MW Relationship:** SV measures mg KOH to saponify 1g fat. Longer fatty acid chains have higher molecular weight, meaning fewer ester groups per gram, resulting in a lower SV.
13	B	**Saponification Products:** Saponification breaks down neutral fats (triglycerides) using a strong alkali into glycerol and fatty acid salts (soaps).
14	B	**Iodine Value Definition:** Iodine Value is the number of grams of iodine absorbed by 100g of oil, directly measuring the degree of carbon-carbon unsaturation.
15	A	**Unsaturation & Oxidative Risk:** Double bonds are chemically reactive sites prone to atmospheric oxygen attack; thus higher IV (more double bonds) increases susceptibility to oxidative rancidity.