AFDC 7 (4025) DTZS
ICS 71.100.60

DRAFT TANZANIA STANDARD

Essential oil of cardamom - Specification

TANZANIA BUREAU OF STANDARDS

0. Foreword

Essential oil of cardamom is a highly valued essential oil extracted primarily from the seeds of the *Elettaria cardamomum* plant, known for its warm, spicy, sweet, and balsamic aroma. It is widely used in perfumery, food and beverage flavoring, aromatherapy, and traditional medicine due to its extensive therapeutic properties.

This Tanzania standard was prepared to ensure the safety and quality of essential oil of cardamom produced for the local and export market.

In reporting the results of a test or analysis made in accordance with this Tanzania Standard, if the final value observed or calculated is to be rounded off, it shall be done in accordance with TZS 4 (see clause 2)

1 Scope

This Tanzania Standard specifies the requirements, methods of sampling and test for essential oil of cardamom intended for human consumption.

2 Normative references

The following referenced documents are indispensable for the application of this standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies

CXS 193, *General standard for contaminants and toxins in food and feed*

TZS 109, Codes of hygiene for food processing units — General

TZS 4, Rounding off numerical values

TZS 538, Packaging and labeling of foods

TZS 1328: 2017 (1st Ed) -ISO 279, Essential oils - Determination of relative density at 20°C – Reference method

AFDC 7 (4438)ISO 280:1998 Essential oils - Determination of refractive index

AFDC 7 (4436)/ ISO 1242:2023 Essential oils - Determination of acid value by two titration methods, manual and automatic

AFDC 7 (4441) / ISO 592:1998 Essential oils - Determination of optical rotation

AFDC 7 (4444)/ISO 875:1999 Essential oils - Evaluation of miscibility in ethanol

AFDC 7 (4439)/ ISO 709:2001 Essential oils - Determination of ester value

AFDC7 (4435) ISO 212:2007, Essential oils — Sampling

3. Terms and definitions

For the purpose of this standard, the following terms and definitions shall apply;

3.1 essential oil of cardamom
volatile oil extracted from seeds of the cardamom plant (*Elettaria cardamomum* or *Amomum subulatum*) with primary sources being the seeds within the green or brown pods

3.2
camphorous

peculiar aromatic smell/taste reminiscent of camphor

3.3
food grade containers
containers which shall safeguard the hygienic, safety, nutritional, technological, and organoleptic qualities of the product

4 Requirements

4.1 General requirements

i. The essential oil of cardamom shall be a clear liquid free from sediment, suspended matter, separated water and added adulterants;
ii. The colour and appearance shall be almost colorless to yellow, liquid; and
iii. The odour shall be characteristic, spicy and camphorous.

4.2 Specific Requirements

4.2.1 Chromatographic Profile
Analysis of the essential oil shall be carried out by Gas Chromatography. In the chromatogram obtained, the representative and characteristic components shown in Table 2 shall be identified. The proportions of these components indicated by the integrator shall be as shown in Table 2. This constitutes the chromatographic profile of the essential oil.

4.2.2 Solubility in Ethanol
The product shall be completely soluble in two to five volume of ethanol (70 percent by volume) when tested as prescribed in AFDC 7 (4444)/ISO 875.

4.2.3 The product shall also comply with the requirements given in Table 1 and Table 2.

Table 1 — Physical-Chemical requirements for essential oil of cardamom

S/No	Characteristics	Requirements	Test method (see clause 2)
i	*Relative density at 27°C	0.9190 – 0.9360	Annex A
ii	Optical rotation at 27°C	+16° to 41°	AFDC 7 (4441)/ ISO 592
iii	Refractive index at 27°C	1.4575 – 1.4605	AFDC 7 (4438) / ISO 280
iv	Acid value,max	7.0	- AFDC 7 (4436)/ISO 1242

v	Ester value	92-150	AFDC 7 (4439) / ISO 709
vi	1,8-Cineole content,% by mass	26.0- 41.0	Annex B
*The correction factor for relative density and refractive index for each degree celsius change in temperature is 0.00064 and 0.00038 respectively.			

