Foreword

The formulation of this national standard was initiated by the Agricultural Machinery Testing and Evaluation Center (AMTEC) through the project "Multicrop Processing Machines for `Commercialization" funded by the Department of Science and Technology (DOST) through its Technology Innovation for Commercialization (TECHNICOM) Program and monitored by the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD).

This standard has been technically prepared in accordance with BPS Directives Part 3:2003 – Rules for the Structure and Drafting of International Standards.

The word "shall" is used to indicate mandatory requirements to conform to the standard.

The word "should" is used to indicate that among several possibilities one is recommended as particularly suitable without mentioning or excluding others.

In the preparation of this standard, the following documents/publications were considered:

ASAE Standard: ASAE S319.1 Method of Determining and Expressing Fineness of Feed Materials By Sieving

Bates, R.P., J. R. Morris and P. G. Gandall. Principles and practices of small-and medium scale fruit juice processing. www.fao.org/docrep/005/Y2515E/y1515e00.htm

Bautista, O.K. and H.B. Aycardo. Ginger: Its Production, Handling, Processing and Marketing with Emphasis on Export. Department of Horticulture, College of Agriculture, University of the Philippines Los Baños. 1979.

CIGR Handbook of Agricultural Engineering- Volume IV- Agro-Processing Engineering. Published by American Society of Agricultural Engineers.

Henderson, S. M. and R. L. Perry. Agricultural Process Engineering. Third Edition. The AVI Publishing Company, Inc., Westport, Connecticut. 1976

Malinis, Arnulfo P., et. al. Development of the Integrated Multicrop Processing System (Zero Waste Ginger Processing Technology). 2004.

Recommended Code of Practice for Handling and Processing Muscovado Products

CONTENTS **Page**

ANNEXES

1 Scope

This standard specifies the methods of test and inspection for crystallizer used for the production of ginger tea (instant "salabat"). Specifically, it shall be used to:

1.1 verify the mechanism, dimensions, materials, accessories of the crystallizer and the list of specifications submitted by the manufacturer;

1.2 determine the performance of the machine;

1.3 evaluate the ease of handling and safety features;

1.4 analyze the products of cooking through laboratory analysis; and

1.5 report the results of the tests.

2 References

The following normative documents contain provisions, which through reference in this text constitute provisions of these standards:

ASTM E11 – Specifications for Wire-Cloth Sieves for Testing Purposes

PAES 103:2000 Agricultural Machinery – Method of Sampling

PAES 236:2008 Agricultural Machinery – Crystallizer - Specifications

3 Definitions

For the purpose of this standard, the definitions given in PAES 236 and the following shall apply:

3.1
biomass fuel
type of fuel from living organisms such as plants, animals and their by-products

3.2
cooking losses
total percent of ginger tea (instant "salabat") loss based on the recovered product

3.3
cooking rate
quantity of juice that the crystallizer can cook per unit of time, expressed in kilogram per hour

3.4
cooking recovery
ratio between the total weight of recovered ginger tea (instant “salabat”) and the weight of sugar added to the input juice, expressed in percentage

3.5
fineness modulus
principal factor which indicates the uniformity of ginger tea (instant “salabat”)

3.6
ginger tea quality
refers to the physical and chemical properties of the product, instant “salabat”

3.7
holding capacity
weight of input juice per batch, expressed in kilogram

3.8
liquefied petroleum gas (lpg)
type of fuel used in cooking ginger juice

3.9
operating time
length of time measured from the time the burner is turned on until it is turned off

3.10
prime mover
electric motor or internal combustion engine used to drive the crystallizer

4 General Conditions for Test and Inspection

4.1 Selection of Crystallizer to be tested
Machine submitted for test shall be sampled in accordance with PAES 103.

4.2 Role of manufacturer/dealer
The manufacturer shall submit specifications and other relevant information about the crystallizer and shall abide with the terms and conditions set forth by an official testing agency.

4.3 Role of the operator
An officially designated operator shall be skilled and shall demonstrate, operate, adjust, repair as the case maybe, related to the operation of the machine.

4.4 Test site conditions
The site should have ample provisions for material handling, temporary storage, work space and normal working conditions.

4.5 Termination of Test
If during testing, the machine stops due to major component breakdown or malfunctions, the test engineer from the official testing agency shall terminate the test.

5 Test Preparation

5.1 Test instruments

The instruments to be used shall have been calibrated and checked by the testing agency prior to the measurements. The suggested list of minimum field and laboratory test equipment and materials needed to carry out the crystallizer test is shown in Annex A.

