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Topic: Biochemistry of Semen

Biochemistry of Semen

Semen, also known as Seminal fluid, is an organic fluid that contains spermatozoa. It is secreted by the gonads (sexual glands) and other sexual organs of male or hermaphroditic animals and can fertilize the female ovum.

In humans, seminal fluid contains several components besides spermatozoa: proteolytic and other enzymes as well as fructose are elements of seminal fluid which promote the survival of spermatozoa, and provide a medium through which they can move or "swim".

Semen is produced and originates from the seminal vesicle, which is located in the pelvis. The process that results in the discharge of semen is called *ejaculation*. Semen is also a form of genetic material. In animals, semen has been collected for cryoconservation.

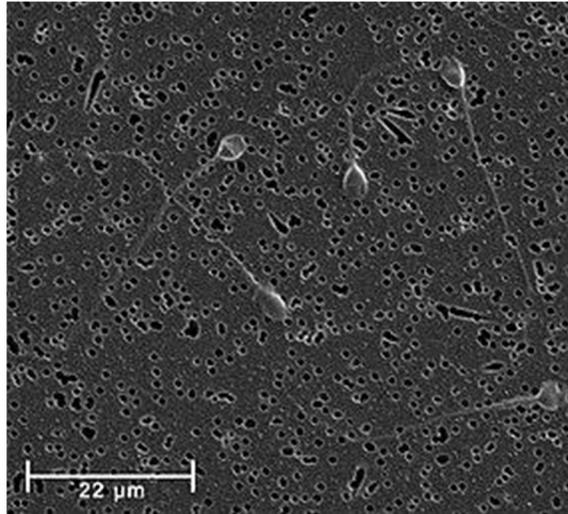


Fig: Spermatozoa, in this case human, are a primary component in normal semen, and the agents of fertilization of female ova

Semen (disambiguation):

Composition:

During the process of ejaculation, sperm passes through the ejaculatory ducts and mixes with fluids from the seminal vesicles, the prostate, and the bulbourethral glands to form the semen.

The seminal vesicles produce a yellowish viscous fluid rich in fructose and other substances that makes up about 70% of human semen. The prostatic secretion, influenced by dihydrotestosterone, is a whitish (sometimes clear), thin fluid containing proteolytic enzymes, citric acid, acid phosphatase and lipid. The bulbourethral glands secrete a clear secretion into the lumen of the urethra to lubricate it.

The accessory genital ducts, the seminal vesicle, prostate glands, and the bulbourethral glands, produce most of the semen.

The components and contributions of semen are as follows:

Gland(s)	Approximate fraction	Description
testes	2–5%	Approximately 200 million – 500 million spermatozoa (also called <i>sperm</i> or <i>spermatozoon's</i>), produced in the testes, are released per ejaculation. If a man has undergone a vasectomy, he will have no sperm in the ejaculation.
seminal vesicles	65–75%	Amino acids, citrate, enzymes, flavins, fructose (2–5 mg per mL semen, the main energy source of sperm cells, which rely entirely on sugars from the seminal plasma for energy), phosphorylcholine, prostaglandins (involved in suppressing an immune response by the female against the foreign semen), proteins, vitamin C.
prostate	25–30%	Acidphosphatase, citric acid, fibrinolysin, prostate specific antigen, proteolytic enzymes, zinc. Zinc serves to help to stabilize the DNA-containing chromatin in the sperm cells. A zinc deficiency may result in lowered fertility because of increased sperm fragility. Zinc deficiency can also adversely affect spermatogenesis.)
bulbourethral glands	< 1%	Galactose, mucus (serve to increase the mobility of sperm cells in the vagina and cervix by creating a less viscous channel for the sperm cells to swim through, and preventing their diffusion out of the semen. Contributes to the cohesive jelly-like texture of semen), pre-ejaculate, sialic acid.

