AFRICAN STANDARD

DARS 463

Third Edition 2022

Pearl millet grains — Specification

Reference No. ARS 463:2022(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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Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ARSO shall not be held responsible for identifying any or all such patent rights.

This African Standard was prepared by the ARSO Technical Committee on Cereals, pulses and derived products ARSO TC 12

This African Standard is a technical revision of the earlier ARS 463:2016 (E), *Standard for pearl millet grains* which is hereby superseded and cancelled.

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Introduction

Of all the world's cereals, pearl millet (*Pennisetum glaucum*) is the sixth most important. It is a staple food in many African countries as well as India. Today, pearl millet is planted on some 14 million hectares in Africa and 14 million hectares in Asia. Global production of its grain probably exceeds 10 million tons a year, to which India contributes nearly half. At least 500 million people depend on pearl millet for their lives.

Pearl millet is supremely adapted to heat and aridity and, for all its current decline, seems likely to spring back as the world gets hotter and drier. Perhaps the best of all "life-support" grains, pearl millet thrives where habitats are harsh. Of all the major cereals, it is the one most able to tolerate extremes of heat and drought. It yields reliably in regions too hot and too dry to consistently support good yields of maize (or even sorghum). These happen to be the regions most desperately in need of help.

Pearl millet is easy to grow. It suffers less from diseases than sorghum, maize, or other grains. Also, it has fewer insect pests.

The widespread impression that pearl millet grain is essentially an animal feed, unpalatable to all but the desperately hungry, is wrong. The grain is actually a superior foodstuff, containing at least 9 percent protein and a good balance of amino acids. It has more oil than maize and is a "high-energy" cereal. It has neither the tannins nor the other compounds that reduce digestibility in sorghum.

Pearl millet is also a versatile foodstuff. It is used mainly as a whole, cracked, or ground flour; a dough; or a grain like rice. These are made into unfermented breads (*roti*), fermented foods (*kisra* and *gallettes*), thin and thick porridges (*toh*), steam-cooked dishes (*couscous*); non-alcoholic beverages, and snacks.

Grain from certain cultivars is roasted whole and consumed directly. The staple food of the mountainous regions in Niger is millet flour mixed with dried dates and dried goat cheese. This nutritious mixture is taken on long journeys across the Sahara and eaten mixed with water—no cooking required. 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.

Pearl millet grains — Specification

1 Scope

This African Standard specifies the requirements, methods of sampling and test for whole and decorticated pearl millet of the of the species Pennisetum glaucum (L.) R.Br. intended for food consumption. This standard also specifies grading requirements for pearl millet grains. It does not apply to processed pearl millet.

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 5984, Animal feeding stuffs -- Determination of crude ash

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 6579-1, Microbiology of the food chain — Horizontal method for the detection, enumeration and serotyping of Salmonella — Part 1: Detection of Salmonella spp.

3 Terms and Definitions

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

3.1
pearl millet grain
whole or decorticated grain of the species *Pennisetum glaucum* (L.) R.Br.

3.2
whole grains
grains of pearl millet obtained after proper threshing

3.3
decorticated grains
grains of pearl millet from which the outer parts have been removed in an appropriate manner using suitable technology method.

3.4
foreign matter
all organic and inorganic material (such as plant parts, sand, soil, glass) other than pearl millet grains

3.5
other edible grains
edible grains (including oil seeds) other than the one which is under consideration

3.6
insect or pest damaged grains
kernels with obvious weevil-bored holes or which have evidence of boring or tunnelling, indicating the presence of insects, insect webbing or insect refuse, or degermed grains, chewed in one or more than one part of the kernel which exhibit evident traces of an attack by rodents, birds, mites, etc.

