
अर्जुन [*Terminalia Arjuna* (Roxb.
ex DC.) Wight and Arn.] छाल –
पारम्परिक औषधियों में प्रयोग हेतु
विशिष्टि

Arjuna [*Terminalia Arjuna* (Roxb. ex
DC.) Wight and Arn.] Bark for use in
Traditional Medicine – Specifications

ICS 11.120.10

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FOREWORD

This Indian Standard was adopted by Bureau of Indian Standards, after the draft finalized by Ayush Sectional Committee had been approved by the Food and Agriculture Division Council.

Arjuna is a large deciduous tree commonly found throughout the greater parts of the country. It is also planted for shade and ornamental purpose. In traditional medicine, it has been used as a common constituent of formulations indicated in various disorders.

Arjuna is having synonyms like *Kakubha*, *Partha* and *Shvetavaha*. Some of the regional names are *Arjun* (Assamese); *Arjuna* (Bengali); Arjun tree (English); *Sadad*, *Arjun* and *Sajada* (Gujarati); *Arjuna* (Hindi); *Matti*, *Bilimatti*, *Neermatti*, *Mathichakke* and *Kudare Kivimase* (Kannada); *Nirmasuthu*, *Vellamaruthi*, *Kellemasuthu*, *Mattimora* and *Torematti* (Malayalam); *Arjuna* and *Sadada* (Marathi); *Arjuna* (Oriya); *Arjon* (Punjabi); *Marutam pattai* and *Marudam* (Tamil); *Maddi* (Telugu); and *Arjun* (Urdu).

The standard is one of the series of standards being brought out on ingredients used in formulations of traditional medicine for the advantage of researchers, academicians, students, clinical practitioners and drug manufacturers.

In the formulation of this standard, significant assistance has been derived from the Ayurvedic Pharmacopoeia of India, Part 1, Vol 2, 1999; Ayurvedic Pharmacopoeia of India, Part 1, Vol 8, 2011; Siddha Pharmacopoeia of India, Part 1, Vol 1, 2008; and Unani Pharmacopoeia of India, Part 1, Vol 4, 2007 published by the Ministry of Ayush, Government of India. Inputs have also been derived from the information available in the public domain in print and electronic media including authoritative books.

In the formulation of this standard due consideration has been given to the provisions of the *Drugs and Cosmetics Act*, 1940 and Rules framed thereunder. However, this standard is subject to the restrictions imposed under these Rules and Regulations, wherever applicable.

The composition of the committee responsible for the formulation of this standard is given in Annex C.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value shall be the same as that of the specified value in this standard.

Indian Standard
**ARJUNA [*Terminalia Arjuna* (Roxb. ex DC.) Wight and Arn.] STEM
 BARK FOR USE IN TRADITIONAL MEDICINE
 — SPECIFICATION**

1 SCOPE

This standard prescribes the requirements and methods of test for *Arjuna* which consists of dried stem bark of *Terminalia Arjuna* (Roxb. ex DC.) Wight and Arn (Fam Combretaceae).

2 REFERENCES

The standards listed below contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

3. REQUIREMENTS

<i>IS No.</i>	<i>Title</i>
IS 1070 : 1992	Reagent grade water — Specification (<i>third revision</i>)
IS 1797 : 2017	Spices and condiments — Methods of test (<i>third revision</i>)
IS 4333 : 2018	Methods of analysis for foodgrains: Part 1 Refractions (<i>third revision</i>)
IS 13145 : 2014	Spices and condiments — Methods of sampling (<i>second revision</i>)
IS 16913 : 2018	Methods of test for cosmetics — Determination of heavy metals (Arsenic, Cadmium, Lead and Mercury) by atomic absorption spectrometry (AAS)
IS 17924 : 2022	Determination of pesticide residue in herbal materials
IS 13859 : 1993/ISO 7513 : 1990	Instant Tea in solid form — Determination of moisture content (Loss in mass at 103 °C)
IS 16287 : 2015/ISO 16050 : 2003	Foodstuffs — Determination of aflatoxin B1, and the total content of aflatoxins B1, B2, G1 and G2 in cereals, nuts and derived products — High performance liquid chromatographic method

3.1 Description**3.1.1 Macroscopic Examination of *Arjuna* Stem Bark**

The dried stem bark available in the form of 0.2 to 1.5 cm thick pieces. The pieces are flat, curved, recurved, channeled to half quilled. Market samples are up to 10 cm in length and 7 cm in width. The outer surface is somewhat smooth and grey, inner surface is somewhat fibrous and pinkish. The transversely cut smoothed bark shows pinkish surface. Fracture is short in inner and laminated in outer part. The stem bark should have bitter and astringent taste.

3.1.2 Microscopic Examination of *Arjuna* Stem Bark

The transverse section (TS) of mature stem bark shows cork consisting of 9 to 10 layers of tangentially elongated cells. A few outer layers are filled with brown colouring matter. The cork cambium and secondary cortex are not distinct and medullary rays observed traversing almost up to outer bark. Secondary phloem occupies a wide zone, consisting of sieve tubes, companion cells, phloem parenchyma and phloem fibres, traversed by phloem rays. Phloem rays are usually uniseriate but biseriate rays also occasionally seen. In the middle and outer phloem region, sieve tubes get collapsed and form ceratenchyma. Phloem fibres are distributed in rows and present in groups of 2 to 10. Rosette crystals of calcium oxalate measuring 80 to 180 μ in diameter are present in most of the phloem parenchyma, alternating with fibres. The idioblasts measuring 260 to 600 μ in diameter, consisting of large cells having aggregates of prismatic and rhomboidal crystals of calcium oxalate are present in row throughout the zone. Round to oval, elliptical, starch grains measuring 5 to 13 μ in diameter are distributed throughout the tissue (absent in *T. alata*) which are mostly simple, compound of 2 or 3 components or sometimes up to 5 components. In a tangential section, the uniseriate phloem rays of 2 to 10 cells high and biseriate rays of 4 to 12 cells high are observed. In longitudinal section rosette crystals of calcium oxalate are found in the form of strands in phloem parenchyma.

3.1.3 Powder

Arjuna stem bark crushed in the form of fine powder appears reddish brown in colour. It shows fragments of cork cells, uniseriate phloem rays, fibres, a number of rosette crystals of calcium

oxalate and a few rhomboidal crystals. Starch grains are simple and compound, round to oval, elliptic, having 2 to 3 components with concentric striations and small narrow hilum, measuring 5 to 13 μ in diameter as in Fig. 1.

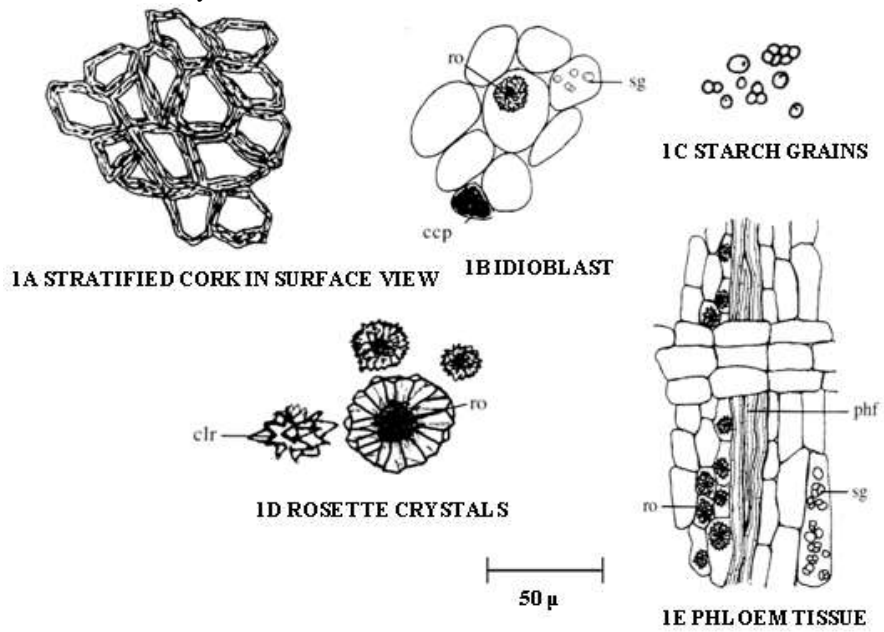


FIG. 1 POWDER OF *ARJUNA* [*Terminalia arjuna* (Roxb. Ex DC.) Wight and Arn.]
STEM BARK

3.2 General

3.2.1 *Arjuna* stem bark shall be free from extraneous/artificial flavours.

