

# GENUS: ACTINOMYCETES

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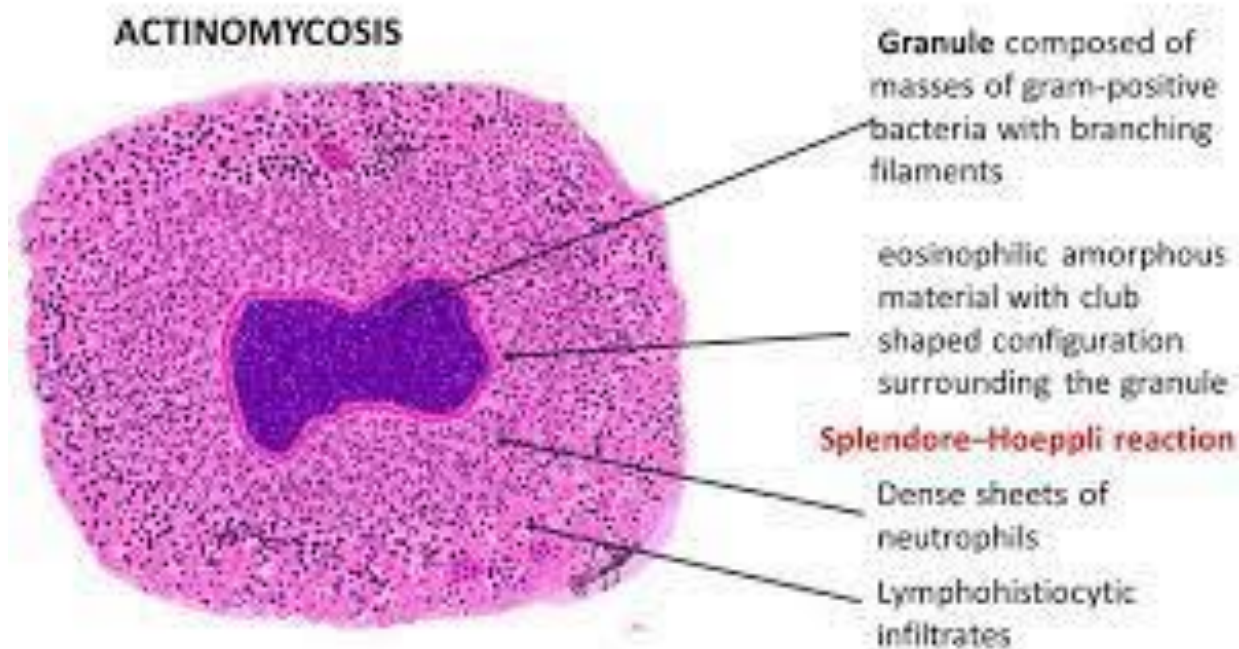
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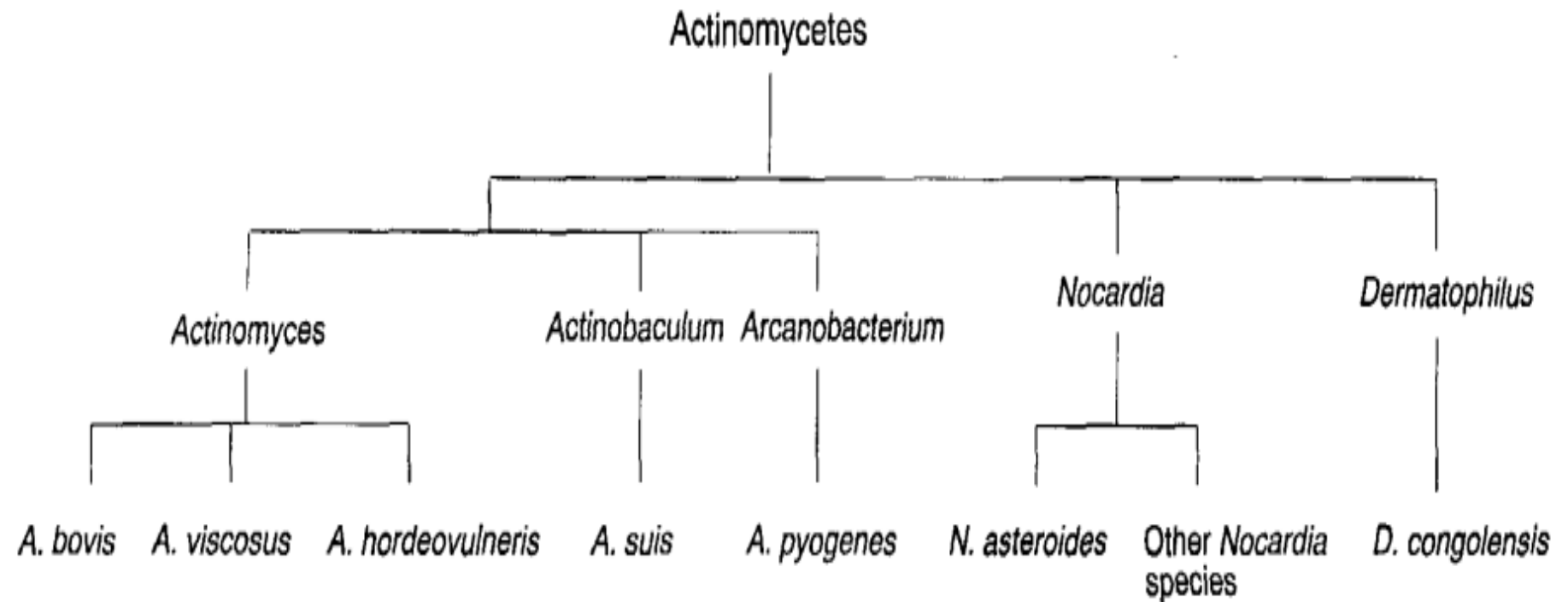
# ACTINOMYCETES