Table 2 — Chromatographic profile

S/NO	Components	Minimum	Maximum	Test Method
i.	Sabinene	2.0	5.0	Annex B
ii.	1,8- Cineole	26.0	41.0	
iii.	Linalool	0.5	4.0	
iv.	Linalyl acetate	1.5	8.0	
v.	Alpha-terpinyl acetate	30.0	42.0	

5. Contaminants

5.1 The product shall comply with those maximum pesticide residue limits established by the Codex Alimentarius Commission.

5.2 Heavy metals contaminants
The product shall not contain any heavy metal contaminants in excess of levels specified in CXS 193.

6. Hygiene

6.1 Essential oil of cardamom shall be prepared under good hygienic practices as stipulated in TZS 109.

7. Sampling and Tests

7.1 Sampling
Sampling shall be done in accordance with AFDC 7 (4435)/ISO 212.

7.2 Testing
Tests shall be done in accordance with methods prescribed in Tables 1 and 2.

8. Packaging, Labelling and Marking

8.1 Packaging
Essential oil of cardamom shall be well packaged in a food grade container.

8.2 Marking and labelling
8.2.1 In addition to the requirements of TZS 538 the following specific labelling requirements shall apply and shall be legibly and indelibly marked;

i. Name of the product “essential oil of cardamom/cardamom essential oil”
ii. Net weight;
iii. Name and physical address of the manufacturer/packer/distributor;
iv. Date of manufacture,
v. Best before date
vi. Batch number;
vii. Instruction for use;
viii. country of origin;
ix. Storage conditions.

8.2.2 Certification mark

Each container may also be marked with TBS certification mark.

NOTE: The use of TBS certification mark is governed by provisions of the standards Act 2009. Details of the conditions under which a license for the use of TBS certification mark may be granted to manufacturers or producers, may be obtained from TBS.

Annex A
(normative)
DETERMINATION OF RELATIVE DENSITY

A.1 General
This method for the determination of the relative density of essential oils at 20 °C.

NOTE: If it is necessary to perform the test at a different temperature on account of the nature of the essential oil, the temperature should be mentioned in the standard appropriate to the essential oil concerned. The average correction in the region of 20 °C is from 0.0007 to 0.0008 per degree Celsius

A.2 Principle
Equal volumes of the essential oil and water, at 20 °C are weighed successively in a pyknometer.

A.3 Reagents

A.3.1 Distilled water, freshly boiled and subsequently cooled to approximately 20 °C

A.4 Apparatus
Ordinary laboratory apparatus and the following

A.4.1 Glass pyknometer, of minimum nominal capacity of 5 ml

NOTE 1: There are available on the market automatic electronic instruments for the accurate measurement of the relative density. Such instruments may be used for routine controls, but in cases of dispute the reference method is the pyknometric method.

NOTE 2: Appropriate pyknometers are described in ISO 3507

A.4.2 Water bath, capable of being maintained at 20 °C to 0.2 °C.
A.4.3 Standardized thermometer, graduated from 10 °C to 30 °C, with 0.2 °C or.0.1 °C divisions.
A.4.4 Analytical balance, accurate to 0.001 g.

A.5 Sampling
It is important that the laboratory receive a representative sample which has not been damaged or modified during transportation or storage. Prepare the test sample in accordance with ISO 356.

A.6 Procedure

A.6.1 Preparation of pyknometer

Carefully clean the pycnometer (**A.4.1**) and then rinse it successively with for example, ethanol and acetone then dry the interior by means of a current of dry air.

If necessary, wipe the outside with a dry cloth or a filter paper.

When temperature equilibrium is reached between the balance case and the pyknometer, weigh the latter with its stopper, if any, to the nearest 1 mg.

A.6.2 Weighing of distilled water

Fill the pyknometer with distilled water (**A.3.1**).

Immerse the pyknometer in the water bath (**A.4.2**). After 30 min, adjust the water to the mark, if necessary. Insert the stopper, if any, and dry the outside as before with a dry cloth or a filter paper.