3.2.2 *Arjuna* stem bark shall comply with physical, chemical and microbiological requirements given in Table 1.

3.2.3 If any pesticides other than those for which minimum requirements are given in Table 1 are applied to the herb before or after harvesting, those should also be tested. Their limit shall be calculated using the following formula:

$$\text{ADI} \times \text{M} / \text{MDD} \times 100$$

where

ADI = acceptable daily intake of pesticide as published by Food and Agriculture Organization-World Health Organization (FAO-WHO), in milligrams per kilogram of body mass,

M = body mass in kilograms (60 kg),

MDD = Maximum daily dose of the drug, in kilograms.

4 PACKING, STORAGE AND MARKING

4.1 Packing

Arjuna stem bark shall be packed in clean, sound and dry container made up of metal, glass, foodgrade polymers, wood or jute bags. The wooden boxes or jute bags shall be suitably lined with moisture-proof lining which does not impart any foreign smell to the product. The packing material shall be free from any fungal or insect infestation and should not impart any foreign smell. Each container shall be securely closed and sealed.

4.2 Storage

Arjuna stem bark shall be stored under conditions that prevent contamination and, as far as possible, deterioration. Storage area shall be clean, well-ventilated, protected from light, moisture, insects and rodents.

4.3 Marking

The following particulars shall be legibly and indelibly marked or labelled on each pack:

- a) Name of the material including part of the plant, botanical name, and trade name or brand name, if any;
- b) Name and address of the producer or packer;
- c) Batch number;
- d) Net quantity;
- e) State and country of production;
- f) Date of packing (MM/YYYY);
- g) Instructions for storage; and
- h) Any other information requested by the buyer, such as the date of harvesting (MM/YYYY) (if known).

The above information, or part of it, may instead appear in the documentation after agreement between the buyer and the seller.

4.4 BIS Certification Marking

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act, 2016* and the Rules and Regulations framed there under, and the product(s) may be marked with the Standard Mark.

5 SAMPLING

5.1 Representative samples of the material shall be drawn and tested for conformity to this specification as prescribed in IS 13145.

5.2 The samples of *Arjuna* stem bark shall be tested for ascertaining conformity of the material to the requirements in accordance with the relevant clauses given in column 4 of Table 1.

Table 1 Requirements for *Arjuna* (*Terminalia Arjuna* (Roxb. ex DC.) Wight and Arn.) Stem Bark
(Clauses 3.2.2, 3.2.3 and 5.2)

Sl No. (1)	Characteristic (2)	Requirement (3)	Method of Test, Ref to (4)
i)	Foreign matter, percent by mass, <i>Max</i>	2.0	6.2 of IS 4333 (Part 1)
ii)	Loss on drying, percent by Mass, <i>Max</i>	12.0	IS 13859
iii)	Total ash, percent by mass, <i>Max</i>	25.0	6 of IS 1797
iv)	Acid insoluble ash, percent by mass, <i>Max</i>	1.0	8 of IS 1797
v)	Alcohol soluble Extractive, percent by mass, <i>Min</i>	20.0	10 of IS 1797
vi)	Water soluble Extractive, percent by mass, <i>Min</i>	20.0	11 of IS 1797
vii)	Total polyphenols, percent, <i>Min</i>	10.0	Annex A
viii)	(calculated as pyrogallol) Total triterpenes, percent, <i>Min</i> (sum of arjunic acid, arjungenin, arjunolic acid and arjunetin calculated as arjungenin)	0.1	Annex A
ix)	Aflatoxin (B1), ng/kg, <i>Max</i>	2.0	IS 16287
x)	Aflatoxin (B1+B2+G1+G2), ng/kg, <i>Max</i>	5.0	IS 16287
xi)	Lead, mg/kg, <i>Max</i>	10.0	IS 16913
xii)	Mercury, mg/kg, <i>Max</i>	1.0	IS 16913
xiii)	Cadmium, mg/kg, <i>Max</i>	0.3	IS 16913
xiv)	Arsenic, mg/kg, <i>Max</i>	3.0	IS 16913
xv)	<i>Staphylococcus aureus</i> , per g	Absent for extract and powder Absent for plant material	Annex B
xvi)	<i>Pseudomonas aeruginosa</i> , per g	Absent for extract and powder Absent for plant material	Annex B
xvii)	<i>Salmonella</i> spp., per g	Absent	Annex B
xviii)	<i>Escherichia coli</i> , per g	Absent for extract and powder 10 for plant material	Annex B
xix)	Total microbial plate count, per g, <i>Max</i>	10 ⁵ for extract and powder 10 ⁷ for plant material	Annex B
xx)	Total yeast and mould, per g, <i>Max</i>	10 ³ for extract and powder 10 ⁵ for plant material	Annex B

SI No. (1)	Characteristic (2)	Requirement (3)	Method of Test, Ref to (4)
xxi)	Pesticide residues		
1)	Alachlor, mg/kg, <i>Max</i>	0.02	IS 17924
2)	Aldrin and dieldrin (sum of), mg/kg, <i>Max</i>	0.05	
3)	Azinphos-methyl, mg/kg, <i>Max</i>	1.0	
4)	Bromopropylate, mg/kg, <i>Max</i>	3.0	
5)	Chlordane (sum of cis-, trans - and Oxythlordane), mg/kg, <i>Max</i>	0.05	
6)	Chlorfenvinphos, mg/kg, <i>Max</i>	0.5	
7)	Chlorpyrifos, mg/kg, <i>Max</i>	0.2	
8)	Chlorpyrifos-methyl, mg/kg, <i>Max</i>	0.1	
9)	Cypermethrin (and isomers), mg/kg, <i>Max</i>	1.0	
10)	DDT (sum of p,p'-DDT, o,p'- DDT, p,p-DDE and p,p'- TDE), mg/kg, <i>Max</i>	1.0	
11)	Deltamethrin, mg/kg, <i>Max</i>	0.5	
12)	Diazinon, mg/kg, <i>Max</i>	0.5	
13)	Dichlorvos, mg/kg, <i>Max</i>	1.0	
14)	Dithiocarbamates (as CS ₂), mg/kg, <i>Max</i>	2.0	
15)	Endosulfan (sum of isomers and endosulfan sulphate), mg/kg, <i>Max</i>	3.0	
16)	Endrin, mg/kg, <i>Max</i>	0.05	
17)	Ethion, mg/kg, <i>Max</i>	2.0	
18)	Fenitrothion, mg/kg, <i>Max</i>	0.5	
19)	Fenvalerate, mg/kg, <i>Max</i>	1.5	
20)	Fonofos, <i>Max</i>	0.05	
21)	Heptachlor (sum of heptachlor and heptachlor epoxide), mg/kg, <i>Max</i>	0.05	
22)	Hexachlorobenzene, mg/kg, <i>Max</i>	0.1	
23)	Hexachlorocyclohexane isomers (other than γ), mg/kg, <i>Max</i>	0.3	
24)	Lindane (γ - hexachlorocyclohexane), mg/kg, <i>Max</i>	0.6	
25)	Malathion, mg/kg, <i>Max</i>	1.0	
26)	Methidathion, mg/kg, <i>Max</i>	0.2	
27)	Parathion, mg/kg, <i>Max</i>	0.5	
28)	Parathion-methyl, mg/kg, <i>Max</i>	0.2	
29)	Permethrin, mg/kg, <i>Max</i>	1.0	
30)	Phosalone, mg/kg, <i>Max</i>	0.1	
31)	Piperonyl butoxide, mg/kg, <i>Max</i>	3.0	
32)	Pirimiphos-methyl, mg/kg, <i>Max</i>	4.0	
33)	Pyrethrins (sum of), mg/kg, <i>Max</i>	3.0	
34)	Quintozene (sum of quintozene, pentachloroaniline and methyl pentachlorophenylsulphide), mg/kg, <i>Max</i>	1.0	

6 QUALITY OF REAGENTS

6.1 Reagents including pure chemicals used shall be of analytical grade.

6.2 Reagent grade water for laboratory use shall be as per IS 1070.

NOTE — 'Pure chemicals' shall mean chemicals that do not contain impurities which effect the results of analysis.

ANNEX A

[Table 1, Sl No. vii), viii), Col 4]

IDENTIFICATION OF TOTAL POLYPHENOLS AND TOTAL TRITERPENES

A-1 GENERAL

Arjuna contains not less than 10.0 percent of total polyphenols calculated as pyrogallol and not less than 0.1 percent of total triterpenes (sum of arjunic acid, arjungenin, arjunolic acid and arjunetin calculated as arjungenin) when assayed.

