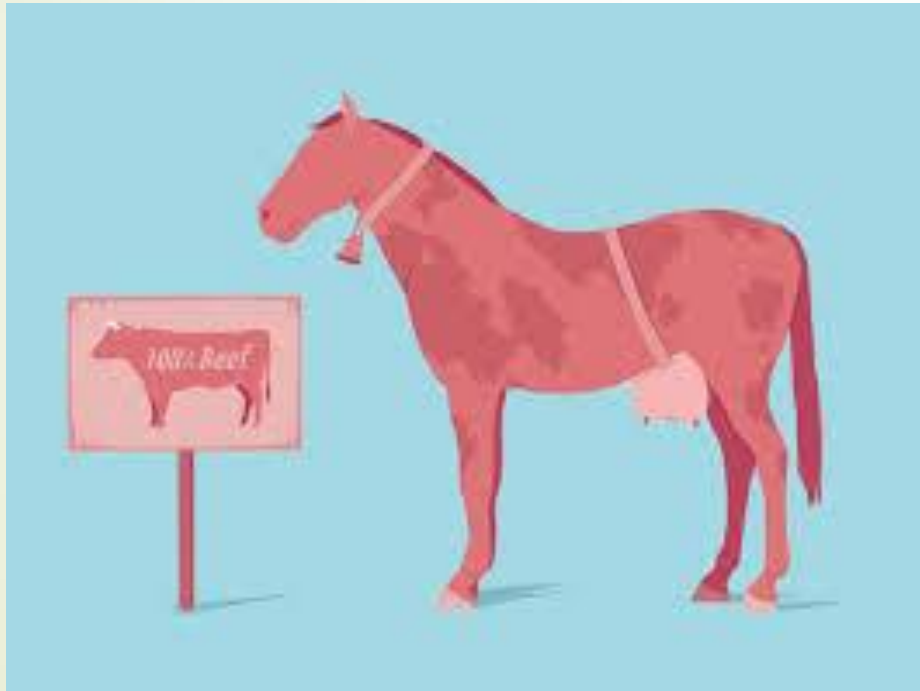


Meat Speciation



Introduction

- **Mixing of meat of one species with another**
- **Mislabeling**
- **Adulteration** of meat is “the fraudulent practice which involves substitution or mixing of flesh of cheaper variety which is objectionable for the reason of health, religion and economics”.
- **Mixing of meat of one species with another is punishable under the Prevention of Adulteration Act, 1973.**
- **Common substitutions include horse flesh as beef, mutton as chevon, mutton as venison and beef as mutton.**

Methods for identification of meat

- **Various methods of identification of meat of different species:**
 - **Anatomical method**
 - **Physical method**
 - **Chemical method**
 - **Biological method**
 - **Immunological method**
 - **Novel methods**

Anatomical Method

Species of meat can be differentiated on the basis of:

► Color, texture and odour of flesh:

- Buffalo meat is **darker and coarser** than cattle meat
- Chevon is associated with a **typical goaty odour**

► Colour consistency & distribution of fat:

- **Fat of cattle** being yellowish as compared to white fat of buffalo
- **Marbling of fat is seen in cattle and buffalo** while most of the fat in pig is subcutaneous in nature.

► Osseous tissue like bones or cartilage:

- Poultry meat can be identified from other species owing to smaller & soft nature of the bones



Anatomical Method

- ▶ Difference in **colour, texture, odour, fat, bone and cartilage** of various species of animals.
- ▶ Buffalo meat is **darker and coarser** than cattle meat.
- ▶ Chevon is associated with a **typical goaty odour**.
- ▶ **Fat of cattle** being yellowish as compared to white fat of buffalo.
- ▶ **Marbling of fat is seen in cattle and buffalo** while most of the fat in pig is subcutaneous in nature.



Species	Meat			Fat	
	Colour	Consistency	Odour	Colour & Consistency	Distribution
Sheep (mutton)	Pinkish	Firm	Faint	White and firm	Inter muscular fat present
Goat (chevon)	Pale red	Firm	Goaty	White	Inter muscular fat absent
Cattle (beef)	Red	Fairly firm	-	Yellowish White and very firm	Inter muscular fat present
Buffalo (cara beef)	Dark red	Fairly firm	-	Pure white and firm	-
Pig (pork)	Pinkish grey	Soft	Urine like	White and soft greasy	S/C and Intramuscular
Young cattle (veal)	Pale pink	Not firm	-	White and firm	Very less fat
Horse (Chevaline)	Dark red/ bluish	Soft	Sweetish	Yellow and soft greasy	No inter muscular fat
Poultry (Chicken)	White	Firm	-	Yellow and loose	Abdominal cavity and S/C