5.2 Test material

Test materials to be used shall be extracted juice from a single variety of locally grown ginger. The amount of test material that will be used in performing the test shall be twice the specified holding capacity of the machine.

5.3 Sample Preparation

Prepare the test material in such a way that the test sample for each trial shall have identical characteristics in terms of variety and condition. Care should be taken so as to prevent alterations of the conditions of the test materials.

6 Pre-test Observation

6.1 Verification of the manufacturer's technical data and information

This inspection is carried out to verify the mechanism, dimensions, materials and accessories of the crystallizer in comparison with the list of manufacturer's technical data and information.

6.2 A plain and level surface shall be used as reference plane for verification of crystallizer dimensional specifications.

6.3 The items to be inspected and verified shall be recorded in Annex B.

7 Performance test

This is carried out to determine overall machine performance.

7.1 Operation of the crystallizer

The crystallizer shall be operated at the recommended settings of the manufacturer. After each test trial, the cooking area shall be cleaned and then prepared for the next test trial.

7.2 Test Trial

A minimum of two (2) test trials shall be adopted. Each test trial shall be one complete cooking operation.

7.3 Duration of Test

The duration of each test trial shall start from loading to unloading of test materials.

7.4 Sampling

7.4.1 Sampling procedure for instant "salabat"

After cooking, randomly take 250 grams of sample in each test trial to be analyzed in the laboratory.

7.4.2 Handling of Samples
All samples shall be placed in appropriate containers, properly labeled and sealed.

7.5 Data Collection

7.5.1 Test material
Weigh and record the initial weight of juice and the total weight of ginger tea (instant "salabat") produced.

7.5.2 Noise level
The noise emitted by the machine shall be measured using a noise level meter at the location of the operator. The noise level shall be measured approximately 50 mm away from the ear level of the operator.

7.5.3 Speed of Components
The speed of the rotating shafts of the major components of the crystallizer shall be taken using tachometer.

NOTE Measurements shall be taken with and without load for sub-clauses 7.5.2 and 7.5.3 as specified in Annex C. Measurements with load shall be randomly taken during the duration of each test trial.

7.5.4 Fuel/Power Consumption
Before the start of each trial, the fuel tank shall be filled to its capacity for internal combustion engines used as power source. After each test trial the tank shall be refilled using graduated cylinder. The amount of refueling is the fuel consumption for the test. When filling up the tank, keep the tank horizontal so as not to leave empty space in the tank.

In case an electric motor is used as the prime mover, a power meter shall be used to measure electric energy consumption. Measurement shall be randomly taken during the duration of each test trial.

7.5.5 Burner Consumption

7.5.5.1 For LPG
During each test trial, the initial and final weight of the LPG tank shall be taken and recorded.

7.5.5.2 For Biomass
During each test trial, the total amount of biomass fuel material to be used shall be measured and recorded.

7.5.6 Sugar Consumption
During each test trial, the amount of sugar to be used shall be measured and recorded.

7.6 Data recording and observations
Record sheet for all data and information during the test is given in Annex C.

8 Laboratory Analysis
Laboratory analysis shall be used to determine the quality of the ginger tea (instant "salabat"). The laboratory test data sheet to be used is given in Annex D.

8.1 Analysis of Ginger Tea (Instant "Salabat")
This shall be taken using Testing Sieve Shaker. A set of sieves as specified in ASTM E11-Specifications for Wire-Cloth Sieves for Testing Purposes shall be used.

8.1.1 For each test trial, place the samples in a testing sieve shaker with a series of sieves screen.

8.1.2 Shake the samples for at least 5 minutes.

8.1.3 After shaking, remove the samples from each sieve screen. Weigh and record each weight.

8.1.4 Calculate the percent of ginger tea (instant "salabat") retained on each sieve screen.

8.1.5 Calculate the cooking recovery using the equation given in Annex E.

9 Formula
The formulas to be used during calculations and testing are given in Annex E.

10 Test Report
The test report shall include the following information in the order given:

10.1 Title

10.2 Summary

10.3 Purpose and Scope of Test

10.4 Methods of Test

10.5 Description of the Machine

Table 1 – Machine Specifications

10.6 Results and Discussions

10.7 Observations (include pictures)
Table 2 –Performance test data

10.8 Name/s, signature/s and designation of test engineers

Annex A
(informative)

