Agar

1 Nonproprietary Names

JP: Agar

PhEur: Agar

USP–NF: Agar

2 Synonyms

Agar-agar; agar-agar flake; agar-agar gum; Bengal gelatin; Bengal gum; Bengal isinglass; Ceylon isinglass; Chinese isinglass; E406; gelosa; gelose; Japan agar; Japan isinglass; layor carang; vegetable gelatin.

3 Chemical Name and CAS Registry Number

Agar [9002-18-0]

4 Empirical Formula and Molecular Weight

See Section 5.

5 Structural Formula

Agar is a dried, hydrophilic, colloidal polysaccharide complex extracted from the agarocytes of algae of the Rhodophyceae. The structure is believed to be a complex range of polysaccharide chains having alternating α-(1→3) and β-(1→4) linkages. There are three extremes of structure noted: namely neutral agarose; pyruvated agarose having little sulfation; and a sulfated galactan. Agar can be separated into a natural gelling fraction, agarose, and a sulfated nongelling fraction, agaropectin.

6 Functional Category

Emulsifying agent; gelling agent; modified-release agent; suppository base; suspending agent; tablet and capsule binder; tablet and capsule disintegrant (treated agar); viscosity-increasing agent.

7 Applications in Pharmaceutical Formulation or Technology

Agar is widely used in food applications as a stabilizing agent. In pharmaceutical applications, agar is used in a handful of oral tablet and topical formulations. It has also been investigated in a number of experimental pharmaceutical applications including as a sustained-release agent in gels, beads, microspheres, and tablets.[1–5] It has been reported to work as a disintegrant in tablets.[6–8] Agar has been used in a floating controlled-release tablet; the buoyancy in part being attributed to air entrapped in the agar gel network.[9] It has been used as a polymeric carrier for buccal delivery in the form of thin films containing a drug[10–12] and as a co-processing excipient to improve compressibility of a poorly compressible drug.[13] It can be used as a viscosity-increasing agent in aqueous systems. Agar can also be used as a base for nonmelting, and nondisintegrating suppositories.[14] Agar has an application as a suspending agent in pharmaceutical suspensions.[15] Agar co-processed with mannitol has been used as a fast disintegrating excipient for orodispersible tablets of a drug.[16] It has also been used to modify the properties of other natural polymers by chemically grafting agar with these natural polymers or by simple hydrogen bonding to result in better hydrogel systems.[17,18]

8 Description

Agar occurs as transparent, odorless, tasteless strips or as a coarse or fine powder. It may be weak yellowish-orange, yellowish-gray to pale-yellow colored, or colorless. Agar is tough when damp, brittle when dry.

9 Pharmacopeial Specifications

See Table I.

Table I: Pharmacopeial specifications for agar.

Test	JP XVII	PhEur 9.2	USP 40–NF 35 S1
Identification	+	+	+
Characters	+	+	–
Swelling index	–	+	–
Arsenic	–	–	≤3 ppm
Lead	–	–	≤10 ppm
Sulfuric acid	+	–	–
Sulfurous acid and starch	+	–	–
Gelatin	–	+	+
Heavy metals	–	–	≤40 ppm
Insoluble matter	≤15.0 mg	≤1.0%	≤15.0 mg
Water absorption	≤75 mL	–	≤75 mL
Loss on drying	≤22.0%	≤20.0%	≤20.0%
Microbial contamination	–	$\leq 10^3$ cfu/g[a]	+
Total ash	≤4.5%	≤5.0%	≤6.5%
Acid-insoluble ash	≤0.5%	–	≤0.5%
Foreign organic matter	–	–	≤1.0%
Limit of foreign starch	–	–	+

(a) Total viable aerobic count, determined by plate-count.

10 Typical Properties

Gelling Agar gels are thermo-reversible, rigid, brittle, and have sharp melting and gelling points. They further demonstrate the phenomenon of syneresis and hysteresis. Gelling occurs at temperatures far below the gel melting temperature. A 1.5% solution of agar forms a gel on cooling to about 32°C to 45°C. The gel strength of agar is influenced by concentration, time, pH and sugar content. The pH demonstrates the most noticeable effect on gel strength where gel strength decreases with a decrease in pH.

Solubility Soluble in boiling water to form a viscous solution; practically insoluble in ethanol (95%), and cold water. A 1% w/v aqueous solution forms a stiff jelly on cooling.

Spectroscopy

IR spectrum *see* Figure 1.

NIR spectrum *see* Figure 2.

Raman spectrum *see* Figure 3.

11 Stability and Storage Conditions

Agar solutions are most stable at pH 4–10. Prolonged exposure to high temperatures can degrade solutions of agar resulting in lower gel strength.

Agar should be stored in a cool, dry, place. Containers of this material may be hazardous when empty since they retain product residues (dust, solids).

12 Incompatibilities

Agar is incompatible with strong oxidizing agents. Agar is dehydrated and precipitated from solution by ethanol (95%). Tannic