DUS ARS 857

DRAFT UGANDA STANDARD

First Edition
2022-mm-dd

Finger millet grains — Specification

Reference number
DUS ARS 857: 2022

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National foreword

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Draft Uganda Standards adopted by the Technical Committee are widely circulated to stakeholders and the general public for comments. The committee reviews the comments before recommending the draft standards for approval and declaration as Uganda Standards by the National Standards Council.

This Draft Uganda Standard, DUS ARS 857: 2022, *Finger millet grains — Specification*, is identical with and has been reproduced from an African Standard, ARS 857: 2022, *Finger millet grains — Specification*, and adopted as a Uganda Standard.

The committee responsible for this document is Technical Committee UNBS/TC 203, *Cereals, pulses and related products and processes*.

Wherever the words, “African Standard" appear, they should be replaced by "Uganda Standard".

AFRICAN STANDARD

DARS 857

Second Edition 2022

Finger millet grains — Specification

Reference No. DARS 857:2022(E)
ICS 67.060

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Foreword

The African Organization for Standardization (ARS) is an African intergovernmental organization made up of the United Nations Economic Commission for Africa (UNECA) and the Organization of African Unity (AU). One of the fundamental mandates of ARSO is to develop and harmonize African Standards (ARS) for the purpose of enhancing Africa's internal trading capacity, increase Africa's product and service competitiveness globally and uplift the welfare of African communities. The work of preparing African Standards is normally carried out through ARSO technical committees. Each Member State interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, Regional Economic Communities (RECs), governmental and non-governmental organizations, in liaison with ARSO, also take part in the work.

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This African Standard was prepared by the ARSO Technical Committee on *Cereals, pulses and derived products* (ARSO/TC 12).

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Introduction

Finger millet (*Eleusine coracana*) is one of the few special species that currently support the world's food supplies and its annual world production is at least 4.5 million tons of grain, of which Africa produces perhaps 2 million tons.

Of all major cereals, this crop is one of the most nutritious. Indeed, some varieties appear to have high levels of methionine, an amino acid lacking in the diets of hundreds of millions of the poor who live on starchy foods such as cassava and plantain. Its grain tastes better than most; Africans who know it usually prefer finger millet over all others. The plant is also productive and thrives in a variety of environments and conditions. Moreover, its seeds can be stored for years without insect damage, which makes them lifesavers for famine-prone areas.

This standard has been revised to take into account:

a) the needs of the market for the product;

b) the need to facilitate fair domestic, regional and international trade and prevent technical barriers to trade by establishing a common trading language for buyers and sellers;

c) the structure of the CODEX, UNECE, USA, ISO and other internationally significant standards;

d) the needs of the producers in gaining knowledge of market standards, conformity assessment, commercial cultivars and crop production process;

e) the need to transport the product in a manner that ensures keeping of quality until it reaches the consumer;

f) the need for the plant protection authority to certify, through a simplified form, that the product is fit for cross-border and international trade without carrying plant disease vectors;

g) the need to promote good agricultural practices that will enhance wider market access, involvement of small-scale traders and hence making farming a viable means of wealth creation; and

h) the need to ensure a reliable production base of consistent and safe crops that meet customer requirements.

—

The grain's protein content (7.4 per cent) is comparable to that of rice (7.5 per cent). However, it shows considerable variation, and at least one Indian cultivar contains as much as 14 per cent protein.

The main protein fraction (eleusinin) has high biological value, with good amounts of tryptophan, cysteine, methionine, and total aromatic amino acids (Total aromatic acids" is the combination of phenylalanine and tyrosine). All of these are crucial to human health and growth and are deficient in most cereals. For this reason alone, finger millet is an important preventative against malnutrition. The methionine level—ranging around 5 per cent of protein—is of special benefit, notably for those who depend on plant foods for their protein.

Finger millet is also a rich source of minerals. Some samples contain 0.33 percent calcium, 5-30 times more than in most cereals. The phosphorus and iron content can also be high.

This African Standard has been prepared to facilitate trade in finger millet grains as a means of achieving food security and nutrition in Africa.

Finger millet grains — Specification

1 Scope

This African Standard specifies the requirements, methods of sampling and test for finger millet grains of varieties (cultivars) grown from *Eleusine coracana* (L.) Gaertner intended for human consumption.