When temperature equilibrium is reached between the balance room and the pyknometer, weigh the latter and its stopper if any, to the nearest 1 mg

A.6.3 Weighing of essential oil

Empty the pyknometer, then wash it and dry it as specified in **A.6.1**

Proceed as specified in **A.6.2** , replacing the water by the test sample prepared according to clause ISO 356..

A.7 Expression of results

The relative density, at 20 °C is given by the following equation:

$$\frac{M2-M0}{M1-M0}$$

where

M0 is the mass, in grams, of the empty pyknometer determined in **A.6.1**;

M1 is the mass, in grams, of the pyknometer filled with water, determined according to **A.6.2** ;

M2 is the mass, in grams, of the pyknometer filled with the essential oil, determined according to **A.6.3**

Express the result to three decimal places.

NOTE 1: In practice, no correction is made for the upthrust due to air.

NOTE 2: Electronic instruments often register higher accuracy levels

If the absolute density of the essential oil is required, multiply the value obtained for the relative density by the absolute density of water at 20 °C (i.e. 0,99823 g/ml).

A.8 Conversion

The cardamom oil contains 1,8-cineole and α-terpinyl acetate. These component gives a moderate thermal expansion behavior. In order to convert the relative density from 20 °C to 27 °C the realistic thermal expansion value is 0.00082

The conversion formula for converting relative density from 20 °C to 27 °C

Relative density at 27 °C is given by $\frac{\text{density at 20 °C}}{1 + (0.00082 * 7)}$

A.9 Test report

The test report shall state:

— the method used;

— the result obtained; and

— if repeatability has been verified, the final result obtained

It shall also mention any operating conditions not specified in this International Standard, or regarded as optional, as well as any circumstances that might have influenced the results.

The test report shall include all details required for the complete identification of the sample.

Annex B
(normative)

DETERMINATION OF 1,8-CINEOLE CONTENT

B.1 Scope and field of application

This annex B specifies a method for the determination of the content of 1,8-cineole in essential oils, the principal constituents of which are 1,8-cineole and terpene hydrocarbons.

The method is also applicable to the essential oils of cajuput and niaouli, provided that an appropriate table is used; such a table will be included in the section entitled “Requirements” in the relevant International Standards dealing with these essential oils.

Parallel to this method, methods for the determination of 1,8-cineole in certain essential oils, by gas chromatography, will be the subject of future International Standards.

B.2 Principle

Measurement of the crystallization temperature of a mixture of essential oil and o-cresol. This temperature depends on the 1,8-cineole content of the essential oil.

B.3 Reagents

B.3.1 o-Cresol, purified, anhydrous, melting-point not less than 30.5 °C.

As this reagent is hydroscopic, it should be stored in small, well-stoppered bottles, or preferably in sealed flasks. These containers should also be protected from light.

When the o-cresol is not in the condition specified above, it is possible to purify it as follows:

Melt a quantity of o-cresol (analytical reagent grade), add 5 % of its mass of distilled water, and allow to crystallize at a temperature of 20 °C to 25 °C. Drain the crystals, and transfer them to a flask fitted with a fractionating column. Distil the first 10 % (V/V) and discard it. Replace the column by a similar one, but dry, and distil 80 % (V/ V), the residue in the flask being discarded. Allow the main fraction to crystallize. If its melting point is still below 30.5 °C, repeat the distillation as before, as many times as is necessary to obtain a product having a melting point not less than 30.5 °C, which is colourless on melting.

B.3.2. 1,8-Cineole, analytical reagent grade.

The purity of cineole shall be checked, for example, by measurement of the refractive index at 20 °C, which shall be between 1.4550 and 1.4600.

B.3.3 1,8-Cineole-o-cresol complex, prepared by mixing equimolecular proportions (in the ratio 154.24/108.13) of the cineole (**3.2**) and the o-cresol (**3.1**), and purified by crystallization from light petroleum (of analytical grade), of distillation range between 40 °C and 60 °C. The crystallization point of the complex shall not be below 65.2 °C

B.4 Apparatus

B. 4.1 Calibrated thermometers, mercury in glass, fulfilling the following requirements:

— length of bulb :10 to 15 mm;

– diameter of bulb :5 to 6 mm;

– graduation :0,1 °C;

— calibration :0,1 °C.