- The actinomycetes are Gram-positive bacteria
- Grow slowly and produce branching filaments.
- Because of filament formation and granulomatous responses to tissue invasion, these organisms were originally regarded as fungi.
- However, filaments of the prokaryotic actinomycetes rarely exceed 1.0  $\mu\text{m}$  in width, whereas hyphae of the eukaryotic fungi are usually more than 5  $\mu\text{m}$  wide.



- The actinomycetes which cause disease in domestic animals belong to the genera *Actinomyces*, *Arcanobacterium*, *Actinobaculum*, *Nocardia* and *Dermatophilus*





*Figure 12.1* Pathogenic actinomycetes of veterinary importance.

- Some thermophilic actinomycetes, such as *Micropolyspora faeni* found in poor-quality overheated hay, produce spores which can induce allergic pulmonary disease in cattle, horses and man – **Farmers lung**
- The species in these genera are **non-motile, non-spore-forming, Gram-positive bacteria** which require enriched media for growth.
- *Arcanobacterium pyogenes* has undergone name changes in recent years; it was formerly called *Actinomyces pyogenes* and before that *Corynebacterium pyogenes*.



# USUAL HABITAT

- *Actinomyces bovis* is found in the oropharynx of cattle and other domestic animals.
- *Actinomyces viscosus* is a commensal in the oral cavity of dogs and humans.
- *Arcanobacterium pyogenes* is commonly present on the nasopharyngeal mucosa of cattle, sheep and pigs.
- The usual habitat of *Actinobaculum suis* is the preputial mucosa of boars.
- *Actinomyces hordeovulneris* is uncertain, the organism appears to be closely associated with awns in the seed heads of grasses of the genus *Hordeum*.



# DIFFERENTIATION OF THE GENERA

**Table 12.1** Comparative features of actinomycetes of veterinary importance.

Feature	<i>Actinomyces</i> species	<i>Arcanobacterium pyogenes</i>	<i>Actinobaculum suis</i>	<i>Nocardia</i> species	<i>Dermatophilus congolensis</i>
Atmospheric growth requirements	Anaerobic or facultatively anaerobic and capnophilic	Facultatively anaerobic and capnophilic	Anaerobic	Aerobic	Aerobic and capnophilic
Aerial filament production	—	—	—	+	—
Modified Ziehl-Neelsen staining	—	—	—	+	—
Growth on Sabouraud dextrose agar	—	—	—	+	—
Usual habitat	Nasopharyngeal and oral mucosae	Nasopharyngeal mucosa of cattle, sheep and pigs	Prepuce and preputial diverticulum of boars	Soil	Skin of carrier animals, scabs from lesions
Site of lesions	Many tissues including bone	Soft tissues	Urinary tract of sows	Thoracic cavity, skin and other tissues	Skin



## Biochemical reactions

- In routine diagnosis, a presumptive identification of *A. pyogenes* is based on colonial morphology and pitting of a Loeffler's serum slope within 24 hours, which indicates proteolytic activity.
- It also hydrolyses gelatin.
- Urease is produced by *A. suis*