Mutton



Chevon



Beef



Cara beef



Pork



Veal



chevaline

- Animal carcass can be differentiated **on the basis of the dentition, number of bones, presence or absence of a specific structure on bones.**
- **Dentition of different animal species**

Species	Temporary	Permanent
Cattle/ sheep/ goat/ buffalo	$2(0030/ 3130) = 20$	$2(0030/ 3133)= 32$
Pig	$2(3130/3130)= 28$	$2(3143/3143)= 44$
Horse	$2(3030/3030)= 24$	$2(3133/3133)= 40$

- **Vertebrae of different species**

Species	Vertebrae
Cattle/ Buffalo	C7T13L6S5Cy18-20
Sheep/ Goat	C7T13L6S4Cy16-18
Horse	C7T18L6S5Cy15-21
Pig	C7T14-15L6-7S4Cy20-23
Poultry	C15-17T7L+S14Cy5-6

Differentiation of carcass of horse and cattle

- In case of horse there is unusual **length of sides**, together with the **great muscular development of hindquarters**
- The **thoracic cavity is longer** in horse with **18 pairs of ribs**, whereas in cattle there are 13 pairs ribs
- The **ribs of horse are narrower** but more markedly **curved**
- The superior spinous processes of the first six dorsal vertebrae are more developed and less inclined posteriorly in horse.
- In the forequarter the **ulna extends only half the length of the radius in horse**. In cattle it extends and articulates with the carpus.

Differentiation of carcass of horse and cattle

- ▶ The **fibula of horse extends upto two thirds the length of the tibia**
In cattle femur possesses **no third trochanter** and the fibula is only a **small pointed projection**.
- ▶ The **last three lumbar transverse processes articulate with each other**, the sixth articulating in the similar manner with the sacrum in horses, while in cattle they do not articulate
- ▶ Carcass of horse shows considerable development of **soft yellow fat beneath the peritoneum**, especially in mares, but in stallion the fat is generally of a lighter colour and almost white.
- ▶ In **ox the kidney fat is always firmer, white and more abundant** than in horse.
- ▶ **Horse flesh is dark bluish red** and the meat has **pronounced sweet taste and well-defined muscle fibers**.

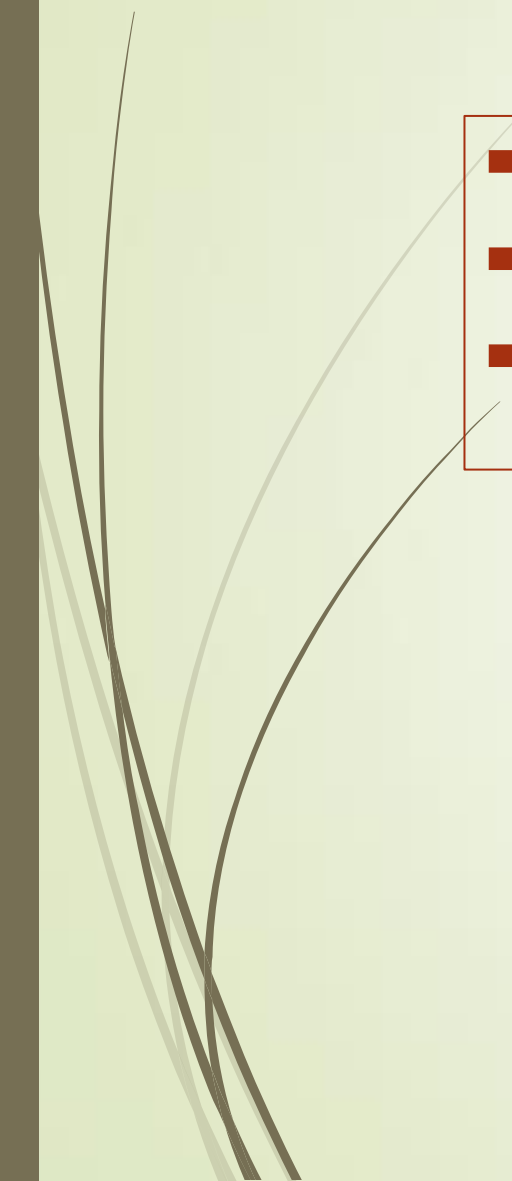
Differentiation of carcass of sheep and goat

