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Rice — Determination of rice kernel resistance to extrusion after cooking

Riz — Détermination de la résistance à l'extrusion des grains de riz après cuisson

Reference number
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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 11747 was prepared by Technical Committee ISO/TC 34, *Food products*, Subcommittee SC 4, *Cereals and pulses*.

Rice — Determination of rice kernel resistance to extrusion after cooking

1 Scope

This International Standard specifies a method for the determination of resistance to extrusion of milled rice kernels, parboiled or not parboiled, after cooking under specified conditions.

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.

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

ISO 7301, *Rice — Specification*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 7301 and the following apply.

3.1
cooked rice
rice brought into contact with hot liquids with the intention of making it suitable for consumption

3.2
resistance to extrusion
ease of pushing cooked rice through a perforated plate using compression and shear

NOTE An example of suitable perforated plate is the Ottawa cell.[1)]

4 Principle

Measurement of the force required to extrude cooked rice through a perforated plate.

5 Apparatus

Usual laboratory apparatus and, in particular, the following.

5.1 Beakers, borosilicate glass, capacity of 100 ml.

5.2 Cooking container, with a non-hermetic lid and a perforated plate on which the beakers (5.1) are placed. The level of water in the cooking container shall be such that it does not rise above the perforated plate during boiling, ensuring that cooking occurs exclusively by steam.

5.3 Sample divider,[2)] **conical sampler** or **multiple-slot sampler** with a distribution system, or other equivalent equipment.

1) The Ottawa cell is an example of a suitable product available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product.

2) Some sample dividers are described in ISO 24333.[2]

5.4 Heat source, suitable to allow water in the cooking container (5.2) to boil in a vigorous and steady way.

5.5 Balance, capable of being read to the nearest 0,1 g.

5.6 Glass rod.

5.7 Watch-glasses, 6 cm in diameter.

5.8 Dynamometer, able to work under compression, at a constant speed of 10 cm/min, equipped with the devices specified in 5.8.1 and 5.8.2.

5.8.1 Loading cell, with a loading capacity of at least 50 kg.

5.8.2 Extrusion cell, see Figures A.1 and A.2, consisting of the components specified in 5.8.2.1 to 5.8.2.3.

5.8.2.1 Parallelepiped, with the following characteristics:

a) integral with the dynamometer;

b) about 20 cm high;

c) with a hole of area 7,5 cm^2 in the centre;

d) with a basis area adequate to house the hole mentioned in c) and a removable plate intersecting the parallelepiped at about one-third of its height.

5.8.2.2 Perforated plate, 3 mm thick, with holes of 6,0 mm in diameter and a wheelbase of 7,0 mm (centre to centre), suitable for insertion into the parallelepiped (5.8.2.1).

5.8.2.3 Piston, with the following characteristics:

a) suitable for the loading cell (5.8.1);

b) 20 cm high;

c) with a section base having a minimum tolerance (about 0,5 mm) that allows it to run freely within the parallelepiped hole (5.8.2.1).

5.9 Timer.

5.10 Spatula.

5.11 Plastic bags, or other vessels able to contain 17 g of cooked rice while preventing its dehydration.

5.12 Data entry system, with a sample rate of at least 5/s.

6 Reagents

6.1 Deionized water, or **distilled water**.

7 Sampling

Sampling is not part of the method specified in this International Standard. A recommended sampling method is given in ISO 24333.[2]

It is important the laboratory receive a truly representative sample which has not been damaged or changed during transport or storage.

8 Procedure

8.1 Preparation of the test sample

8.1.1 Carefully mix the laboratory sample to make it as uniform as possible.

8.1.2 Determine the laboratory sample moisture content according to ISO 712. The acceptability range is a mass fraction of (13,0 ± 1,0) %.

8.1.3 If the moisture content differs, condition the laboratory sample at room temperature until moisture lies within the acceptability range (8.1.2).

8.1.4 Proceed to reduce the laboratory sample, if necessary, using a sample divider (5.3) to a quantity of about 50 g to obtain the test sample.

8.2 Determination

8.2.1 Heating

Adjust the heat source (5.4) so that the water vigourously and steadily boils in the cooking container (5.2).