The set of thermometers used shall permit the measurement of any temperature between 20 °C and 60 °C.

B.4.2 Ordinary thermometer.

B.4.3 Test tube, about 20 mm diameter and 100mm long.

B.4.4 Stout-walled test tube, about 30 mm diameter and 125 mm long.

B.4.5 Water bath.

B.4.6 Agitator.

B. 5 Sampling

The sample is sampled according to ISO 212.

B.6 Procedure

B.6.1 Preparation of test sample

During this analysis, the sample were prepared according to ISO 356.

B.6.2 Preliminary test

Weigh to the nearest 0.001 g about 3g of the freshly prepared test sample (**see B.6.1**) in the test tube (**B.4.3**) carefully dried, and add 2.10 g of the melted o-cresol (**B.4.1**).

Place the tube in the apparatus assembly for determination of freezing point and allow the mixture to crystallize by cooling, stirring with the agitator (4.6). When crystallization takes place, there is a smell increase in temperature. Note the maximum value obtained as t_1.

B.6.3 Determination

Remelt the mixture, at a temperature not exceeding t_1 by more than 5 ^{o}C, using the water bath (**B.4.5**). Place the test tubes (**B.4.3**) into the apparatus assembly for determination of freezing point maintained at a temperature 5 ^{o}C below t_1, checking with the ordinary thermometer (**B.4.2**).

When crystallization begins, or when the temperature of the mixture has fallen to a value 3 ^{o}C below t_1, stir continuously by means of the agitator (**B.4.6).** Take care that the bulb of the thermometer is always completely immersed. Induce the crystallization by rubbing the wall of the test tube with the bulb of the thermometer. Note the maximum temperature at which the mixture crystallizes as t_2.

Repeat the determination until the two highest values obtained for t_2 do not differ by more than 0,2 ^{o}C.

If supercooling occurs, induce the crystallization by adding a small crystal of the 1,8-cineole-o-cresol complex **(B.3.3**).

If t_2 is below 27.4 ^{o}C, repeat the determination after the addition of 5.10 g of the 1,8-cineole-o-cresol complex (**B.3.3).**

B.7 Expression of results

The content of 1,8-cineole, corresponding to the highest temperature observed (t_2), is given in the table.

If 5.10 g of the 1,8-cineole-o-cresol complex (**B.3.3**) has been added, the 1,8-cineole content of the sample, expressed as percentage by mass, is given by the formula.

$$2(A - 50)$$

where **A** is the percentage of 1,8-cineole indicated in the table 1.

The results shall be expressed to two significant figures. The content of 1,8-cineole, corresponding to the highest temperature observed (t_2), is obtained, where necessary, by interpolation from the data in the table 1.

B.8 Test report

The test report shall state the method used and the result obtained. It shall also mention any operating conditions not specified in this annex, or regarded as optional, as well as any circumstances that might have affected the results.

The test report shall include all details required for the complete identification of the sample.

Table 1– 1,8-Cineole content, as a percentage by mass, as a function of the crystallization temperature of the essential oil-o-cresol mixture

Crystallization temperature	1,8-Cineole content	Crystallization temperature	1,8-Cineole content	Crystallization temperature	1,8-Cineole content	Crystallization temperature	1,8-Cineole content
°C	% {m/m	°C	% {m/m	°C	% {m/m	°C	% {m/m
24	45.5	32	56	40	67	48	82
25	47	33	57	41	68.5	49	84
26	48.5	34	58.5	42	70.5	50	86
27	49.5	35	60	43	72.5	51	88.5
28	50.5	36	61	44	74	52	91
29	52	37	62.5	45	76	53	93.5
30	53.5	38	63.5	46	78	54	96
31	54.5	39	65	47	80	55	99

Bibliography
IS 15068:2001) oil of cardamom (*Elettaria cardamomum* Maton) — Specification