Feature	Sheep	Goat
Back & withers	Round and well fleshed	Sharp, little flesh
Thorax	Barrel shaped	Flattened laterally
Tail	Fairly broad	Thin
Radius	1.25 times length of metacarpus	Twice as long as metacarpus
Scapula	Short and broad. Superior spine, bent back and thickened	Possesses distinct neck. Spine straight and narrow
Sacrum	Lateral borders thickened in form of rolls	Lateral borders thin and sharp
Flesh	Pale red and fine in texture	Dark red and coarse with goaty odour. Sticky subcutaneous tissue, which may have adherent goat hairs





Disadvantages

- Method can not be applied in minced form of meat
 - Cooked/ boiled meat
 - Absence of characteristic osseous structures
- 

Chemical Method

- ▶ **Linoleic acid:** Horse fat contains 1 to 2% linoleic acid whereas all other fat contain less than 0.1%.
- ▶ **Glycogen content:** The glycogen content of horse flesh is very high but in case of animals that are exhausted or emaciated the value may be low leading to misinterpretation of results.

Physical Method

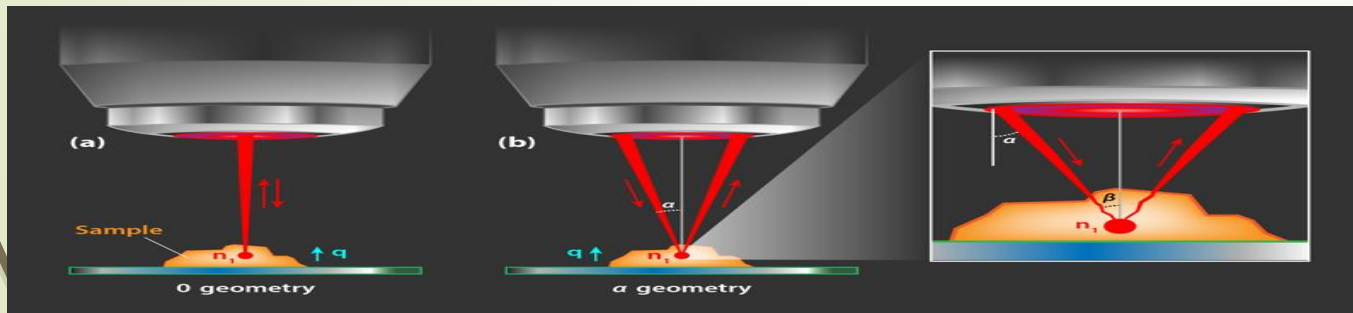
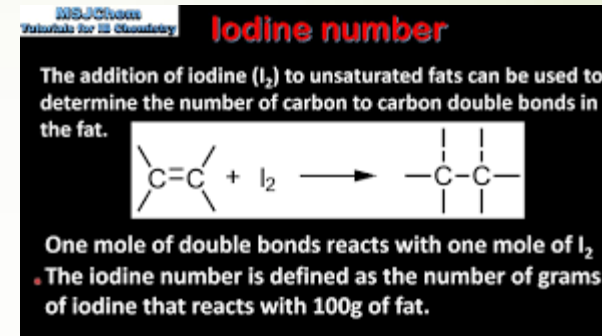
These tests are based on the presence or absence of a certain chemicals or their quantity in meat.

➤ **Iodine value:** the test is based on the amount of iodine absorbed by the unsaturated fatty acids present in fat and varies with the species of animal.

- Horse: 71-86
- Cattle: 38-46
- Sheep: 35-46
- Pig: 50-70.

➤ **Refractive index:** Fat is heated and converted to oil and the refractive index estimated by means of a refractometer.

- Horse: 53.3
- Cattle: <40
- Pig: <51.9





Disadvantages: Physical and chemical methods

- Method can not be employed in minced meat, lean meat mixture of meats having closer indices form of meat
- Cooked/ boiled and processed meat

Biochemical Method

- Various biochemical tests based on the **size, migration pattern etc. of proteins** can be utilized for meat speciation.
- These tests are **useful in minced meat** but do not give good results for cooked meat.

