Energy drinks

• Athletes increasingly use energy bars or energy drinks specially adapted for them during prolonged efforts such as cycling races or marathons.

• Energy drinks are developed in the laboratory by sport nutrition specialists. Their composition of carbohydrates, minerals and vitamins is adapted to the demand of the sportsman.

• Their composition is then submitted to a quality control laboratory.

In this subject, we will be particularly interested in one of these drinks.

This energy drink is specially adapted to very long efforts requiring a maximum energy contribution throughout the effort.

Its formula is an association of maltodextrins with slow assimilation and fructose, providing a constant energy diffusion throughout the effort, with water, vitamin and mineral requirements necessary during high endurance tests.

The food quality control laboratory must analyze the various components of this energy drink.

I. Qualitative analysis of the APTONIA energy drink.

<u>Step1 :</u> Solving the problem

The manufacturer indicates the presence of carbohydrates in his energy drink.

• What carbohydrates are they? Glucose, fructose, starch, sucrose, etc.

In order to identify sugars in a solution, it is common in the laboratory to use a fractionation technique called <u>Thin Layer Chromatography</u> (TLC).

TLC is carried out using a solid support (stationary phase) on which the solutions to be analyzed are deposited; A mobile phase (eluent) migrates by capillarity on the support, carrying with it the various constituents of the mixtures as a function of their affinity with either the mobile phase or the stationary phase.

The migration of each constituent is evaluated by the calculation of a constant: the frontal relationship (denoted Rf) which is characteristic of the constituent.

Rf = Distance traveled by the compound / Distance traveled by the solvent

<u>Step 2 : Performing the manipulation</u>

Follow protocol 1 on the laboratory bench

Step 3 : Communicating the results

Complete the distributed results sheet.

II. Quantitative analysis of the APTONIA energy drink

<u>Step1 : Solving the problem</u>

The manufacturer indicates a carbohydrate concentration of 50,8 g.L⁻¹.

• What is the amount of glucose brought by this energy drink?

In order to determine the concentration of glucose in the beverage, <u>a colorimetric method</u> is used.

A colorimetric assay consists in reacting the solute to be assayed with a specific reagent in order to develop a coloration. This coloring will be proportional to the quantity of the solute to be assayed. Any colored solution absorbs some radiation from white light. By means of a spectrophotometer, it is possible to measure this absorbance.

The absorbance is proportional to the concentration of the colored solution (Beer Lambert's Law).

The DNS (3,5-dinitrosalycilic acid) reagent which takes on an orange coloration by combining with the glucose is used here. This color absorbs the radiation of white light for a wavelength of 540nm.

<u>Step 2 : Perform the manipulation</u>

Follow protocol 2 on the laboratory bench

Step 3 : Communicate the results

Complete the distributed results sheet.

PROTOCOL 1 : QUALITATIVE ANALYSIS OF AN APTONIA ENERGY DRINK

Caution ! Wear latex gloves.

1. Activate the silica plate by drying it with the hair dryer.

2. Prepare the plate:

• Draw a 1.5 cm light pencil line starting from the bottom edge on the plate.

• Draw as many dots as there are solutions (G: glucose, M: maltose, D: energy drink, F: fructose) regularly spaced 1cm apart.

3. Making deposits:

• Dip each toothpick in each solution and put 2 drops of each one on the plate. Dry with the hair dryer between the 2 drops.

Caution: use one toothpick for each solution.

4. Migration:

• Place the plate in the solvent saturated chromatography tank (eluent) under the hood.

Caution: check that the deposition line does not dip into the solvent.

5. Reveal Sugars: (with teacher)

- Remove the plate from the chromatography tank.
- Immediately draw a line at the high limit of the solvant.
- Dry the plate with a hairdryer.
- Give the teacher the plateto realize the revelation
- Dry with the hairdryer.
- Circle with a pencil each yellow spot.

PROTOCOL 2 : QUANTITATIVE ANALYSIS OF AN APTONIA ENERGY DRINK

1. Prepare the tubes

- Let the 2 annotated test tubes E1 and E2 for the assay and 1 blank annotated tube for the adjustment of the spectrophotometer.

• Fill the tubes according to the following table with a 1 mL pipette.