2 Normative references

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

ARS 53, *General principles of food hygiene — Code of practice*

ARS 56, *Prepackaged foods — Labelling*

AOAC Official Method 2001.04, *Determination of Fumonisins B_1 and B_2 in corn and corn flakes — Liquid chromatography with immunoaffinity column cleanup*

CODEX STAN 193, *Codex general standard for contaminants and toxins in food and feed*

ISO 520, *Cereals and pulses — Determination of the mass of 1000 grains*

ISO 605, *Pulses — Determination of impurities, size, foreign odours, insects, and species and variety — Test methods*

ISO 711, *Cereals and cereal products — Determination of moisture content (Basic reference method)*

ISO 712, *Cereals and cereal products — Determination of moisture content — Routine reference method*

ISO 6561-1, *Fruits, vegetables and derived products — Determination of cadmium content — Part 1: Method using graphite furnace atomic absorption spectrometry*

ISO 6561-2, *Fruits, vegetables and derived products — Determination of cadmium content — Part 2: Method using flame atomic absorption spectrometry*

ISO 6633, *Fruits, vegetables and derived products — Determination of lead content — Flameless atomic absorption spectrometric method*

ISO 9648, *Sorghum — Determination of tannin*

ISO 16050, *Foodstuffs — Determination of aflatoxin B_1, and the total content of aflatoxin B_1, B_2, G_1 and G_2 in cereals, nuts and derived products — High performance liquid chromatographic method*

ISO 21527-2, *Microbiology of food and animal feeding stuffs — Horizontal method for the enumeration of yeasts and moulds — Part 2: Colony count technique in products with water activity less than or equal to 0.95*

ISO 24333, *Cereals and cereal products — Sampling*

ISO 27085, *Animal feeding stuffs — Determination of calcium, sodium, phosphorus, magnesium, potassium, iron, zinc, copper, manganese, cobalt, molybdenum, arsenic, lead and cadmium by ICP-AES*

ISO 5498, Agricultural food products — Determination crude fibre content — General method

ISO 7251, *Microbiology of food and animal feeding stuffs — Horizontal method for the detection and enumeration of presumptive Escherichia coli — Most probable number technique*

ISO 6579 - Microbiology of food and animal feeding stuffs — Horizontal method for the detection of Salmonella spp.

3 Terms and definitions

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

3.1
finger millet grain
dried grain having the characteristics of the species *Eleusine coracana* (L.) *Gaertner*

3.2
whole grains
grains of finger millet obtained after proper threshing

3.3
foreign matter
all organic and inorganic material other than finger millet, broken kernelsand other grains. Foreign matter includes loose finger millet seed coats.

3.4
other edible grains
any edible grains (including oil seeds) other than finger millet

3.5
insect damaged grains
grains that are partially or wholly bored by insects injurious to grains but does not include germ eaten grains and egg spotted grains

3.6
immature / shrivelled grains
grains which are underdeveloped, thin and papery in appearance

3.7
food grade packages
packages which safeguard the hygienic, nutritional, technological and organoleptic qualities of the products.

3.8
poisonous, toxic and/or harmful seeds
seed which if present in quantities above permissible limit may have damaging or dangerous effect on health, organoleptic properties or technological performance such as Jimson weed — Datura (*D. fastuosa* Linn and *D. stramonium* Linn.) corn cockle (*Agrostemma githago* L., Machai *Lallium remulenum* Linn.) Akra (*Vicia species*), *Argemone mexicana*, Khesari and other seeds that are commonly recognized as harmful to health

3.9
filth
impurities of animal origin

4 Requirements

4.1 General requirements

4.1.1 Finger millet shall meet the following general requirements as determined using the relevant standards listed in Clause 2. Finger millet shall be:

a) the dried mature grains of *Eleusine coracana* (L.) *Gaertner;*

b) clean, wholesome, uniform in size, colour and in sound condition;

c) safe and suitable for human consumption;

d) practically free from foreign odours, live pests, toxic or noxious weed seeds, and other injurious contaminants as determined from samples representative of the lot.

4.2 Specific requirements

4.2.1 Grading

Finger millet grain shall comply with maximum limits given in Table 1 when tested in accordance with the test methods specified therein.

Table 1 — Specific requirements

S/NO	Characteristic		Grade			Method of test
			1	2	3	
1	Foreign matter, whole grains, % m/m, *max*.	Organic	0.25	0.50	0.75	ISO 605
2		Inorganic	0.10	0.25	0.25	
3	Other edible grains, % m/m, *max*.		1.5	2.0	4.0	
4	Filth		0.1	0.1	0.1	
5	Damaged grain, % m/m, *max.*		2.0	3.0	5.0	
6	Immature and shrivelled, % m/m, *max.*		3.0	4.0	4.0	
7	Insect damaged grains % max. by count		0.2	0.3	0.5	
9	Moisture content, % m/m, max		13.5	13.5	13.5	ISO 711/712
10	Ergot affected grains %m/m,max		0.05			Annex A
11	**1000 Kernel weight, g**					
12	Whole millet grains		5.0 to 10.0			ISO 520
16	Tannin content, % by mass, *max.*		0.5			ISO 9648
17	Crude fibre, % by dry mass basis:		3.0 to 4.5			ISO 5498
18	Total aflatoxin (AFB1+AFB2+AFG1 +AFG2)), ppb, max		10			ISO 16050
19	Aflatoxin B1 only, ppb max		5			
20	Fumonisin ppm max		2			AOAC 2001.04

5 Contaminants

5.1 Heavy metal contaminants

Finger millet grains shall comply with those maximum limits for metal contaminants specified in CODEX STAN 193

5.2 Pesticide residues

Finger millet grains shall comply with those maximum pesticide residue limits established by the Codex Alimentarius Commission for this commodity.