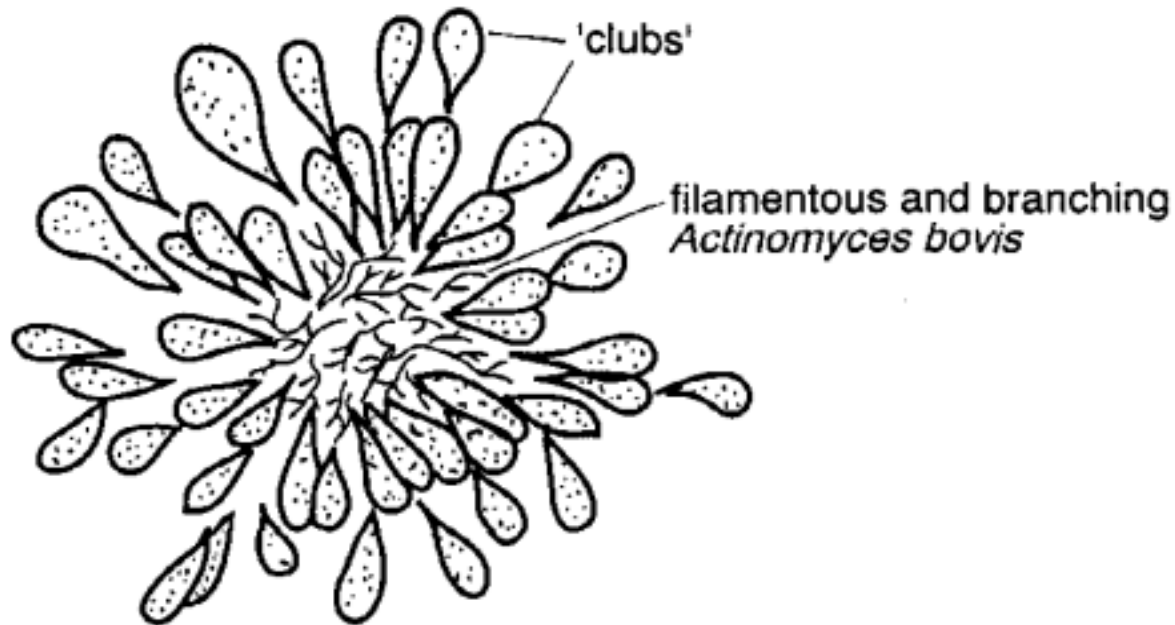




# GRANULES IN PUS

- Granules can be detected when pus is diluted with distilled water in a Petri dish.
- In infections caused by *A. bovis*, pinhead-sized, yellowish 'sulphur granules' are found.
- Whitish, soft, grey granules are demonstrable in pus from animals infected with *A. viscosus*.
- Granules in lesions caused by *A. bovis* contain characteristic clubs.
- Club colony formation is a feature of other chronic infections such as bovine actinobacillosis caused by *Actinobacillus lignieresii* and botryomycosis usually associated with *Staphylococcus aureus*.





**Figure 12.3** A club colony with a core of branching filaments of *Actinomyces bovis* surrounded by club-shaped structures. These structures are part of the host response to this chronic infection.



**Table 12.3** Differentiation of *Actinomyces*, *Arcanobacterium* and *Actinobaculum* species of veterinary importance.

Characteristic	<i>Actinomyces bovis</i>	<i>Actinomyces viscosus</i>	<i>Actinomyces hordeovulneris</i>	<i>Arcanobacterium pyogenes</i>	<i>Actinobaculum suis</i>
Morphology	Filamentous branching, some short forms	Filamentous branching, short forms	Filamentous branching, short forms	Coryneform	Coryneform
Atmospheric requirements	Anaerobic + CO <sub>2</sub>	10% CO <sub>2</sub>	10% CO <sub>2</sub>	Aerobic	Anaerobic
Haemolysis on sheep blood agar	±	–	±	+	±
Catalase production	–	+	+	–	–
Pitting of Loeffler's serum slope	–	–	–	+	–
Granules in pus	'Sulphur granules'	White granules	No granules	No granules	No granules

**Table 12.2** Disease conditions produced by *Actinomyces*, *Arcanobacterium* and *Actinobaculum* species in domestic animals.

Species	Hosts	Disease conditions
<i>Arcanobacterium pyogenes</i>	Cattle, sheep, pigs	Abscessation, mastitis, suppurative pneumonia, endometritis, pyometra, arthritis, umbilical infections
<i>Actinomyces hordeovulneris</i>	Dogs	Cutaneous and visceral abscessation, pleuritis, peritonitis, arthritis
<i>Actinomyces bovis</i>	Cattle	Bovine actinomycosis (lumpy jaw)
<i>A. viscosus</i>	Dogs	Canine actinomycosis: — cutaneous pyogranulomas — pyothorax and proliferative pyogranulomatous pleural lesions — disseminated lesions (rare)
	Horses	Cutaneous pustules
	Cattle	Abortion
<i>Actinomyces</i> species (unclassified)	Pigs	Pyogranulomatous mastitis
	Horses	Poll evil and fistulous withers
<i>Actinobaculum suis</i>	Pigs	Cystitis, pyelonephritis