A-2 THIN LAYER CHROMATOGRAPHY (TLC)**A-2.1 Apparatus**

A-2.1.1 Thin layer chromatograph with a pre coated silica gel 60F₂₅₄ plate.

A-2.1.2 Analytical Balance

A-2.1.3 Standard Glassware

A-2.1.4 Water Bath

A-2.2 Reagents

A-2.2.1 Reference Standard – Arjunic acid, of Known Purity

A-2.2.2 Reference Standard – Arjungenin, of Known Purity

A-2.2.3 Reference Standard – Arjunolic acid, of Known Purity

A-2.2.4 Reference Standard – Arjunetin, of Known Purity

A-2.2.5 Ethyl Acetate – AR or Equivalent Grade

A-2.2.6 Toluene – AR or Equivalent Grade

A-2.2.7 Formic Acid – AR or Equivalent Grade

A-2.2.8 Glacial Acetic Acid – AR or Equivalent Grade

A-2.2.9 Methanol – AR or Equivalent Grade

A-2.2.10 Anisaldehyde Sulphuric Acid– AR or Equivalent Grade

A-2.3 Procedure**A-2.3.1 Solvent System**

Dissolve ethyl acetate, toluene, formic acid and glacial acetic acid in the ratio of 6.0 : 3.0 : 0.5 : 1.0.

A-2.3.2 Preparation of Test Solution

To 3 g of the substance being examined, add 50 ml of methanol, heat on a water bath for 10 to 15 min cool and filter.

A-2.3.3 Preparation of Standard Solution

Dissolve 1 mg each of arjunic acid RS, arjungenin RS, arjunolic acid RS and arjunetin RS in 10 ml of methanol.

A-2.3.4 Estimation

Apply 10 µl each of the test and standard solutions on a TLC plate as bands of 10 mm. Develop the plate to a distance of 80 mm from the line of application. Dry the plate in air and spray with solution of anisaldehyde sulphuric acid reagent. Heat the plate at 110 °C for about 5 min or till the bands are clearly visible. The chromatogram obtained with test solution shows a band at R_f~0.80 corresponding to that of arjunic acid, R_f ~0.65 corresponding to that of arjunolic acid, R_f ~0.60 corresponding to that of arjungenin and at R_f ~0.30 corresponding to arjunetin and the profile should be similar to the one given in the TLC as in Fig. 2.

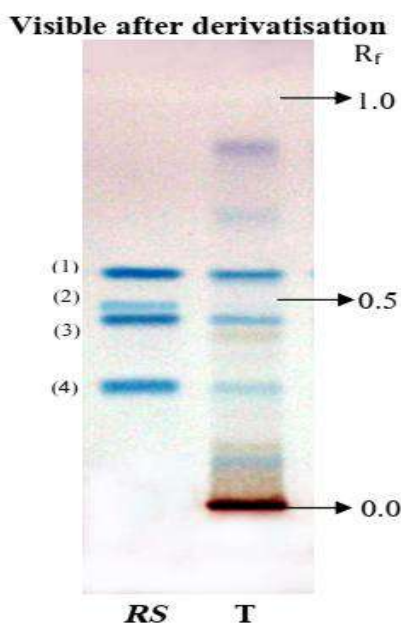


FIG. 2 THIN LAYER CHROMATOGRAM OF *ARJUNA* (*Terminalia arjuna* (Roxb. ex DC.) Wight And Arn.) STEM BARK
RS: (1) ARJUNIC ACID, (2) ARJUNOLIC ACID, (3) ARJUNGENIN AND (4) ARJUNETIN, T: TEST SOLUTION

A-3 ASSAY FOR TOTAL POLYPHENOLS

A-3.1 Apparatus

A-3.1.1 Spectrophotometer

A-3.1.2 Analytical Balance

A-3.1.3 Standard Glassware

A-3.2 Reagents

A-3.2.1 Reference Standard – Pyrogallol, of Known Purity

A-3.2.2 Folin's Reagent – AR or Equivalent Grade

A-3.2.3 Sodium Carbonate – AR or Equivalent Grade

A-3.2.4 Water – HPLC Grade

A-3.2.5 Methanol – AR or Equivalent Grade

A-3.3 Procedure

A-3.3.1 Preparation of Test solution

Always prepare fresh solution. Take about 100 mg, accurately weighed substance being examined in a 250 ml conical flask, add 50 ml of 50.0 percent aqueous methanol and reflux, cool and filter in a 100 ml volumetric flask. Reflux the residue further with 50 ml of 50.0 percent aqueous methanol and filter to the same volumetric flask and make up the volume. Further dilute 5.0 ml aliquot to 50 ml with water in a volumetric flask.

A-3.3.2 Preparation of Standard Solution

Take about 100 mg accurately weighed pyrogallol RS in a 100 ml volumetric flask and dissolve in 50.0 percent aqueous methanol and make up to 100 ml with 50.0 percent aqueous methanol. Further dilute 5.0 ml to 50 ml with water in volumetric flask.

A-3.3.3 Estimation

Pipette out 2, 5, 7 and 10 ml of standard solution and 5, 7 ml of test solution to different 100 ml volumetric flasks. Add 40 ml of water, 5 ml of Folin's reagent and 10 ml of 30.0 percent sodium carbonate solution in each of the volumetric flasks. Allow to stand for 30 min. Make up the volume with water, shake and allow to stand for 20 min more. Read in a suitable spectrophotometer at 750 nm using water as blank. Prepare a calibration curve from the values obtained. Calculate the content of polyphenols in the sample from the absorbance using the calibration curve.

A-4 HIGH PERFORMANCE LIQUID CHROMATOGRAPHY (HPLC)

A-4.1 Apparatus

A-4.1.1 The high performance liquid chromatograph equipped with UV-VIS detector. The operative condition suggested below are typical which can be changed provided the standardization is done:

- a) Column – 250 mm x 4.6 mm, 5 micron SS packed with C18
- b) Detector – UV (205nm)
- c) Mobile phase – Filtered and degassed gradient mixture of phosphate buffer (prepared by dissolving 0.14 g of potassium dihydrogen orthophosphate in 500 ml of water, adding 0.5 ml of orthophosphoric acid and making up the volume to 1 000 ml) and acetonitrile in the following proportions:

<i>Sl No.</i>	<i>Time (min)</i>	<i>Phosphate buffer (percent)</i>	<i>Acetonitrile (percent)</i>
(1)	(2)	(3)	(4)
i)	0	70	30
ii)	18	40	60
iii)	20	15	85
iv)	22	15	85
v)	25	70	30
vi)	30	70	30

d) Flow rate – 1.5 ml per min

e) Injection volume – 20 µl

f) Temperature – ambient

A-4.1.2 Microlitre Syringe – 50 µl Capacity

A-4.1.3 Analytical Balance

A-4.1.4 Standard Glassware

A-4.1.5 Water Bath

A-4.2 Reagents

A-4.2.1 Reference Standard – Arjungenin, of Known Purity

A-4.2.2 Potassium Dihydrogen Orthophosphate – AR or Equivalent Grade

A-4.2.3 Orthophosphoric Acid – AR or Equivalent Grade

A-4.2.4 Methanol – AR or Equivalent Grade

A-4.2.5 Diethyl Ether – AR or Equivalent Grade

A-4.2.6 Water – HPLC Grade

A-4.2.7 Acetonitrile – HPLC Grade

A-4.3 Procedure

A-4.3.1 Test Solution

Take about 5 g accurately weighed substance being examined and reflux with 100 ml diethyl ether on water bath for 15 min, cool and filter. Reflux the residue further with diethyl ether two times more, cool and filter. Combine all the filtrates and evaporate to dryness under reduced pressure. Dissolve the residue in 10 ml of methanol in a volumetric flask.

A-4.3.2 Standard Solution

Take about 10 mg, accurately weighed, arjungenin RS in a 100 ml volumetric flask and dissolve in 50 ml of methanol and make up the volume with methanol.

A-4.3.3 Estimation

Inject 20 µl of the filtered standard solution and record the chromatogram. Inject 20 µl of the filtered test solution, record the chromatogram and identify the peaks using the relative retention time.