8.2.2 Sample preparation for cooking

Prepare two beakers (5.1) for each test, put in each one 20 g of milled rice taken from the test sample (8.1.4) and weighed with the balance (5.5) to the nearest 0,1 g, add 38 ml of deionized water (6.1). Carefully stir with the glass rod (5.6) and cover the beakers with watch-glasses (5.7).

8.2.3 Cooking

Place the two beakers prepared according to 8.2.2 on the perforated plate in the cooking container (5.2) and replace the lid immediately. Start the timer (5.9). Remove the heat source after 20 min and allow to stand for 10 min. Remove the beakers from the cooking container and place them upside down on the watch-glasses in a room at an ambient temperature of 20 °C to 25 °C . Allow to cool to room temperature for at least 1 h.

8.2.4 Dynamometer adjustment

Adjust the dynamometer (5.8) and the data entry system (5.12) according to the manufacturer's instructions, checking the response of the loading cell (values between 0 kg and 15 kg) and the speed of the movement (10 cm/min).

8.2.5 Dynamometer measurements

Remove the cylinder of cooked rice from one of the beakers, split it longitudinally with a spatula (5.10) to obtain three portions of about 17 g each and store them in plastic bags (5.11) to prevent dehydration until the time of measurement.

Place a portion in the parallelepiped hole (5.8.2.1), allow the piston (5.8.2.3) to descend, and continuously record (5.12) the force applied during the extrusion of the mass of cooked rice.

Calculate the mean force applied during the step corresponding to the plateau of the extrusion plot.

Proceed in the same way with the other portions.

Remove the rice from the second beaker and proceed as with the first.

Between measurements on portions from the same test sample, it is not necessary to wash the extrusion cell, perforated plate and piston. Washing (with tap water and brush only) is necessary when passing from one sample to another. It is suggested that any excess water on the extrusion cell, perforated plate and piston after washing be wiped away with a damp cloth.

9 Calculation and expression of results

9.1 Calculation

Calculate the arithmetic mean of the six measurements done on the test sample and divide it by the area of the parallelepiped hole (7,5 cm^2).

9.2 Expression of results

Report the mean value in kg/cm^2, to two decimal places.

10 Precision

10.1 Interlaboratory test

Details of an interlaboratory test on the precision of the method is summarized in Annex B. It is possible that the values derived from this interlaboratory test are not applicable to other types of rice and mixtures of other varieties.

10.2 Repeatability

The absolute difference between two independent single test results, obtained using the same method on identical test material in the same laboratory by the same operator using the same equipment within a short interval of time, will in not more than 5 % of cases be greater than the repeatability limit, r, of

— 0,056 kg/cm^2 for non-parboiled milled rice;

— 0,082 kg/cm^2 for parboiled milled rice.

10.3 Reproducibility

The absolute difference between two single test results, obtained using the same method on identical test material in different laboratories with different operators using different equipment, will in not more than 5 % of cases be greater than the reproducibility limit, R, of

— 0,107 kg/cm^2 for non-parboiled milled rice;

— 0,219 kg/cm^2 for parboiled milled rice.

11 Test report

The test report shall contain at least the following information:

a) all information necessary for the complete identification of the sample;

b) the sampling method used, if known;

c) the test method used, with reference to this International Standard (ISO 11747:2012);

d) all operating details not specified in this International Standard, or regarded as optional, together with details of any incidents which may have influenced the test result(s);

e) the test result(s) obtained;

f) if the repeatability has been checked, the final quoted result obtained.

Annex A
(informative)