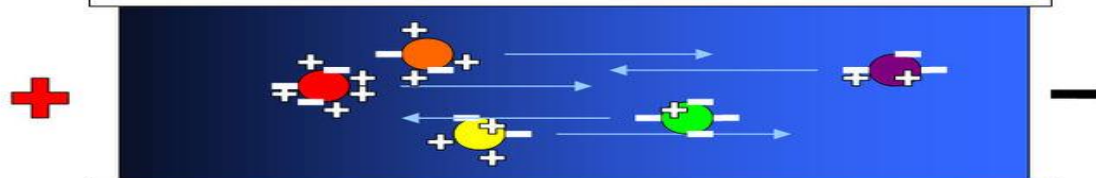
Iso-electric focusing

- The specific pH of proteins at which their overall electric charge becomes zero and they get precipitated is known as the iso-electric point.
- This technique involves the migration of protein through pH gradient in polyacrylamide or agarose gel.
- The muscle proteins migrate on gel having ampholyte bed under strong electric field and precipitate at specific iso-electric point giving bands.

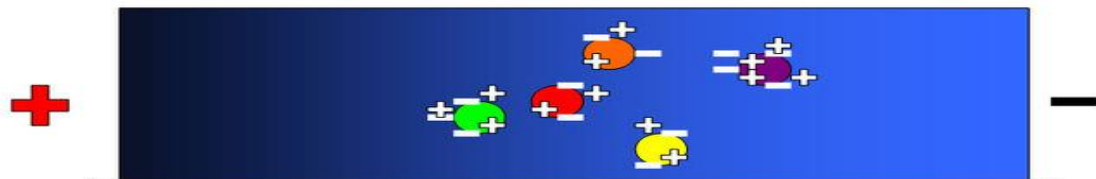
Stable pH gradient



At low pH, most proteins have a positive charge while at high pH, most proteins have a negative charge.



When an electric field is present, the cathode and anode ends pull the proteins to their isoelectric point where each individual protein possesses a neutral charge.



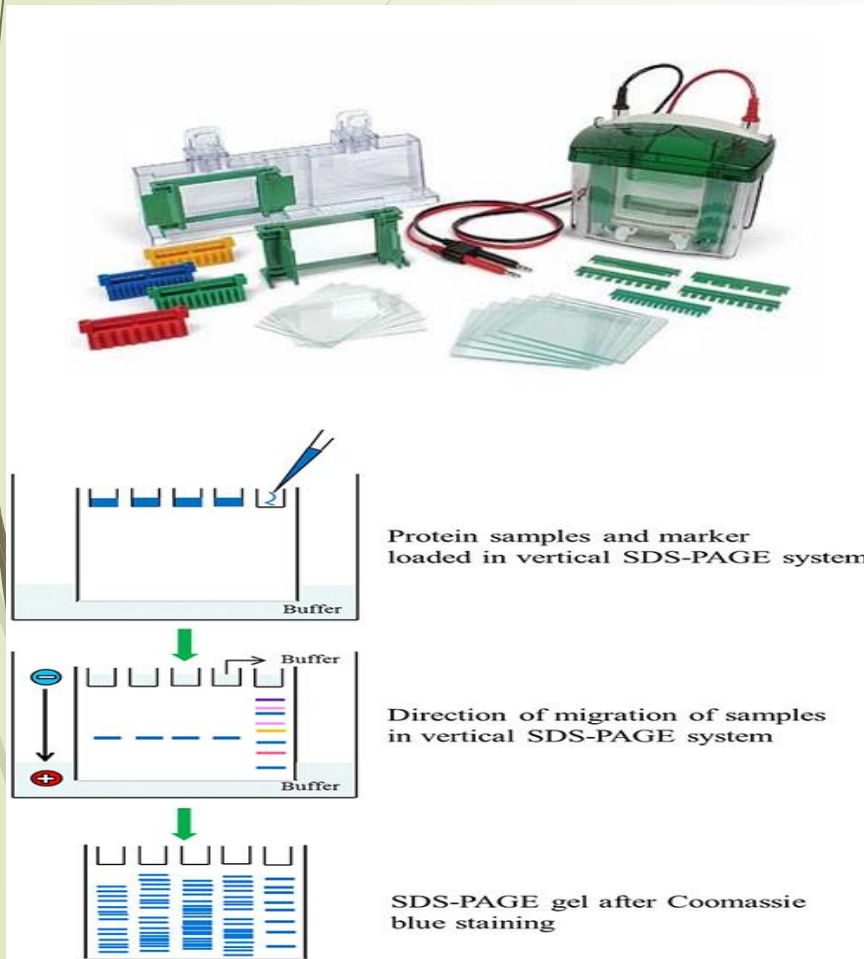
The proteins stopped migrating because they've reached their isoelectric point at a unique pH level.