6 Hygiene

Finger millet shall be produced and handled under hygienic conditions in accordance with ARS 53.

7 Weights and measures

Finger millet grains shall be packaged in accordance with the weights and measures regulations of the destination country.

NOTE: Maximum package weight of 50 kg where human loading and offloading is involved'

8 Packaging

Finger millet grains shall be packed in food grade packaging material, which will safeguard the hygienic, nutritional and organoleptic qualities of the products. Each package shall be securely closed and sealed.

9 Labelling

The following specific labelling requirements shall apply and shall be legibly and indelibly marked in accordance with the requirements of ARS 56:

i) product name as "Finger Millet Grains"

ii) variety;

iii) grade;

iv) name, address and physical location of the producer/ packer/importer;

v) lot/batch/code number;

vi) net weight, metric units;

vii) the declaration "Food for Human Consumption'';

viii) storage instruction as "Store in a cool and dry place away from any contaminants'';

ix) crop year;

x) packing date;

xi) best before date

xii) instructions on disposal of used package;

xiii) country of origin;

xiv) a declaration on whether the finger millet was genetically modified or not.

10 Sampling

Sampling shall be done in accordance with the requirements of ISO 24333.

Annex A
(normative)

Determination of ergot

A.1 Test for presence of ergot in food grains

A.1.1 Reagents

(a) **Petroleum ether** — 40 – 60 °C

(b) **Solvent ether**

(c) **Dilute Ammonia** 10 % (v/ v)

(d) **Tartaric acid solution** — 1 % (freshly prepared)

(e) **p-dimethyl amino benzaldehyde (PDAB)** — Dissolve 0.125 gm of PDAB in a cold mixture of 65 ml of conc sulphuric acid and 35 ml of distilled water.

Add 0.1 ml of 5 % Ferric chloride solution and let it stand for 24 hours before use.

A.1.2 Apparatus

(a) Grinding mill

(b) Electric shaker

A.1.3 Procedure

Grind about 50 gm of sample in the grinding mill to a fine powder. Take 10 gm of powdered sample in a stoppered conical flask. Add sufficient petroleum ether and shake for half an hour in the electric shaker. Allow to settle and decant off the petroleum ether. Dry the material in air. Add to the material 8 ml of dilute ammonia and sufficient quantity of solvent ether. Again shake for ½ hour. Filter ether portion in a beaker and concentrate to a small volume. Add 2 ml of tartaric acid solution to the beaker and shake thoroughly. Mix 1 ml of this tartaric acid – sample solution with 1 or 2 ml of p-dimethyl benzaldehyde solution.

The appearance of blue colour indicates presence of ergot.

A.2 Determination of quantity of ergot (*Claviceps purpurea* Tul.)

A.2.1 Objective and field of application

The method is used for both qualitative and quantitative determination of ergot in food and feed. The method is suitable for the examination of food and feed of different particle sizes. In pelleted feedingstuff only qualitative determination is possible.

A.2.2 Principle

Ergot in food and feed is determined by the macroscopic and microscopic identification of the ergot sclerotia and fragments. Quantification is done by weighing the amount of identified sclerotia and fragments with a particle size >0.5 mm.

A.2.3 Reagents

A.2.3.1 Chloral hydrate, β = 60%

A.2.3.2 Sodium hydroxide (pelleted)

A.2.3.3 Potassium hydroxide (pelleted)

A.2.3.4 Ethanol, σ = 50%

A.2.3.5 Acetone

The reagents listed can be replaced by others which produce comparable results.