<i>Sl No.</i>	<i>Analyte</i>	<i>Relative retention time</i>
(1)	(2)	(3)
i)	Arjunetin	0.67
ii)	Arjungenin	1.00
iii)	Arjunolic acid	1.50
iv)	Arjunic acid	1.70

A-4.4 Calculation

Calculate the content of arjunetin, arjungenin, arjunolic acid and arjunic acid in the substance being examined as arjungenin from the peak response of analytes and from the declared content of arjungenin RS as in Fig. 3.

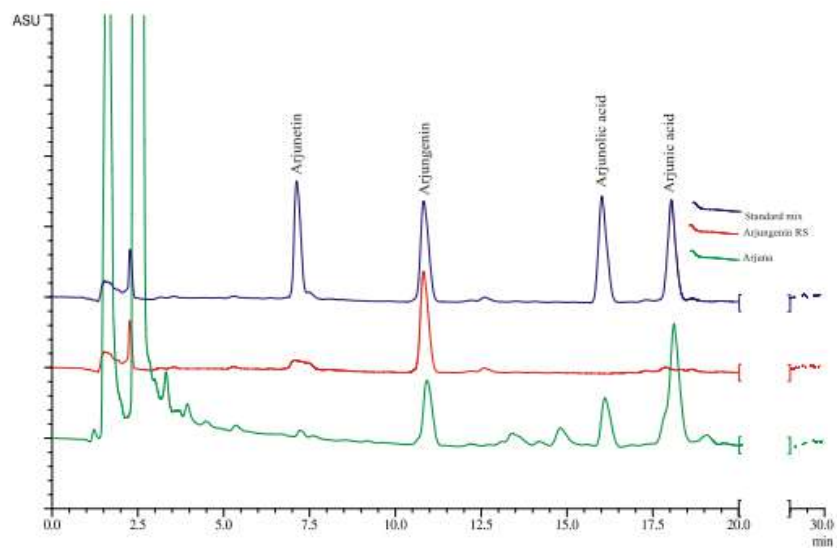


FIG. 3 HPLC CHROMATOGRAM OF ARJUNA [*Terminalia arjuna* (Roxb. ex DC.) Wight and Arn.] STEM BARK WITH ARJUNGENIN AS RS AND STANDARD MIX

ANNEX B

[Table 1, Sl No. (xv, xvi, xvii, xviii, xix, xx), Col 4]

MICROBIAL LIMIT TESTS

B-1 GENERAL

The tests are designed for the estimation of the number of viable aerobic microorganisms present and for detecting the presence of designated microbial species in the extract. The term 'growth' is used to designate the presence and presumed proliferation of viable microorganisms.

B-2 APPARATUS**B-2.1 Oven for Dry Sterilization****B-2.2 Autoclave for Wet Sterilization****B-2.3 Incubator****B-2.4 Water Bath****B-2.5 pH-Meter****B-2.6 Sterile Membrane Filters, 50 mm in Diameter****B-2.7 Colony Counting Equipment****B-2.8 Analytical Balance****B-2.9 Standard Glassware****B-3 MEDIA**

Culture media may be prepared as given below or dehydrated culture media may be used provided that, when reconstituted as directed by the manufacturer, they have similar ingredients and/or yield media comparable to those obtained from the formulae given below.

Where agar is specified in a formula, use agar that has a moisture content of not more than 15 percent. Where water is called for in a formula, use purified water. Unless otherwise indicated, the media should be sterilized by heating in an autoclave (15 psi) at 121 °C for 15 min. In preparing media by the formulas given below, dissolve the soluble solids in the water, using heat if necessary, to effect complete solution, add solutions of 0.1N hydrochloric acid or 0.1N sodium hydroxide in quantities sufficient to yield the required pH in the medium when it is ready for use. Determine the pH at 25 °C ± 2 °C.

B-3.1 Baird Parker Agar Medium**B-3.1.1 Composition**

Pancreatic digest of casein	10.0 g
Beef extract	5.0 g
Yeast extract	1.0 g
Lithium chloride	5.0 g
Agar	20.0 g
Glycine	12.0 g
Sodium pyruvate	10.0 g
Water	1 000 ml

B-3.1.2 Preparation

Suspend the components in 1 000 ml of water, heat with frequent agitation and boil for 1 min. Sterilize, cool in between 45 °C to 50 °C, add 10 ml of a one percent w/v solution of sterile potassium tellurite and 50 ml of egg yolk emulsion. Mix thoroughly, but gently and pour into plates. (Prepare the egg yolk emulsion by disinfecting the surface of whole shell eggs, aseptically cracking the eggs, and separating out intact yolks into a sterile graduated cylinder. Add sterile saline solution, get a 3 to 7 ratio of egg yolk to saline. Add to a sterile blender cup and mix at high speed for 5 seconds). Adjust the pH after sterilization to 6.8 ± 0.2.

B-3.2 Bismuth Sulphite Agar Medium**B-3.2.1 Composition**

Solution (1)

Beef extract	6 g
Peptone	10 g
Agar	24 g
Ferric citrate	0.4 g
Brilliant green	10 mg
Water	1 000 ml

Solution (2)

Ammonium bismuth citrate	3 g
Sodium sulphite	10 g
Anhydrous disodium hydrogen phosphate	5 g
Dextrose monohydrate	5 g
Water	100 ml

B-3.2.2 Preparation

Suspend the components of Solution 1 in 1 000 ml of water. Heat to boiling to dissolve the medium completely. Sterilize by maintaining at 115 °C for 30 min.

Suspend the components of Solution 2 in 100 ml of water. Heat to boiling to dissolve the medium completely. Do not autoclave.

Add 1 volume of solution 2 to 10 volumes of solution 1 previously melted and cooled to a temperature of 55 °C. Bismuth Sulphite Agar Medium should be stored at 2 °C to 8 °C for 5 days before use.

B-3.3 Brilliant Green Agar Medium**B-3.3.1 Composition**

Peptone	10.0 g
Yeast extract	3.0 g
Lactose	10.0 g
Sucrose	10.0 g
Sodium chloride	5.0 g
Phenol red	80.0 g
Brilliant green	12.5 mg
Agar	12.0 g
Water	1 000 ml

B-3.3.2 Preparation

Mix the components, allow to stand for 15 min, sterilize by maintaining at 115 °C for 30 min and mix before pouring.

B-3.4 Buffered Sodium Chloride Peptone Solution pH 7.0**B-3.4.1 Composition**

Potassium dihydrogen phosphate	3.56 g
Disodium hydrogen phosphate	7.23 g
Sodium chloride	4.30 g
Peptone (meat or casein)	1.0 g
Water	1 000 ml

B-3.4.2 Preparation

Mix the components and heat if necessary to dissolve the medium completely. 0.1 to 1.0 percent w/v Polysorbate 20 or polysorbate 80 may be added. Sterilize by heating in an autoclave at 121°C for 15 min.

B-3.5 Casein Soyabean Digest Agar Medium**B-3.5.1 Composition**

Pancreatic digest of casein	15.0 g
Papaic digest of soyabean meal	5.0 g
Sodium chloride	5.0 g
Agar	15.0 g
Water	1 000 ml

B-3.5.2 Preparation

Suspend the components in water. Heat to boiling to dissolve the medium completely. Sterilize at 121 °C for 15 min in an autoclave and adjust the pH after sterilization to 7.3 ± 0.2.

B-3.6 Cetrinide Agar Medium**B-3.6.1 Composition**

Pancreatic digest of gelatin	20.0 g
Magnesium chloride	1.4 g
Potassium sulphate	10.0 g
Cetrinide	0.3 g
Agar	13.6 g
Glycerin	10.0 g
Water	1 000 ml

B-3.6.2 Preparation

Dissolve the components in 1 000 ml of water. Heat to boiling for 1 min with shaking. Sterilize at 121 °C for 15 min in an autoclave and adjust the pH after sterilization to 7.0 to 7.4.

B-3.7 Desoxycholate Citrate Agar Medium**B-3.7.1 Composition**

Beef extract	5.0 g
Peptone	5.0 g
Lactose	10.0 g
Trisodium citrate	8.5 g
Sodium thiosulphate	5.4 g
Ferric citrate	1.0 g
Sodium desoxycholate	5.0 g
Neutral red	0.02 g
Agar	12.0 g
Water	1 000 ml

B-3.7.2 Preparation

Mix the components and allow to stand for 15 min. Gently boil with continuous stirring and continue boiling until solution is complete. Cool to 80 °C, mix, pour and cool rapidly.

Care should be taken not to overheat Desoxycholate Citrate Agar during preparation. It should not be re-melted and the surface of the plates should be dried before use.