Example of rice extrusion for the determination of resistance to extrusion

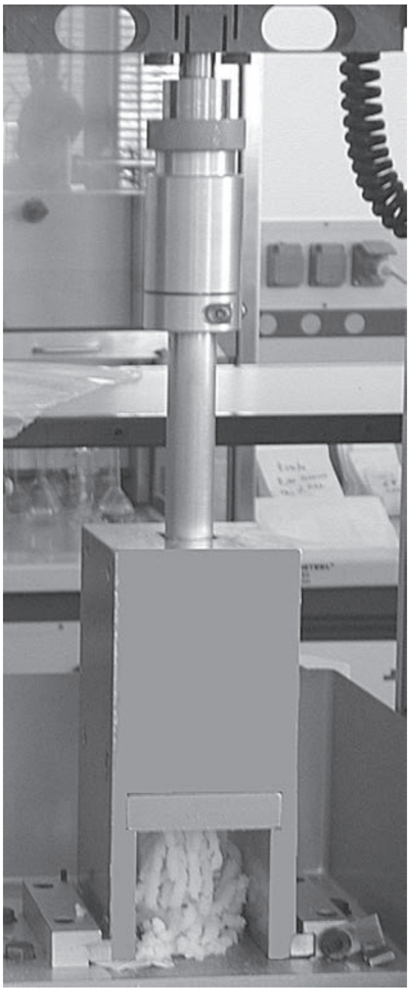
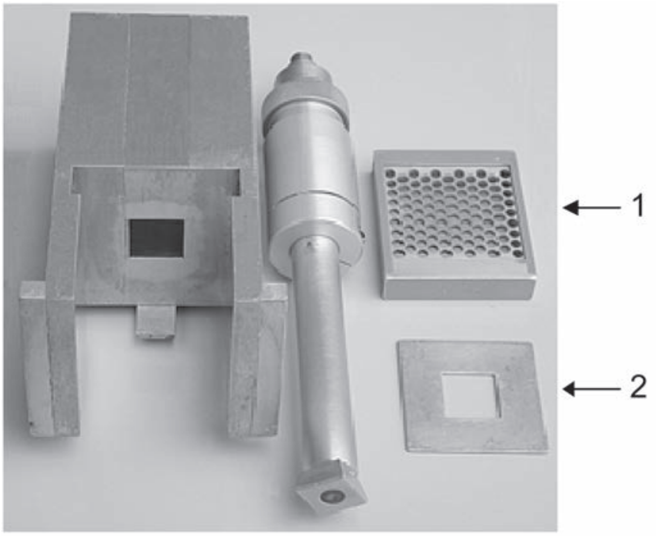


Figure A.1 — Extrusion cell



Key

1 section

2 reductor (7,5 cm^2) for perforated plate

Figure A.2 — Extrusion cell fittings

Annex B
(informative)

Results of interlaboratory test

An interlaboratory test was organized in 2010 by UNI involving nine laboratories. Samples of milled rice of round grain (sample 1), long grain (sample 2), and parboiled long grain (sample 3) were tested. The results obtained were subjected to statistical analysis in accordance with ISO 5725-2[1] to give the precision data shown in Table B.1 and Table B.2.