A.2.4 Equipment and accessories

A.2.4.1 Optical equipment

A.2.4.1.1 Stereo microscope (up to 70x magnification)

A.2.4.1.2 Magnifier (up to 10x magnification)

A.2.4.2 Mortar and pestle

A.2.4.3 Sieves fitted with wire nettings or perforations with different mesh sizes (e.g. 2.0 mm, 1.0 mm, 0.5 mm, 0.25 mm) and collecting tray; recommended additional equipment: sieve towers, sieve shaker

A.2.4.4 Analytical balance (accuracy 0.001 g)

A.2.4.5 Oven (up to 130 °C)

A.2.4.6 Laboratory glassware

A.2.4.7 Filters (e.g. paper, gaze)

A.2.4.8 Freeze dryer

A.2.4.9 Hot plate or Bunsen burner

A.2.4.10 Reference material

A.2.5 Procedure

The examination is performed in non-pelleted food and feed. Pelleted food and feed have to be depelleted before examination (A.2.4.2; A.2.8.1).

Qualitative determination of the sclerotia is performed macroscopically and microscopically considering ergot and its fragments in both the sieve fraction >0.5mm and < 0.5mm.

Quantification is performed by selecting and weighing of ergot and its fragments with a particle size >0.5mm out of the laboratory sample or an aliquot of it.

A.2.5.1 Preparation of the laboratory sample

A.2.5.1.1 Whole kernel feedingstuff (at least 250g) are weighed (A.2.4.4) and used directly for the investigation (A.2.5.2 and A.2.5.3).

A.2.5.1.2 Non-pelleted feedingstuff (at least 10g) are weighed (A.2.4.4) and fractionated bysieving. The obtained fractions > 0.5mm and ≤ 0.5mm are weighed (A.2.4.4).

A.2.5.2 Identification of ergot

Ergot sclerotia are identified based on their characteristic features. The identification may be facilitated by comparison to reference material (A.2.4.10) and existing descriptions.

Morphology: *Ergot sclerotia* Tul. are elongated with a length up to several centimetres, coloured dark violet to black. The shape is similar to cereal kernels. They only consist of fungal hyphae.

Anatomy: Cross sections through the random parts of ergot sclerotia show very small, narrow interconnected hyphae which yield a dense pseudoparenchymatic tissue. The cells contain lots of fat oil. The outer layers of the hyphae are coloured dark violet to black, whereas the inner parts are coloured light pink to violet.

For the identification of ergot fragments in the sieve fractions <0.5mm the following colour reaction can be used. This staining procedure is only applicable to fresh sclerotia material.

A filter paper is soaked with a solution of 3ml ethanol (A.2.3.4) and 2 sodium hydroxide pellets (A.2.3.2) or 2 potassium hydroxide pellets (A.2.3.3). The sample is distributed on the filter paper.

After app. 5 min. a red-violet halo around the ergot fragments is observed.

The dark violet colouring of the outer hyphae layers is dissolved also in chloralhydrate (A.2.3.1) and colours it violet.

A.2.5.3 Quantification

The quantification of ergot is performed using the sieve fractions > 0.5 mm.

Material identified as ergot in each fraction is selected and weighed. An aliquot of the sieved fractions may be used if necessary. The ergot content of the fractions >0.5mm is summarized and expressed in mg/kg feedingstuff (A.2.6.1).

A.2.6 Calculation and report

A.2.6.1 Calculation

The amount of ergot fragments in mg/kg (ppm) feeding stuff (original sample) is calculated using the following formula:

$$C = \frac{BC \times 1000}{E} \text{ [mg/kg]}$$

C = amount of component in mg/kg feeding stuff (ppm)

BC = selected fragments of component in the laboratory sample or an aliquot of it [mg]

E = total weight of the laboratory sample or an examined aliquot of the laboratory sample [g]

A.2.6.2 Report

A.2.6.2.1 Negative result:

As far as was discernible using a microscope, ergot was not found in the submitted sample.

A.2.6.2.2 Positive result:

As far as was discernible using a microscope xx mg ergot/kg feedingstuff were found in the submitted sample. For quantification ergot particles >0.5 mm are considered.

A.2.6.2.3 Possible adding to the report:

In pelleted feedingstuff only qualitative determination of ergot is possible.

A.2.8 Remarks

A.2.8.1 For the identification of ergot in pelleted feedingstuffs, the sample is depleted using either of the following procedures:

(a) At least 10 g of the pressed material is mixed with at least three times as much water. The suspension is stirred up several times and left standing until the pellets disintegrate. Then the depelletised material is filtered (A.2.4.7) and dried at room temperature or freeze-dried (A.2.4.8).

(b) For depelletising at high humidity pressed material (at least 10 g) is left standing in humid atmosphere at 70 °C (A.2.4.5) until the pellets disintegrate. The material is crushed, sieved (A.2.4.3) and dried at room temperature immediately to prevent the particles from sticking together again.

A.2.8.2 Ergot are the permanent forms or sclerotia of ergot which mainly occur in rye, more seldom in wheat, triticale and barley.

A.2.8.3 This method also is suitable for the examination of raw material and food.

Bibliography

EAS 758:2012, *Finger millet grains — Specification*