B-3.8 Fluid Casein Digest Soya Lecithin Polysorbate 20 Medium

B-3.8.1 Composition

Pancreatic digest of casein	20 g
Soya lecithin	5 g
Polysorbate 20	40 ml
Water	1 000 ml

B-3.8.2 Preparation

Dissolve the pancreatic digest of casein and soya lecithin in water, heating in a water bath at 48 °C to 50 °C for about 30 min to effect solution. Add polysorbate 20, mix and dispense as desired. Sterilize at 121 °C for 15 min in an autoclave.

B-3.9 Fluid Lactose Medium

B-3.9.1 Composition

Beef extract	3.0 g
Pancreatic digest of gelatin	5.0 g
Lactose	5.0 g
Water	1 000 ml

B-3.9.2 Preparation

Suspend the components in 1 000 ml water. Heat if necessary to dissolve the medium completely. Sterilize at 121 °C for 15 min in an autoclave. Cool as quickly as possible after sterilization. Adjust the pH after sterilization to 6.9 ± 0.2 .

B-3.10 Lactose Broth Medium

B-3.10.1 Composition

Beef extract	3.0 g
Pancreatic digest of gelatin	5.0 g
Lactose	5.0 g
Water	1 000 ml

B-3.10.2 Preparation

Suspend the components in water and heat if necessary to dissolve the medium completely. Sterilize at 121 °C for 15 min in an autoclave. Adjust the pH after sterilization to 6.9 ± 0.2 .

B-3.11 Levine Eosin Methylene Blue Agar Medium

B-3.11.1 Composition

Pancreatic digest of gelatin	10.0 g
Dibasic potassium phosphate	2.0 g
Agar	15.0 g
Lactose	10.0 g
Eosin Y	400 mg
Methylene blue	65 mg
Water	1 000 ml

B-3.11.2 Preparation

Dissolve the pancreatic digest of gelatin, dibasic potassium phosphate and agar in water with warming and allow to cool. Just prior to use, liquify the gelled agar solution and the remaining ingredients, as solutions, in the following amounts and mix. For each 100 ml of the liquified agar solution use 5 ml of a 20 percent w/v solution of lactose, 2 ml of a 2 percent w/v solution of eosin Y and 2 ml of a 0.33 percent w/v solution of methylene blue. The finished medium may not be clear. Adjust the pH after sterilization to 7.1 ± 0.2 .

B-3.12 MacConkey Agar Medium

B-3.12.1 Composition

Pancreatic digest of gelatin	17.0 g
Peptone (meat and casein, equal parts)	3.0 g
Lactose	10.0 g
Sodium chloride	5.0 g
Bile salts	1.5 g
Agar	13.5 g
Neutral red	30 mg
Crystal violet	1 mg
Water	1 000 ml

B-3.12.2 Preparation

Boil the mixture of solids and water for 1 min to effect solution. Sterilize at 121 °C for 15 min in an autoclave. Adjust the pH after sterilization to 7.1 ± 0.2 .

B-3.13 MacConkey Broth Medium

B-3.13.1 Composition

Pancreatic digest of gelatin	20.0 g
Lactose	10.0 g
Dehydrated ox bile	5.0 g
Bromocresol purple	10 mg

Water 1 000 ml

B-3.13.2 Preparation

Suspend the components in 1 000 ml of water and heat if necessary to dissolve the medium completely. Sterilize at 121 °C for 15 min in an autoclave and adjust the *pH* after sterilization to 7.3 ± 0.2 .

B-3.14 Mannitol Salt Agar Medium**B-3.14.1 Composition**

Pancreatic digest of gelatin	5.0 g
Peptic digest of animal tissue	5.0 g
Beef extract	1.0 g
D-Mannitol	10.0 g
Sodium chloride	75.0 g
Agar	15.0 g
Phenol red	25 mg
Water	1 000 ml

B-3.14.2 Preparation

Mix the components, heat with frequent agitation and boil for 1 min to effect solution. Sterilize at 121 °C for 15 min in an autoclave and adjust the *pH* after sterilization to 7.4 ± 0.2 .

B-3.15 Nutrient Broth Medium**B-3.15.1 Composition**

Beef extract	10.0 g
Peptone	10.0 g
Sodium chloride	5 mg
Water	1 000 ml

B-3.15.2 Preparation

Dissolve the components with the aid of heat. Adjust the *pH* to 8.0 to 8.4 with 5M sodium hydroxide and boil for 10 min. Filter and sterilize by maintaining at 115 °C for 30 min and adjust *pH* to 7.3 ± 0.1 .

B-3.16 Nutrient Agar Medium

Nutrient broth gelled by the addition of 1 to 2 percent w/v of agar.

B-3.17 Pseudomonas Agar Medium for Detection of Flourescein**B-3.17.1 Composition**

Pancreatic digest of casein	10.0 g
Peptic digest of animal tissue	10.0 g

Anhydrous dibasic potassium phosphate	1.5 g
Magnesium sulphate hepta hydrate	1.5 g
Glycerin	10.0 ml
Agar	15.0 g
Water	1 000 ml

B-3.17.2 Preparation

Dissolve the solid components in water before adding glycerin. Heat with frequent agitation and boil for 1 min to effect solution. Sterilize at 121 °C for 15 min in an autoclave and adjust the *pH* after sterilization to 7.2 ± 0.2 .

B-3.18 Pseudomonas Agar Medium for Detection of Pyocyanin**B-3.18.1 Composition**

Pancreatic digest of gelatin	20.0 g
Anhydrous magnesium chloride	1.4 g
Anhydrous potassium sulphate	10.0 g
Agar	15.0 g
Glycerin	10.0 ml
Water	1 000 ml

B-3.18.2 Preparation

Dissolve the solid components in water before adding glycerin. Heat with frequent agitation and boil for 1 min to effect solution. Sterilize at 121 °C for 15 min in an autoclave and adjust the *pH* after sterilization to 7.2 ± 0.2 .

B-3.19 Sabouraud Dextrose Agar Medium**B-3.19.1 Composition**

Dextrose	40 g
Peptic digest of animal tissue and Pancreatic digest of casein (1:1)	10 g
Agar	15 g
Water	1 000 ml

B-3.19.2 Preparation

Mix the components and heat to boiling to dissolve completely. Sterilize at 121 °C for 15 min in an autoclave and adjust the *pH* after sterilization to 5.6 ± 0.2 .

B-3.20 Sabouraud Dextrose Agar Medium with Antibiotics

To 1 000 ml of Sabouraud Dextrose Agar Medium, add 0.1 g of benzylpenicillin sodium and 0.1 g of

tetracycline HCL or alternatively add 50 mg of chloramphenicol immediately before use.

B-3.21 Selenite F Broth

B-3.21.1 Composition

Peptone	5 g
Lactose	4 g
Disodium hydrogen phosphate	10 g
Sodium hydrogen selenite	4 g
Water	1 000 ml

B-3.21.2 Preparation

Suspend the components in water and mix well. Warm to dissolve the medium completely. Distribute in sterile containers and sterilize by maintaining at 100 °C for 30 min.

B-3.22 Fluid Selenite Cystine Medium

B-3.22.1 Composition

Pancreatic digest of casein	5.0 g
Lactose	4.0 g
Sodium phosphate	10.0 g
Sodium hydrogen selenite	4.0 g
L-Cystine	10.0 mg
Water	1 000 ml

B-3.22.2 Preparation

Suspend the components in water and heat in flowing steam for 15 min. Adjust the final pH to 7.0 ± 0.2. Do not sterilize.

B-3.23 Tetrathionate Broth Medium

B-3.23.1 Composition

Beef extract	0.9 g
Peptone	4.5 g
Yeast extract	1.8 g
Sodium chloride	4.5 g
Calcium carbonate	25.0 g
Sodium thiosulphate	40.7 g
Water	1 000 ml

B-3.23.2 Preparation

Dissolve the solids in 1 000 ml of water and heat the solution to boil. On the day of use, add a solution prepared by dissolving 5 g of potassium iodide and 6 g of iodine in 20 ml of water.

B-3.24 Tetrathionate Bile Brilliant Green Broth Medium

B-3.24.1 Composition

Peptone	8.6 g
Dehydrated ox bile	8.0 g
Sodium chloride	6.4 g
Calcium carbonate	20.0 g
Potassium tetrathionate	20.0 g
Brilliant green	70 mg
Water	1 000 ml

B-3.24.2 Preparation

Suspend the components in 1 000 ml of water. Heat just to boiling. Do not autoclave or reheat. Adjust the pH so that after heating it is 7.0 ± 0.2.