Tubes	Blan k	E1	E2
Volume of distilled water (in mL)	1	0	0
Volume of energy drink diluted to 50th (in mL)	0	1	1
Volume of DNS reagent (in mL)	2	2	2

Caution: the volumes are taken precisely using a 1mL pipette and a suction bulb. The DNS reagent is located under the hood in a vending machine.

- 2. **Plug the tubes** with carded cotton.
- 3. **Homogenize** by gently stirring the tubes.
- 4. **Place the tubes** in a boiling water bath for exactly 5 minutes.

5. **Remove the tubes** and replace them in the tube holder in the sink filled with water to cool them.

6. Add 7 mL of distilled water to each tube.

7. **Read the absorbances**: pour each solution into a plastic tank and place it in the spectrophotometer at 540 nm against Blank reagent, without glucose.

Caution: Take pen and paper to score the results

8. **Record** the results.

In parallel, a calibration range is carried out; The results will be given.

SECURITY

	PRODUCT	Hazard identification	
Eluant	Butan-2-one	H225, H319, H336,EUH066	
	Méthanol	H225,H331,H311,H301,H370	
	Acide acétique	Н226,Н314	

	Product	Hazard identification
	Tartrate de sodium et de potassium	
Réactif au 3,5-DNS	Soude	H314
☞ 🦅 六 伦	Acide dinitrosalicylique	H302,H315,H335,P261

	Product	Hazard identification
Révélateur des sucres	Permanganate de potassium	Н302,Н315,Н411 Р264,Р270,Р273
💎 🥎 六 🁚	Carbonate disodique anhydre	Н319

H225 Liquide et vapeurs très inflammables H302 Nocif en cas d'ingestion	P210 Tenir à l'écart de la chaleur/des étincelles/des flammes nues/des surfaces
H315 Provogue une irritation cutanée	P220 Tenir/stocker à l'écart des vêtements/matières combustibles
H319 Provoque une sévère irritation des	P221 Prendre toutes précautions pour éviter de mélanger avec des matières combustibles
yeux	P264 Se laversoigneusement après manipulation
H336 Peut provoquer somnolence ou	P270 Ne pas manger, boire ou fumer en manipulant ce produit
vertiges	P273 Éviter le rejet dans l'environnement.
H410 Très toxique pour les organismes aquatiques, entraîne des effets néfastes à	P280 Porter des gants de protection/des vêtements de protection/un équipement de protection des yeux/du visage
long terme	P305+P351+P338 EN CAS DE CONTACT AVEC LES YEUX : rincer avec précaution à l'eau pendant plusieurs minutes. Enlever les lentilles de contact si la victime en porte et si elles peuvent être facilement enlevées. Continuer à rincer

RESULTS

I. Qualitative analysis of the APTONIA energy drink:

-	the	1. Mea e compound e distance tra	sure from t for each sp aveled by th	the chromatogram th ot (take the center of ne solvant .	e distance traveled by f each spot) as well as
7 M A	c-				
	Glucose	Fructose	Maltose	Drink	
Distance traveled (in cm)					

Distance traveled by the solvant = cm

2. Deduce the Rf for each compound. Complete the table.

Rf = Distance traveled by the compound / Distance traveled by the solvent

Giucose Fruciose Maitose Drink	Glucose Fructose Maltose Drink
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Rf		
NI		

3. Name the carbohydrates in the sport solution, comparing the Rf (s) of the solution (s) with the proposed sugars.

II. Quantitative analysis of a energy drink APTONIA:

1. Fill in the table below with the values of the standard range

TUBES	0	1	2	3	4	5
Amount of glucose per tube (in mg)	0	0,4	0,8	1,2	1,6	2
A 540 nm						

2. **Draw** the calibration line: A $_{540 \text{ nm}}$ = f (amount of glucose per tube) from the values given by the teacher (Cf slideshow)

A 540 nm

Amount of glucose (mg/tubes)

3. Find the amount of glucose for each test by referring to the right calibration. Report your results in the table below.

	A 540 nm	Amount of glucose (mg/tube)
E1		
E2		

Concentration = ((E1+E2)/2) x 50

<u>Calculations :</u>

Concentration APTONIA energy drink =
$$g.L^{-1}$$

Conclusion :

What carbohydrates are they?

What is the amount of glucose brought by this energy drink?

With the help of the document distributed, conclude on the quality control carried out. Do the results coincide with the data?