Table B.1 — Cooked rice hardness

Values in kilograms per centimetre squared

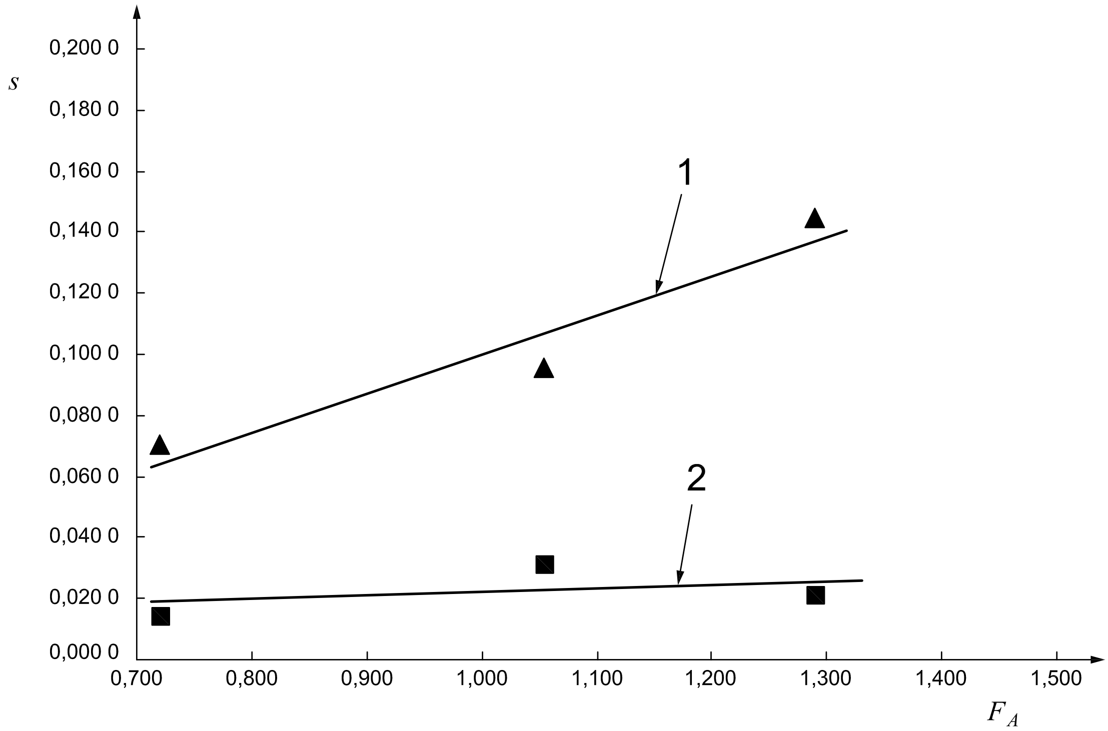
Laboratory	Sample								
	1			2			3		
A	0,71	0,73	0,74	1,07	1,06	1,07	1,14	1,21	1,19
B	0,74	0,77	0,78	1,13	1,17	1,17	1,24	1,24	1,26
C	0,70	0,70	0,67	1,04	1,06	1,02	1,54	1,54	1,55
D	0,64	0,61	0,62	0,92	0,93	0,95	1,30	1,33	1,28
E	0,79	0,80	0,81	1,05[a]	1,05[a]	1,17[a]	1,42	1,44	1,45
F	0,62[b]	0,69[b]	0,73[b]	0,97	0,90	0,96	1,44[b]	1,52[b]	1,59[b]
G	0,76	0,77	0,76	1,15	1,12	1,17	1,24	1,21	1,27
Q	0,76	0,78	0,79	1,13	1,19	1,15	1,28	1,30	1,28
R	0,62	0,63	0,61	0,98	0,94	0,95	1,07	1,08	1,10

a Cochran's test straggler.

b Cochran's test outliers.

Table B.2 — Cooked rice hardness, repeatability and reproducibility

Parameter	Sample		
	1	2	3
Laboratories retained after eliminating outliers, n	8	9	8
Mean value, kg/cm^2	0,72	1,05	1,29
Standard deviation of repeatability, s_r, kg/cm^2	0,014	0,032	0,021
Coefficient of variation of repeatability, $C_{V,r}$,%	2,0	3,0	1,6
Repeatability limit, r ($r = 2{,}83 s_r$), kg/cm^2	0,041	0,090	0,145
Standard deviation of reproducibility, s_R, kg/cm^2	0,070	0,095	0,151
Coefficient of variation of reproducibility, $C_{V,R}$, %	9,8	9,1	11,2
Reproducibility limit, R ($R = 2{,}83 s_R$), kg/cm^2	0,199	0,270	0,410
Each laboratory carried out three determinations per sample.			



Key

s standard deviation

F_A resistance to extrusion, in kilograms per centimetre squared

1 standard deviation of reproducibility for samples 1, 2, and 3, $s_R = 0{,}026\ 36 + 0{,}127\ 19\ \overline{F}_A$

2 standard deviation of repeatability for samples 1, 2, and 3, $s_r = -0{,}007\ 58 + 0{,}014\ 56\ \overline{F}_A$

Figure B.1 — Relationship between the precision values (s_r, s_R) and mean rice resistance to extrusion

Bibliography

[1] ISO 5725-2:1994, *Accuracy (trueness and precision) of measurement methods and results — Part 2: Basic method for the determination of repeatability and reproducibility of a standard measurement method*

[2] ISO 24333, *Cereals and cereal products — Sampling*

[3] Council Regulation (EC) No 1785/2003 of 29 September 2003 on the common organisation of the market in rice. *Off. J. Eur. Union* 2003-10-21, **L270**, pp. 96–113

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