B-3.25 Triple Sugar Iron Agar Medium

B-3.25.1 Composition

Beef extract	3.0 g
Yeast extract	3.0 g
Peptone	20.0 g
Lactose	10.0 g
Sucrose	10.0 g
Dextrose monohydrate	1.0 g
Ferrous sulphate	0.2 g
Sodium chloride	5.0 g
Sodium thiosulphate	0.3 g
Phenol red	24 mg
Water	1 000 ml

B-3.25.2 Preparation

Mix the components in 1 000 ml of water, allow standing for 15 min. Heat to boiling to dissolve the medium completely. Mix well and distribute into test tubes and Sterilize by maintaining at 121 °C for 15 min. Allow the medium to stand in a sloped form with a butt about 2.5 cm long.

B-3.26 Urea Broth Medium

B-3.26.1 Composition

Potassium dihydrogen orthophosphate	9.1 g
Anhydrous disodium hydrogen phosphate	9.5 g
Urea	20.0 g
Yeast extract	0.1 g
Phenol red	10 mg
Water	1 000 ml

B-3.26.2 Preparation

Mix the components, sterilize by filtration and distribute aseptically in sterile containers.

B-3.27 Vogel Johnson Agar Medium**B-3.27.1 Composition**

Pancreatic digest of casein	10.0 g
Yeast extract	5.0 g
Mannitol	10.0 g
Dibasic potassium phosphate	5.0 g
Lithium chloride	5.0 g
Glycerin	10.0 g
Agar	16.0 g
Phenol red	25.0 mg
Water	1 000 ml

B-3.27.2 Preparation

Suspend the components in 1 000 ml of water. Boil the solution of solids for 1 min. Sterilize at 121 °C for 15 min in an autoclave. Cool to 45 °C to 50 °C and add 20 ml of 1 percent w/v sterile solution of potassium tellurite. Adjust the pH after sterilization to 7.0 ± 0.2 .

B-3.28 Xylose Lysine Desoxycholate Agar Medium**B-3.28.1 Composition**

Xylose	3.5 g
l-Lysine	5.0 g
Lactose	7.5 g
Sucrose	7.5 g
Sodium chloride	5.0 g
Yeast extract	3.0 g
Phenol red	80 mg
Agar	13.5 g
Sodium desoxycholate	2.5 g
Sodium thiosulphate	6.8 g
Ferric ammonium citrate	800 mg
Water	1 000 ml

B-3.28.2 Preparation

Suspend the components in 1 000 ml of water. Heat with frequent agitation until the medium boils. Do not overheat or sterilize. Transfer at once to a water bath maintained at about 50 °C and pour into plates as soon as the medium has cooled. Adjust the final pH to 7.4 ± 0.2 .

B-4 SAMPLING

Use 10 ml or 10 g specimens for each of the tests specified in the Indian Standard.

B-5 PRECAUTIONS

The microbial limit tests should be carried out under conditions designed to avoid accidental contamination during the test. The precautions taken to avoid contamination must be such that they do not adversely affect any microorganisms that should be revealed in the test.

B-6 PRELIMINARY TESTING

Prior to doing the tests, inoculate diluted extracts being examined with separate viable cultures of *Escherichia coli*, *Salmonella* species, *Pseudomonas aeruginosa* and *Staphylococcus aureus*. This is done by adding 1 ml of 24 h broth culture containing not less than 1 000 microorganisms to the first dilution (in buffer solution pH 7.2, fluid soyabean casein digest medium or fluid lactose medium) of the test material and following the test procedure. If the organisms fail to grow in the relevant medium the procedure should be modified by (a) increasing the volume of diluent with the quantity of test material remaining the same, or (b) incorporating a sufficient quantity of a suitable inactivating agent in the diluents, or (c) combining the afore mentioned modifications so as to permit growth of the organisms in the media. If inhibitory substances are present in the extracts, 0.5 percent of soya lecithin and 4 percent of polysorbate 20 may be added to the culture medium. Alternatively, repeat the test as described in the previous paragraph, using fluid casein digest soya lecithin polysorbate 20 medium, to demonstrate neutralization of preservatives or other antimicrobial agents in the test material. Where inhibitory substances are contained in the extracts and the latter is soluble, the membrane filtration method described under Total Aerobic Microbial Count may be used. If in spite of incorporation of suitable inactivating agents and a substantial increase in the volume of diluent it is still not possible to recover the viable cultures described above and where the article is not suitable for applying the membrane filtration method, it can be assumed that the failure to isolate the inoculated organism may be due to the bactericidal activity of the product. This may indicate that the article is not likely to be contaminated with the given species of microorganisms. However, monitoring should be continued to establish the spectrum of inhibition and bactericidal activity of the article.

B-7 TOTAL AEROBIC MICROBIAL COUNT

Pre-treat the extracts and raw materials being examined as described below.

NOTE – The raw material needs to be ground as a coarse powder before analysis.

B-7.1 Water Soluble Products

Dissolve 10 g or dilute 10 ml of the extract preparation being examined, unless otherwise specified, in buffered sodium chloride peptone solution pH 7.0 or any other suitable medium shown to have no antimicrobial activity under the conditions of test and adjust the volume to 100 ml with the same medium. If necessary, adjust the pH to about 7.

B-7.2 Products Insoluble in Water (Non Fatty)

Suspend 10 g or 10 ml of the extract preparation being examined, unless otherwise specified, in buffered sodium chloride peptone solution pH 7.0 or any other suitable medium shown not to have antimicrobial activity under the conditions of the test and dilute to 100 ml with the same medium. If necessary, divide the preparation being examined and homogenize the suspension mechanically. A suitable surface active agent such as 0.1 percent w/v of polysorbate 80 may be added to assist the suspension of poorly wetttable substances. If necessary, adjust pH of the suspension to about 7.

B-7.3 Fatty Products

Homogenise 10 g or 10 ml of the extract preparation being examined, unless otherwise specified, with 5 g of polysorbate 20 or polysorbate 80. If necessary, heat to not more than 40 °C. Mix carefully while maintaining the temperature in the water bath or in an oven. Add 85 ml of buffered sodium chloride peptone solution pH 7.0 or any other suitable medium shown to have no antimicrobial activity under the conditions of the test, heated to not more than 40 °C if necessary. Maintain this temperature for the shortest time necessary for formation of an emulsion and in any case for not more than 30 min. If necessary, adjust the pH to about 7.

B-7.4 Examination of the Sample

Determine the total aerobic microbial count in the extract being examined by any of the following methods.

B-7.5 Membrane Filtration

Use membrane filters 50 mm in diameter and having a nominal pore size not greater than 0.45 µm the effectiveness of which in retaining bacteria has been established for the type of preparation being examined. Transfer 10 ml or a quantity of each dilution containing 1g of the preparation being examined to each of two membrane filters and filter immediately. If necessary, dilute the pretreated extract preparation so that a colony count of 10 to 100 may be expected. Wash each membrane by filtering through it three or more successive quantities, each of about 100 ml, of a suitable liquid such as buffered sodium chloride peptone solution pH 7.0. For fatty substances add to the liquid polysorbate 20 or polysorbate 80. Transfer one of the membrane filters, intended for the enumeration of bacteria, to the surface of a plate of casein soyabean digest agar and the other, intended for the enumeration of fungi, to the surface of a plate of Sabouraud dextrose agar with antibiotics. Incubate the plates for 5 days, unless a more reliable count is obtained in shorter time, at 30 °C to 35 °C in the test for bacteria and 20 °C to 25 °C in the test for fungi. Count the number of colonies that are formed. Calculate the number of microorganisms per g or per ml of the extract preparation being examined, if necessary count bacteria and fungi separately.

B-7.6 Plate Count for Bacteria

Using Petri dishes 9 to 10 cm in diameter, add to each dish a mixture of 1 ml of the pretreated extract preparation and about 15 ml of liquified casein soyabean digest agar at not more than 45 °C. Alternatively, spread the pretreated extract preparation on the surface of the solidified medium in a Petri dish of the same diameter. If necessary, dilute the pretreated extract preparation as described above so that a colony count of not more than 300 may be expected. Prepare at least two such Petri dishes using the same dilution and incubate at 30 °C to 35 °C for 5 days, unless a more reliable count is obtained in a shorter time. Count the number of colonies that are formed. Calculate the results using plates with the greatest number of colonies but taking 300 colonies per plate as the maximum consistent with good evaluation.