- = Isoelectric point at pH 7.5
- = Isoelectric point at pH 6.8
- = Isoelectric point at pH 8.5
- = Isoelectric point at pH 10.1
- = Isoelectric point at pH 5.6

- ❖ The number of bands, their distribution pattern and iso-electric point are specific for every species and help in identification from a mixture of meats.
- ❖ The test can be performed on blood, serum, milk, organ etc.

SDS-PAGE

(Sodium Dodecyl Sulfate Polyacrylamide Gel Electrophoresis)

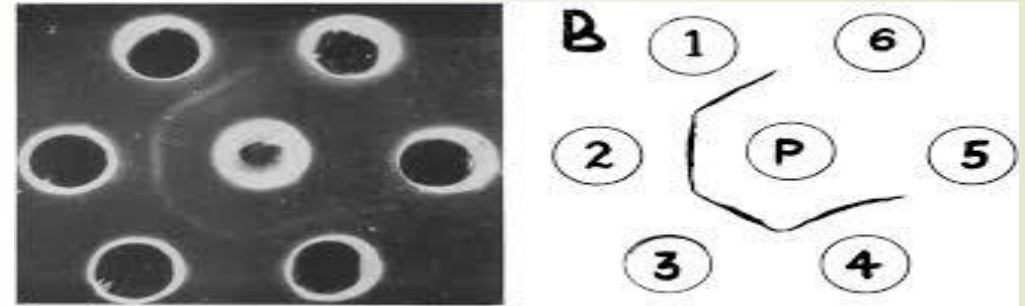


- The charge on proteins gets neutralized on treatment with detergents like sodium dodecyl sulphate.
- Such proteins migrate through polyacrylamide gel on the basis of size giving a specific banding pattern on staining with suitable dye.
- The band pattern is specific for a particular species and thus helps in identification of species.

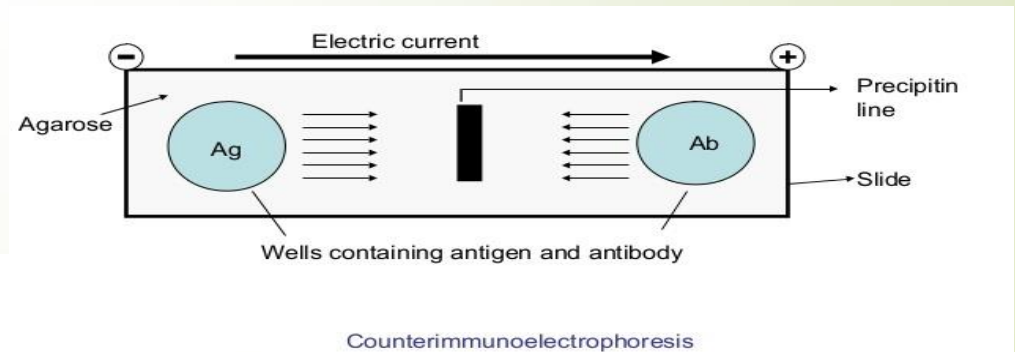
Immunological tests

➤ These tests are based on the antigen antibody reaction.

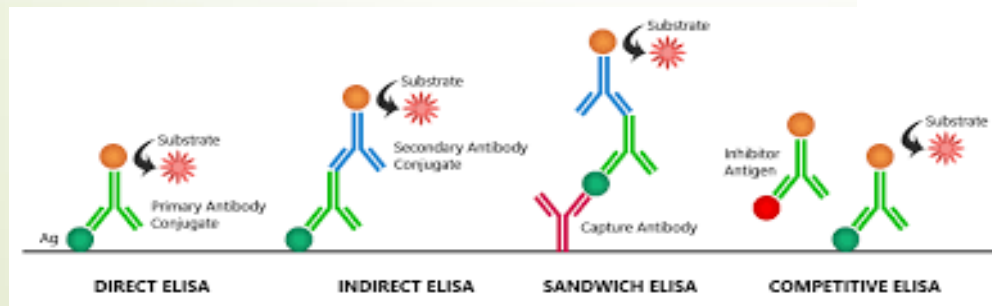
➤ **Agar gel precipitation test**



➤ **Counter current immunoelectrophoresis**



➤ **ELISA**



Molecular Method

- Modern DNA based techniques like **Polymerase chain reaction** and **gene probes** are being used for identification of species.