Appearance and consistency:

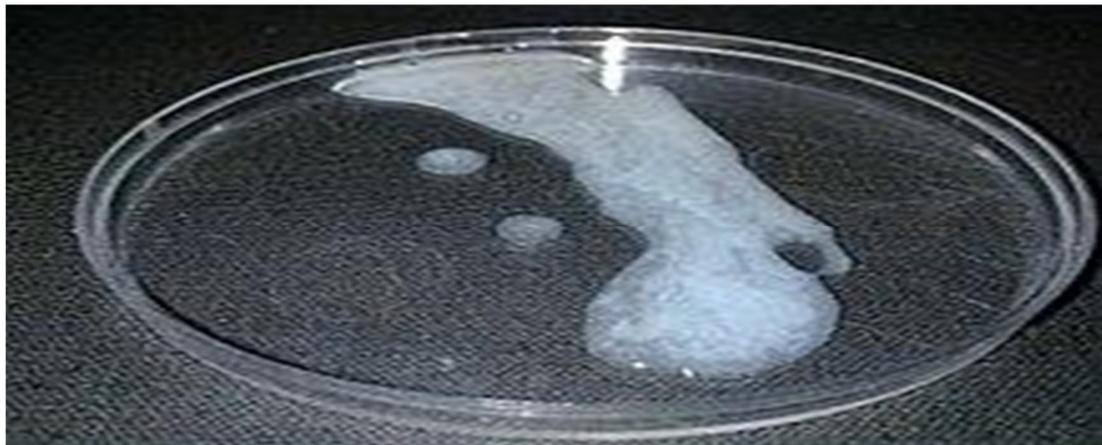


Fig: Human semen in a Petri dish

Semen is typically translucent with white, grey or even yellowish tint. Blood in the semen can cause a pink or reddish colour, known as *hematospermia*.

After ejaculation, the latter part of the ejaculated semen coagulates immediately, forming globules, while the earlier part of the ejaculate typically does not. After a period typically ranging from 15 – 30 minutes, prostate-specific antigen present in the semen causes the decoagulation of the seminal coagulum. It is postulated that the initial clotting helps keep the semen in the vagina, while liquefaction frees the sperm to make their journey to the ova.

Quality:

Semen quality is a measure of the ability of semen to accomplish fertilization. Thus, it is a measure of fertility in a man. It is the sperm in the semen that is the fertile component, and therefore semen quality involves both sperm quantity and sperm quality.

Quantity:

A usual semen volume per ejaculate is around 2 to 3 ml or more. Sperm constitute approximately 10% of semen volume.

Storage:

Semen can be stored in diluents such as the *Illini Variable Temperature* (IVT) diluent, which have been reported to be able to preserve high fertility of semen for over seven days. The IVT diluent is composed of several salts, sugars and antibacterial agents and gas CO₂.

Disease transmission:

Semen can transmit many sexually transmitted diseases and pathogens, including viruses like HIV and Ebola. This includes transmission risk for sexually transmitted diseases such as human papillomavirus (HPV) or herpes, especially for people with bleeding gums, gingivitis or open sores.

Blood in semen: (hematospermia)

The presence of blood in semen or hematospermia may be undetectable (it can only be seen microscopically) or visible in the fluid. Its cause could be the result of inflammation, infection, blockage, or injury of the male reproductive tract or a problem within the urethra, testicles, epididymis and prostate.

Physiology:**Fertilization**

Depending on the species, spermatozoa can fertilize ova externally or internally. In external fertilization, the spermatozoa fertilize the ova directly, outside of the female's sexual organs. Female fish, for example, spawn ova into

their aquatic environment, where they are fertilized by the semen of the male fish.

During internal fertilization, however, fertilization occurs inside the female's sexual organs. Internal fertilization takes place after insemination of a female by a male through copulation.

In most vertebrates including amphibians, reptiles, birds and monotreme mammals, copulation is achieved through the physical mating of the cloaca of the male and female. In marsupial and placental mammals, copulation occurs through the vagina.

Semen Analysis:

Inability to fertilize the ova leads to infertility in a couple. In these cases the semen from the male partner is collected for analysis.

Semen analysis is the most important single item in the evaluation of male infertility. It is a simple and inexpensive clinical test. The World Health Organization (WHO) gives out criteria for semen analysis to detect abnormalities in the semen of the male partner contributing to infertility.

Normal semen and sperm qualities according to the World Health Organization are:

- ❖ there should be at least 20 million sperms per ml for fertility
- ❖ the total volume of semen should be at least 2ml
- ❖ per ejaculate at least 40 million sperms should be present
- ❖ at least 30 per cent of the sperms should be mature and developed
- ❖ at least 75 per cent of the spermatozoa should be alive or viable
- ❖ at least 25 per cent of the sperms should be swimming with rapid forward movement
- ❖ at least 50 per cent of the sperms should be swimming even if it is sluggish