B-7.7 Plate Count for Fungi

Proceed as described in the test for bacteria but use Sabouraud dextrose agar with antibiotics in place of casein soyabean digest agar and incubate the plates at 20 °C to 25 °C for 5 days, unless a more reliable

count is obtained in a shorter time. Calculate the results using plates with not more than 100 colonies.

B-7.8 Multiple Tube or Serial Dilution Method

In each of fourteen test tubes of similar size place 9.0 ml of sterile fluid soyabean casein digest medium. Arrange twelve of the tubes in four sets of three tubes each. Put aside one set of three tubes to serve as controls. Into each of three tubes of one set ("100") and into fourth tube (A) pipette 1 ml of the solution of suspension of the test specimen (extract) and mix. From tube A pipette 1 ml of its contents into the one remaining tube (B) not included in the

set and mix. These two tubes contain 100 mg (or 100 µl) and 10 mg (or 10 µl) of the specimen respectively. Into each of the second set ("10") of three tubes pipette 1 ml from tube A, and into each tube of the third set ("1") pipette 1 ml from tube B. Discard the unused contents of tube A and B. Close well and incubate all of the tubes.

Following the incubation period, examine the tubes for growth. The three control tubes remain clear. Observations in the tubes containing the test specimen, when interpreted by reference to Table 2, indicate the most probable number of microorganisms per g or per ml of the test specimen.

Table 2 Most Probable Total Count by Multiple Tube or Serial Dilution Method

(Clause B-7.8)

Sl No.	Observed Combination of Numbers of Tubes Showing Growth in Each Set			Most Probable Number of Microorganisms per g or per ml
	Number of mg (or ml) of Specimen per Tube			
(1)	100 (100 µL) (2)	10 (10 µL) (3)	1 (1 µL) (4)	(5)
i)	3	3	3	> 1 100
ii)	3	3	2	1 100
iii)	3	3	1	500
iv)	3	3	0	200
v)	3	2	3	290
vi)	3	2	2	210
vii)	3	2	1	150
viii)	3	2	0	90
ix)	3	1	3	160
x)	3	1	2	120
xi)	3	1	1	70
xii)	3	1	0	40
xiii)	3	0	3	95
xiv)	3	0	2	60
xv)	3	0	1	40
xvi)	3	0	0	23

B-8 TESTS FOR SPECIFIED MICROORGANISMS

B-8.1 Pre-Treatment of the Extract Sample Being Examined

Proceed as described under the test for total aerobic microbial count but using lactose broth or any other suitable medium shown to have no antimicrobial activity under the conditions of test in place of buffered sodium chloride peptone solution pH 7.0.

B-8.2 *Escherichia coli*

Place the prescribed quantity in a sterile screw capped container, add 50 ml of nutrient broth, shake,

allow to stand for 1 h (4 h for gelatin) and shake again. Loosen the cap and incubate at 37 °C for 18 to 24 h.

B-8.2.1 Primary Test

Add 1.0 ml of the enrichment culture to a tube containing 5 ml of MacConkey broth. Incubate in a water bath at 36 °C to 38 °C for 48 h. If the contents of the tube show acid and gas, carry out the secondary test.

B-8.2.2 Secondary Test

Add 0.1 ml of the contents of the tubes containing (a) 5 ml of MacConkey broth and (b) 5 ml of peptone

water. Incubate in a water bath at 43.5 °C to 44.5 °C for 24 h and examine tube (a) for acid and gas and tube (b) for indole. To test for indole, add 0.5 ml of Kovac's reagent, shake well and allow to stand for 1 min. If a red colour is produced in the reagent layer indole is present. The presence of acid and gas and of indole in the secondary test indicates the presence of *Escherichia coli*.

Carry out a control test by repeating the primary and secondary tests, adding 1.0 ml of the enrichment culture and a volume of broth containing 10 to 50 *Escherichia coli* (NCTC 9002) organisms, prepared from a 24 h culture in nutrient broth, to 5 ml of MacConkey broth. The test is not valid unless the results indicate that the control contains *Escherichia coli*.

B-8.2.3 Alternative Test

By means of an inoculating loop, streak a portion from the enrichment culture (obtained in the previous test) on the surface of MacConkey agar medium. Cover and invert the dishes and incubate. Upon examination, if none of the colonies are brick red in colour and have a surrounding zone of precipitated bile the sample meets the requirements of the test for the absence of *Escherichia coli*. If the colonies described above are found, transfer the suspect colonies individually to the surface of Levine eosin methylene blue agar medium, plated on petri dishes. Cover and invert the plates and incubate. Upon examination, if none of the colonies

exhibits both a characteristic metallic sheen under reflected light and a blue black appearance under transmitted light, the sample meets the requirements of the test for the absence of *Escherichia coli*. The presence of *Escherichia coli* may be confirmed by further suitable cultural and biochemical tests.

B-8.3 Salmonella

Transfer a quantity of the pretreated preparation being examined containing 1 g or 1 ml of the product to 100 ml of nutrient broth in a sterile screw capped jar, shake, allow to stand for 4 h and shake again. Loosen the cap and incubate at 35 °C to 37 °C for 24 h.

B-8.3.1 Primary Test

Add 1.0 ml of the enrichment culture to each of the two tubes containing (a) 10 ml of selenite F broth and (b) tetrathionate bile brilliant green broth and incubate at 36 °C to 38 °C for 48 h. From each of these two cultures subculture on at least two of the following four agar media: bismuth sulphate agar, brilliant green agar, deoxycholate citrate agar and xylose lysine deoxycholate agar. Incubate the plates at 36 °C to 38 °C for 18 to 24 h. Upon examination, if none of the colonies conforms to the description given in Table 3, the sample meets the requirements of the test for the absence of the genus *Salmonella*. If any colonies conforming to the description in Table 3 are produced, carry out the secondary test.

Table 3 Interpretation of the Confirmatory Tests for *Salmonella*
(Clause B-8.3.1)

Sl No. (1)	Medium (2)	Description of Colony (3)
i)	Bismuth sulphite agar	Black or green
ii)	Brilliant Green Agar	Small, transparent and colorless, or opaque, pinkish or white (frequently surrounded by a pink or red zone)
iii)	Deoxycholate citrate agar	Colorless and opaque, with or without black centers
iv)	Xylose lysine desoxycholate agar	Red with or without black centres

B-8.3.2 Secondary Test

Subculture any colonies showing the characteristics given in Table 2 in triple sugar iron agar by first inoculating the surface of the slope and then making a stab culture with the same inoculating needle, and at the same time inoculate a tube of urea broth. Incubate at 36 °C to 38 °C for 18 to 24 h. The formation of acid and gas in the stab culture (with or without concomitant blackening) and the absence of

acidity from the surface growth in the triple sugar iron agar, together with the absence of a red color in the urea broth, indicate the presence of *Salmonella*. If acid but no gas is produced in the stab culture, the identity of the organisms should be confirmed by agglutination tests.

Carry out the control test by repeating the primary and secondary tests using 1.0 ml of the enrichment culture and a volume of broth containing 10 to 50 *Salmonella abony* (NCTC 6017) organisms,

prepared from a 24 h culture in nutrient broth, for the inoculation of the tubes (a) and (b). The test is not valid unless the results indicate that the control contains *Salmonella*.

B-8.4 *Pseudomonas aeruginosa*

Pretreat the preparation being examined as described above and inoculate 100 ml of fluid soyabean casein digest medium with a quantity of the solution, suspension or emulsion thus obtained containing 1 g or 1 ml of the preparation being examined. Mix and incubate at 35 °C to 37 °C for 24 to 48 h. Examine the medium for growth and if growth is present, streak a portion of the medium on the surface of cetrimide agar medium, each plated on Petri dishes. Cover and incubate at 35 °C to 37 °C for 18 to 24 h.

If, upon examination, none of the plates contains colonies having the characteristics listed in Table 4 for the media used, the sample meets the

requirement for freedom from *Pseudomonas aeruginosa*. If any colonies conforming to the description in Table 4 are produced, carry out the oxidase and pigment tests. Streak representative suspect colonies from the agar surface of cetrimide agar on the surfaces of *Pseudomonas* agar medium for detection of fluorescein and *Pseudomonas* agar medium for detection of pyocyanin contained in Petri dishes. Cover and invert the inoculated media and incubate at 33 °C to 37 °C for not less than 3 days. Examine the streaked surfaces under ultra violet light. Examine the plates to determine whether colonies conforming to the description in Table 4 are present. If growth of suspect colonies occurs, place 2 or 3 drops of a freshly prepared 1 per cent w/v solution of N,N,N1,N1-tetramethyl-4-phenylenediamine dihydrochloride on filter paper and smear with the colony. If there is no development of a pink color, changing to purple, the sample meets the requirements of the test for the absence of *Pseudomonas aeruginosa*.