**Table 12.4** Disease conditions produced by *Nocardia* species in domestic animals.

Species	Hosts	Disease conditions
<i>Nocardia asteroides</i>	Dogs	Canine nocardiosis: — cutaneous pyogranulomas — pyogranulomatous pleural lesions and pyothorax — disseminated lesions
	Cattle	Chronic mastitis, abortion
	Pigs	Abortion
	Sheep, goats, horses	Wound infections, mastitis, pneumonia, other pyogranulomatous conditions
<i>Nocardia farcinica</i>	Cattle	Bovine farcy <sup>a</sup>

a some mycobacteria have also been implicated in bovine farcy



**Table 12.5** Differentiation of *Nocardia asteroides* and *Actinomyces viscosus*.

Characteristic	<i>Nocardia asteroides</i>	<i>Actinomyces viscosus</i>
MZN-staining of filaments	+	–
Atmospheric requirement	Aerobic	10% CO <sub>2</sub>
Growth on Sabouraud dextrose agar	+	–
Susceptibility to Penicillin G	–	+

MZN modified Ziehl-Neelsen stain



# BOVINE ACTINOMYCOSIS (LUMPY JAW)

- Invasion of the mandible and, less commonly, the maxilla of cattle by *A. bovis* causes a chronic rarefying osteomyelitis.
- A painless swelling of the **affected bone** enlarges over a period of several weeks.
- The swelling becomes painful and fistulous tracts, discharging purulent exudate, develop.



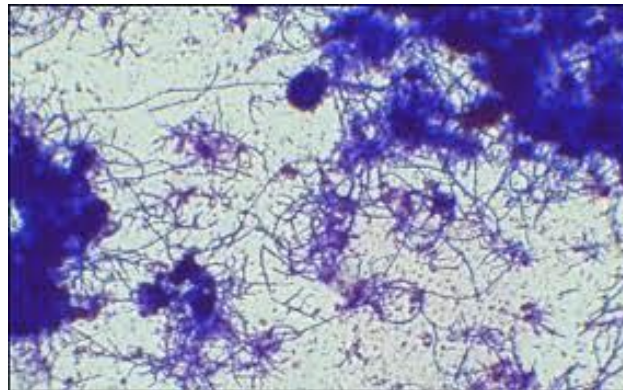


- Spread to continuous soft tissues may occur but there is minimal involvement of regional lymph nodes.
- Lumpy jaw should be distinguished from other conditions which result in swelling of the bones of the jaw and from Actinobacillosis which may involve the soft tissues of the head.

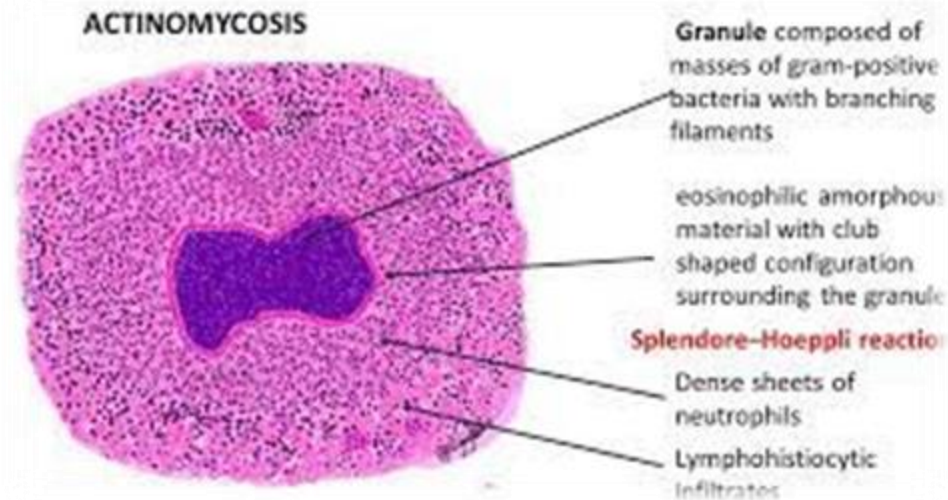


# DIAGNOSTIC PROCEDURES

- Clinical presentation, species affected and type and location of lesions may suggest the species involved.
- Gram-stained smears may reveal morphological forms typical of the aetiological agent.
- Unlike *Nocardia* species, these bacteria are modified Ziehl-Neelsen (MZN) negative.



- Histopathological examination of specimens from lesions caused by *A. bovis* reveals aggregates of filamentous organisms surrounded by eosinophilic club shaped structures



- Identification criteria for isolates:
  - ❖ Colonial characteristics
  - ❖ Morphology in stained smears
  - ❖ Presence or absence of haemolysis on blood agar
  - ❖ Absence of growth on MacConkey agar
  - ❖ Absence or presence of growth when subcultured onto Sabouraud dextrose agar
  - ❖ Pitting of a Loeffler's serum slope (*A. pyogenes*)
  - ❖ Urease production (*A. suis*)



## FURTHER READINGS

- Clinical Veterinary Microbiology 2nd Edition 2013 By Bryan Markey
- Veterinary Microbiology and Microbial Disease