Minimum List of Field and Laboratory Test Equipment and Materials

A.1	**Equipment**	
		Quantity
A.1.1	**Field**	
A.1.1.1	Tachometer (contact type or photo electric type) Range: 0 rpm to 5,000 rpm	1
A.1.1.2	Digital timers (range: 60 minutes) Accuracy: 0.1 sec	2
A.1.1.3	Tape measure (with maximum length of 5m)	1
A.1.1.4	Noise level meter Range: 30 dB (A) to 130 dB (A)	1
A.1.1.5	Portable digital scale (capacity: 100 kg) Scale divisions: 100 g or Weighing scale (capacity: 100 kg) Scale divisions: 100 g	1
A.1.1.6	Graduated cylinder (for engines) (500 mL capacity) or power meter (for electric motors) 60 Hz, 220 V	1
A.1.1.8	Vernier Caliper Accuracy: 0.1mm	1
A.1.1.7	Camera	1
A.2	**Laboratory**	
A.2.1	Sieve Shaker	1
A.2.2	Sieves screen ASTM E-11 #12, # 16, #20, #30, #40, #50, Pan	
A.2.3	Electronic balance Sensitivity: 0.1 g	1
A.3	**Materials**	
A.3.1	Sample bags	
A.3.2	Labeling tags which include	
A.3.2.1	Date of test	
A.3.2.2	Crystallizer on test	
A.3.2.3	Sample source	
A.3.2.4	Variety	
A.3.2.5	Trial number	

Annex B
(informative)

Specifications of Crystallizer

Name of Applicant/ Distributor: _____
Address: _____
Tel No: _____
Name of Manufacturer: _____
Address: _____
Tel No: _____

GENERAL INFORMATION

Make: _____ Type: _____
Serial No: _____ Brand/Model: _____
Production date of Crystallizer to be tested: _____
Testing Agency: _____ Test Engineer: _____
Date of Test: _____ Location of Test: _____

Items to be inspected

ITEMS	Manufacturer's Specification	Verification by the Testing agency
B.1 Main structure		
B.1.1 Overall dimensions, mm		
B.1.1.1 length		
B.1.1.2 width		
B.1.1.3 height		
B.1.2 Weight, without prime mover (kg), if applicable		
B.2 Cooking Basin		
B.2.1 Material		
B.2.2 Thickness, mm		
B.2.3 Height from the ground, mm		
B.2.4 Location		
B.3 Power Transmission		
B.3.1 Pulley		
B.3.1.1 Type		
B.3.1.2 Diameter, mm		
B.3.2 Speed Reducer Input Shaft Pulley		
B.3.2.1 Type		
B.3.2.2 Diameter, mm		
B.3.2.3 Speed Ratio		
B.3.3 Speed Reducer Output Shaft Pulley		
B.3.3.1 Type		
B.3.3.2 Diameter, mm		
B.3.3.3 Speed ratio		
B.4 Stirrer Assembly		
B.4.1 Shaft		
B.4.1.1 Length, mm		

ITEMS	Manufacturer's Specification	Verification by the Testing agency
B.4.1.2 Outer diameter, mm		
B.4.1.3 Material		
B.4.2 Paddle		
B.4.2.1 Material		
B.4.2.2 Thickness, mm		
B.5 Main Frame		
B.5.1 Material		
B.5.2 Thickness, mm		
B.6 Prime mover		
B.6.1 Electric motor		
B.6.1.1 Brand		
B.6.1.2 Make or manufacturer		
B.6.1.3 Serial No.		
B.6.1.4 Type		
B.6.1.5 Rated Power, kW		
B.6.1.6 Rated Speed, rpm		
B.6.1.7 Frequency, Hz		
B.6.1.8 Voltage		
B.6.1.9 Weight, kg		
B.6.2 Engine		
B.6.2.1 Brand		
B.6.2.2 Model		
B.6.2.3 Make or manufacturer		
B.6.2.4 Serial No.		
B.6.2.5 Type		
B.6.2.6 Rated Power, kW		
B.6.2.7 Rated Speed, rpm		
B.6.2.8 Displacement (cm^3)		
B.6.2.9 Cooling system		
B.6.2.10 Starting system		
B.6.2.11 Weight, kg		

Annex C
(informative)

Performance Test Data Sheet

Test Trial No. _____ Date: _____
Test Engineer: _____ Location: _____
Assistants: _____ Test Specimen: _____
Test Requested by: _____ Manufacturer: _____