Table 4 Interpretation of the Confirmatory Tests for *Pseudomonas aeruginosa*
(Clause B-8.4)

Sl No.	Selective Medium	Characteristic Colonial Morphology	Fluorescence in UV Light	Oxidase Test	Gram Stain
(1)	(2)	(3)	(4)	(5)	(6)
i)	Cetrimide agar	Generally greenish	Greenish	Positive	Negative rods
ii)	<i>Pseudomonas</i> agar medium for detection of fluorescein	Generally colorless to yellowish	Yellowish	Positive	Negative rods
iii)	<i>Pseudomonas</i> agar for detection of pyocyanin	Generally greenish	Blue	Positive	Negative rods

B-8.5 *Staphylococcus aureus*

Proceed as described under *Pseudomonas aeruginosa*, if upon examination of the incubated plates, none of them contains colonies having the characteristics listed in for the media used, the sample meets the requirements for the absence of

Staphylococcus aureus. If growth occurs, carry out the coagulase test. Transfer representative suspect colonies from the agar surface of any of the media listed in Table 5 to individual tubes, each containing 0.5 ml of mammalian, preferably rabbit or horse, plasma with or without additives.

Table 5 Interpretation of the Confirmatory Tests for *Staphylococcus aureus*
(Clause B-8.5)

Sl No.	Selective Medium	Characteristic Colonial Morphology	Gram Stain
(1)	(2)	(3)	(4)
i)	Vogel Johnson agar	Black surrounded by yellow zones	Positive cocci (in clusters)
ii)	Mannitol salt agar	Yellow colonies with yellow zones	Positive cocci (in clusters)
iii)	Baird parker agar	Black, shiny, surrounded by clear zones of 2 to 5 mm	Positive cocci (in clusters)

Incubate in water bath at 37 °C examining the tubes at 3 h and subsequently at suitable intervals up to 24 h. If no coagulation in any degree is observed, the sample meets the requirements of the test for the absence of *Staphylococcus aureus*.

B-8.6 Validity of the Tests for Total Aerobic Microbial Count

Grow the following test strains separately in tubes containing fluid soyabean casein digest medium at 30 °C to 35 °C for 18 to 24 h or, for *Candida albicans*, at 20 °C for 48 h.

Staphylococcus aureus (ATCC 6538; NCTC 10788)
Bacillus subtilis (ATCC 6633; NCIB 8054)
Escherichia coli (ATCC 8739; NCIB 8545)
Candida albicans (ATCC 2091; ATCC 10231)

Dilute portions of each of the cultures using buffered sodium chloride peptone solution pH 7.0 to make test suspensions containing about 100 viable microorganisms per ml. Use the suspension of each of the microorganisms separately as a control of the counting methods, in the presence and absence of the preparation being examined, if necessary.

A count for any of the test organisms differing by not more than a factor of 10 from the calculated value for the inoculum should be obtained. To test the sterility of the medium and of the diluent and the aseptic performance of the test, carry out the total aerobic microbial count method using sterile buffered sodium chloride peptone solution pH 7.0 as the test preparation. There should be no growth of microorganisms.

B-8.7 Validity of the Tests for Specified Microorganisms

Grow separately the test strains of *Staphylococcus aureus* and *Pseudomonas aeruginosa* in fluid soyabean casein digest medium and *Escherichia coli* and *Salmonella typhimurium* at 30 °C to 35 °C for 18 to 24 h. Dilute portions of each of the cultures using buffered sodium chloride peptone solution pH 7.0 to make test suspensions containing about 10³ viable microorganisms per ml. Mix equal volume of each suspension and use 0.4 ml (approximately 10² microorganisms of each strain) as an inoculum in the test for *E. coli*, *S. typhimurium*, *P. aeruginosa* and *S. aureus*, in the presence and absence of the extract preparation being examined, if necessary. A positive result for the respective strain of microorganism should be obtained.

ANNEX C

(Foreword)

COMMITTEE COMPOSITION

Ayush Sectional Committee, FAD 26

<i>Organization</i>	<i>Representative(s)</i>
Ministry of Ayush, New Delhi	DR D. C. KATOCH (<i>Chairperson</i>)
Association of Manufacturers of Ayurvedic Medicines, New Delhi	DR V. SASHIBHUSHAN SHRI ARJUN MULTANI (<i>Alternate</i>)
Ayurvedic Drug Manufacturers Association, Mumbai	DR NAGESH SANDU SHRI NIMISH SHROFF (<i>Alternate</i>)
Ayurvedic Medicines Manufacturer Organization of India	DR D. RAMANATHAN DR SINDHU A. (<i>Alternate</i>) DR MEENU M. (<i>Young Professional</i>)
Central Council for Research in Ayurvedic Sciences, New Delhi	DR ARJUN SINGH DR (MS) SHRUTI KHANDURI (<i>Alternate</i>)
Central Council for Research in Yoga and Naturopathy, New Delhi	DR B. VENKATESWAR RAO SHRI SURENDER SANDHU (<i>Alternate</i>)
Central Drug Standards Control Organization, New Delhi	DR S. P. SHANI SHRI SUSHANTA SARKAR (<i>Alternate</i>)
Central Institute of Medicinal and Aromatic Plants, Lucknow	DR KARUNA SHANKAR
Dabur India Limited, Ghaziabad	DR RAJIV RAI DR RANJAN MITRA (<i>Alternate</i>) DR VINOD KUMAR UPADHYAYA (<i>Young Professional</i>)
Defence Research and Development Organization, New Delhi	DR A. D. SEMWAL DR NIDHI SANDAL (<i>Alternate</i>) DR DHRUV K. NISHAD (<i>Young Professional</i>)
Indian Yoga Association, New Delhi	SHRI ANIL JAUHRI SHRI S. KRISHNAMURTHY (<i>Alternate</i>) MS RENU JAIN (<i>Young Professional</i>)
Morarji Desai National Institute of Yoga, New Delhi	DR ISHWAR BASAVARADDI SHRIMATI HIMANI SHOKHAND (<i>Alternate</i>)
National Ayurveda Research Institute for Panchakarma, Cheruthuruthy	DR V. C. DEEP DR ASWANI P. S. (<i>Alternate</i>) DR REMYA E. (<i>Young Professional</i>)
National Botanical Research Institute, Lucknow	MS SAYYADA KHATOON SHRI C. H.V. RAO (<i>Alternate</i>)
National Dairy Research Institute, Karnal	DR VIVEK SHARMA
National Institute of Ayurveda, Jaipur	DR SANJEEV SHARMA

<i>Organization</i>	<i>Representative(s)</i>
	DR SUDIPTA KUMAR RATH (<i>Alternate</i>)
Pharmacopoeial Commission of Indian Medicine and Homoeopathy, Ghaziabad	DR P. K. PRAJAPATI DR G. V. R. JOSEPH (<i>Alternate</i>) SHRI JITENDRA PAL SINGH (<i>Young Professional</i>)
Quality Council of India, New Delhi	DR MANISH PANDE DR VANDANA SIROHA (<i>Alternate</i>)
BIS Directorate General	SHRIMATI SUNEETI TOTEJA, SCIENTIST 'E'/DIRECTOR AND HEAD (FOOD AND AGRICULTURE DEPARTMENT) [REPRESENTING DIRECTOR GENERAL (<i>Ex – officio</i>)]

Member Secretary

DR PRADEEP KUMAR DUA

SCIENTIST 'D'/JOINT DIRECTOR (FOOD AND AGRICULTURE DEPARTMENT), BIS

Panel for Herbal materials and related subjects, FAD 26/Panel 1

<i>Organization</i>	<i>Representative(s)</i>
Pharmacopoeial Commission of Indian Medicine and Homoeopathy, Ghaziabad	DR G. V. R. JOSEPH (<i>Convener</i>)
Bureau of Indian Standards, New Delhi	DR RAGHAVENDRA NAIK DR SNEH LATA JAIN
Spices Board of India, Cochin	DR REMA SHREE A. B

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This Indian Standard has been developed from Doc No.: FAD 26 (19494).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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