3.7
immature and shrivelled grains
grains that are not properly developed

3.8
weevilled grains
grains that are partially or wholly bored by insects injurious to grains but does not include germ eaten grains and egg spotted grains

3.9
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

3.10

extraneous matter
foreign matter/extraneous matter
all organic and inorganic material other than pearl millet

3.11
food grade packaging materials
packaging material, made of substances which are safe and suitable for their intended use and which will not impart any toxic substance or undesirable odour or flavour to the product

4 Requirements

4.1 General requirements

Pearl millet shall meet the following general requirements:

a) the dried mature grains of *Pennisetum (glaucum) americanum* Linn;

b) clean, wholesome, uniform in size and colour.

c) Pearl Millet grain shall be practically free from foreign odours, live pests, toxic or noxious seeds, and other injurious contaminants as determined from samples representative of the lot.

d) free from abnormal flavours, obnoxious smell and discolouration.

e) free from poisonous, toxic and/or harmful seeds in amounts that may constitute a hazard to human health.

4.2 Specific requirements

Pearl 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 for pearl millet grains

S/NO	Characteristic		Grade			Method of test
			1	2	3	
1	Foreign matter, whole grains, % m/m, *max*.	Organic	0.35	0.75	1	ISO 605
2	Foreign matter, decorticated, % m/m, *max*.		0.5	0.5	0.5	
3	Filth, *% m/m, max*		0.1	0.1	0.1	
4	Other edible grains, % m/m, *max*.		2.0	2.5	3.0	
5	Damaged grain, % m/m, *max.*		1.0	2.0	4.0	
6	Immature and shrivelled, % m/m, *max.*		3.0	5.0	8.0	
7	Weevilled grains % by count, max		2.5	4.0	6.0	
8	Moisture content, % m/m, max		13.5	13.5	13.5	ISO 711/712
9	Ergot affected grains %m/m, max		0.05			Annex A
10	Total ash (decorticated) % by dry mass, max		1.0			ISO 5984
11	Tannin content, % by mass, *max.*		0.5			ISO 9648
12	1000 Kernel weight, g **a.** Whole millet grains		5.0 to 10.0			ISO 520
	b. Decorticated millet grains		4.0 to 8.0			ISO 520

13	Decortication %m/m max	20	Undefined
14	Total Aflatoxin (AFB_1+AFB_2+AFG_1 +AFG_2)), ppb max	10	ISO 16050
15	Aflatoxin B_1 only, ppb max	5	
16	Fumonisin, ppm max	2	AOAC Official Method 2001.04

5 Contaminants

5.1 Heavy metals

Pearl millet grains shall comply with those maximum limits for metal contaminants specified in CODEX STAN 193 and in particular those listed in Table 2.

Table 2 — Heavy Metal contaminants for Pearl millet grains

S/N	Parameter	Limit (ppm max)	Test method
(1)	Lead (Pb)	0.1	ISO 6633
(2)	Cadmium (Cd)	0.02	ISO 6561-1 or ISO 6561-2

5.2 Pesticide residues

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

6 Hygiene

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

7 Weights and measures

Pearl 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

8.1 Pearl millet grains shall be packed in food grade packaging materials which shall be clean, sound, free from insect and fungal infestation, and the packing material shall be securely closed and sealed.

8.3 Each package shall contain pearl millet grains of the same type and of the same grade designation.

8.4 If pearl millet grains are presented in bags, the bags shall also be free of pests and contaminants.

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 “Whole Pearl Millet Grains” or “Decorticated Pearl 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 unit;

vii) the declaration “Food for Human Consumption’’;

viii) storage instruction as “Store in a cool dry place away from any contaminants’’;

ix) crop year;

x) best before date’

xi) instructions on disposal of used package;

xii) country of origin;

xiii) a declaration on whether the pearl millet was genetically engineered or not

10 Sampling

Sampling shall be done in accordance with the 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 feedstuff (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 feedstuff (at least 10g) are weighed (A.2.4.4) and fractionated by sieving. 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 feedstuff (A.2.6.1).

A.2.6 Calculation and report

A.2.6.1 Calculation

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

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

C = amount of component in mg/kg feedstuff (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 feedstuff 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 feedstuff only qualitative determination of ergot is possible.

A.2.8 Remarks

A.2.8.1 For the identification of ergot in pelleted feedstuffs, 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 284:2012, *Pearl millet grains — Specification*

CODEX STAN 169:1987 (Rev.1:1995), *Whole and decorticated pearl millet grains*

CODEX STAN 228:2001 (Rev.1:2004), *General methods of analysis for contaminants*