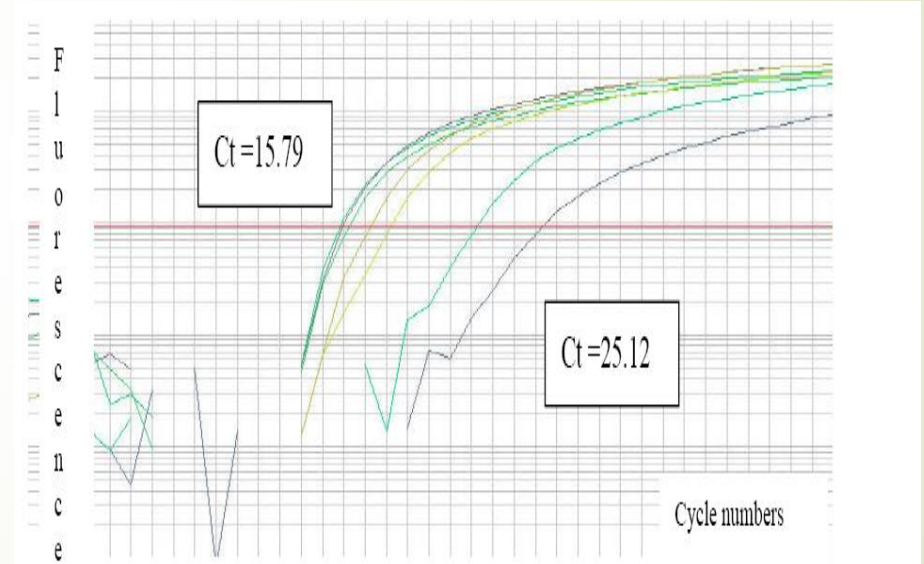
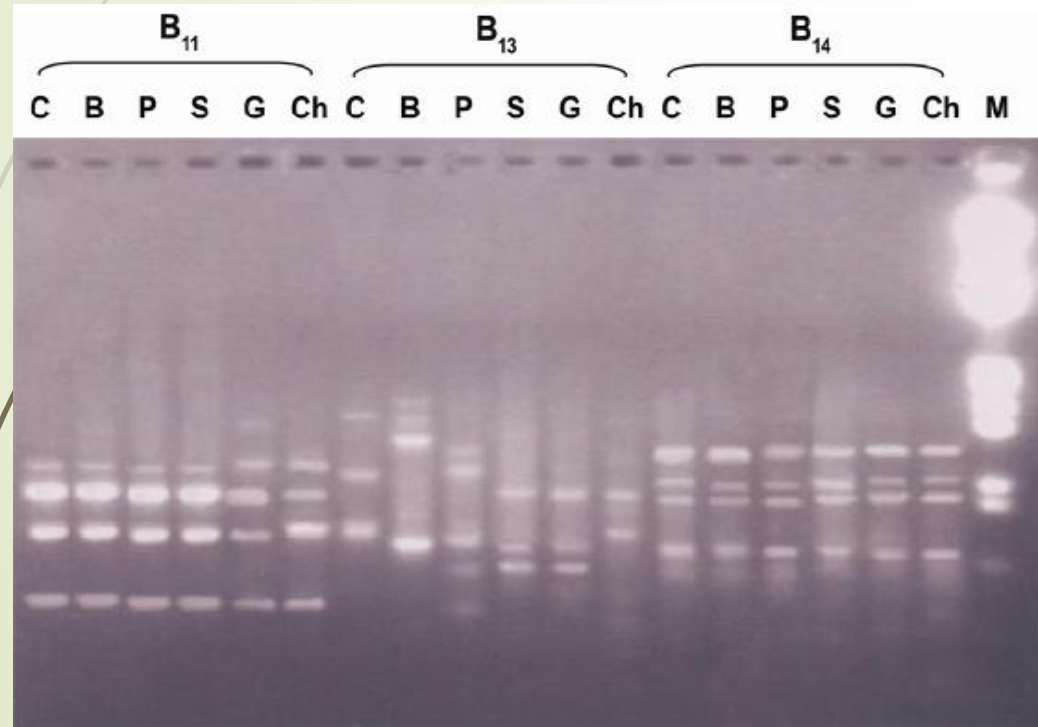


Figure 2. Example of Fluorescent profiles of PCR products amplified with animal set PCR from a mtDNA of sea bream (Ct=15.79), chicken (Ct=15.93), turkey (Ct=16.13), rabbit (Ct=17.01), sheep (Ct=18), cattle (Ct=22) and swine (Ct=25).