ITEMS	Trial 1	Trial 2	Ave.
C.1 Information on the test materials			
C.1.1 Variety			
C.1.2 Crop source			
C.2 Weight of Input, kg			
C.3 Loading time, s			
C.4 Unloading time, s			
C.5 Holding capacity, kg/batch			
C.6 Operating time, h			
C.7 Ginger Tea recovered, kg			
C.8 Cooking recovery, %			
C.9 Cooking losses, %			
C.10 Cooking rate, kg/h			
C.11 Amount of Energy per kilogram output, MJ/kg			
C.12 Speed of Components, rpm			
C.12.1 Electric Motor			
C.12.1.1 Without load			
C.12.1.2 With load			
C.12.2 Reducer Input Shaft			
C.12.2.1 Without load			
C.12.2.2 With load			
C.12.3 Reducer Output Shaft			
C.12.3.1 Without load			
C.12.3.2 With load			
C.12.4 Stirrer Shaft			
C.12.4.1 Without load			
C.12.4.2 With load			
C.13 Noise Level, dB(A)			
C.13.1 Without load			
C.13.2 With load			
C.14 Power Consumption			
C.14.1 Power, kW			
C.14.1.1 Without load			
C.14.1.2 With load			
C.14.2 Voltage, V			
C.14.2.1 Without load			

C.14.2.2 With load			
C.14.3 Current, A			
C.14.3.1 Without load			
C.14.3.2 With load			
C.15 Sugar Consumption			
C.15.1 Sugar added, kg			
C.16 Fuel consumption (prime mover)			
C.16.1 Operating time, h			
C.16.2 Fuel consumed, L			
C.17 Burner Consumption			
C.17.1 LPG			
C.17.1.1 Operating Time, h			
C.17.1.2 LPG Consumed, kg			
C.17.2 Biomass fuel			
C.17.2.1 Type of biomass fuel			
C.17.2.2 Operating Time, h			
C.17.2.3 Biomass Consumed, kg			

C.17 Rate the following observations:

Items	**Rating***				
	1	**2**	**3**	**4**	**5**
C.17.1 Ease of loading					
C.17.2 Ease of cleaning parts					
C.17.3 Ease of adjusting and repair of parts					
C.17.4 Ease of collecting output					
C.17.5 Ease of transporting the machine					
C.17.6 Safety					
C.17.7 Vibration					

***1** – Very good
2 - Good
3 - Satisfactory
4 - Poor
5 – Very poor

C.18 Other Observations:

_____
_____
_____

Annex D
(informative)

Laboratory Test Data Sheet

Machine Tested: _____
Analyzed by: _____

D.1 Analysis of Ginger Tea (Instant "Salabat")

ASTM E-11 Testing Sieve	**Percent of Material Retained**			**Multiplied by**	
	Trial 1	Trial 2	Ave		
12				6	
16				5	
20				4	
30				3	
40				2	
50				1	
Pan				0	
Total					
Fineness Modulus					
Average Particle Size Diameter					

Annex E
(informative)

Formula Used During Calculations and Testing

E.1 Cooking recovery, C_r (%)

$$Cr = \frac{\mathrm{Tr}}{S} x100$$

where:

C_r	=	Cooking Recovery, %
Tr	=	Weight of recovered ginger tea/instant salabat, kg
S	=	Weight of sugar, kg

E.2 Cooking Losses, L (%)

L = 100 – Cooking recovery, %

E.3 Fineness Modulus, FM

$$FM = \frac{\text{sum of the weight fractions retained above each sieve}}{100}$$

E.4 Particle Size Diameter, D (mm)

$$D = [\ 0.0041\ (2)^{F.M.}]\ (25.4)$$

where:

D	=	Particle size diameter, mm
F.M.	=	Fineness modulus

E.5 Amount of Energy per Kilogram of Output Product, E (MJ/kg)

$$E = \frac{\text{heating value (MJ/kg) x total consumed LPG or biomass (kg)}}{output(kg)}$$

E.6 Fuel/Electrical energy consumption

E.6.1 Electrical energy consumption, E_c (kW-h/kg)

$$E_c = \frac{\mathrm{P}cTo}{\mathrm{J}i}$$

where:

E_c = Electrical energy consumption, kW-h/kg
P_c = Power consumed, kW
T_o = Time of operation, h
J_i = Weight of input juice, kg

E.6.2 Fuel consumption, F_c (L/h)

$$F_c = \frac{F_1}{T_o}$$

where:

F_c = Fuel consumption, L/h
F_1 = Amount of fuel consumed, L
T_o = Time of operation, h