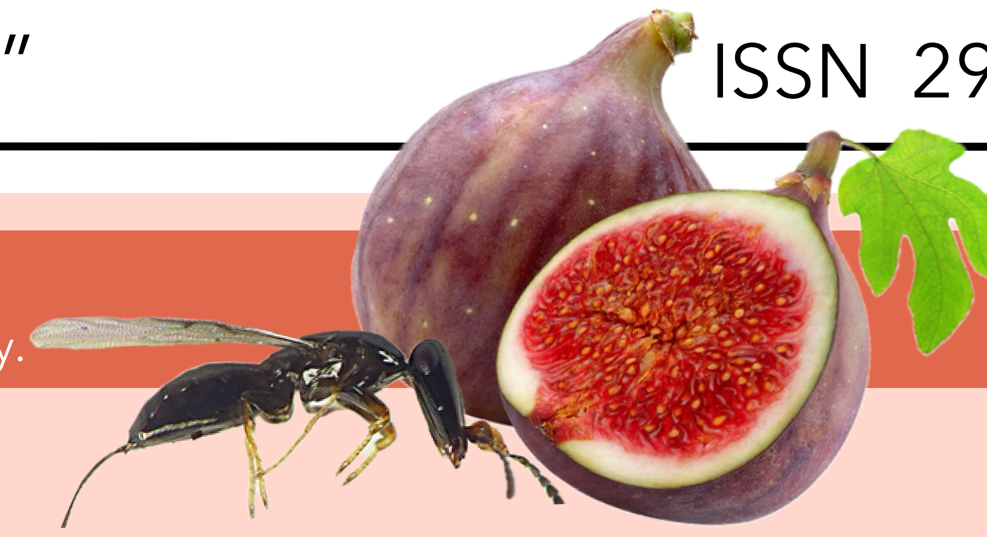
ISSUE 21

February 2024

ISSN 2940 - 4673

BioS Reports

Glimpse into the activities of the Master's course "Biology in Society"



ANIMALS AND MONEY

This part of BioS Reports unravels interesting relations between animals and the economy.

Turkey's Buzzing Fig Economy

Paula Müller

It might come as a surprise to some people, but we would not be able to eat figs in the amount we do today, if it weren't for fig wasps. This is because wasps are the only pollinator of the fig tree [1]. Although they do not look like it, figs are technically inverted flowers [1]. By crawling inside of the fig, female fig wasps deliver pollen to the flower and lay their eggs inside the fruit [1]. The adult wasp dies inside the fig, while her offspring will burrow out of the fig after hatching [2]. Both the fig plant and the wasp can successfully reproduce. However, not all fig trees rely on pollinators anymore to reproduce. Many cultivated fig varieties have been selected to be self-pollinating, to make them more suitable for commercial production. Today, many fig varieties are self-pollinating. Also, fig wasps can carry diseases that may harm the fig tree and lead to yield losses [1]. This can be circumvented with self-pollination. This raises the question, has the economic role of the fig wasp changed since the introduction of self-pollinating plants?

The Republic of Türkiye is the world's largest producer of figs. It is responsible for around a third of global fig production [3,4]. Covering around 54% of the global export market, Türkiye is also the largest exporter of dried figs [5]. An array of traditional fig varieties and fig wasps naturally occur within Türkiye´s borders [1,6]. In areas outside of the wasp´s natural range, fertilization and cultivation of traditional fig varieties is more expensive, because in this case figs have to be pollinated manually [1]. Self-pollinating figs, however, can be cultivated in areas where fig wasps are not present or where traditional fig varieties are not well-suited to local growing conditions [1].

So, in many cases growing self-pollinating figs is more accessible and economical. Despite the possible benefits of self-pollinating plants and the expansion of the fig industry, Türkiye´s position as major market player remains unchanged. But what role do fig wasps and traditional fig varieties still play in Türkiye?

Every year Türkiye produces around 300.000 tons of figs [3,7], generating an export value of US $284,492 in 2019 [8]. Around 90% of Türkiye´s fresh and dry fig produce comes from traditional fig varieties [3,6], meaning they need the fig wasp as pollinator. As it stands today, the Turkish fig industry would collapse without the crucial role of the fig wasp. The fig industry provides jobs to farmers, processors, exporters, and other industries, such as packaging and transportation [6]. Without the fig wasp, Türkiye would experience drops in employment and loss of revenue.

Besides its value for the economy, the fig wasp also plays an important role for the ecological health of traditional fig growing areas. Fig wasps promote cross-pollination and maintain genetic diversity by pollinating wild and less cultivated fig varieties6. Although self-pollinating crops may provide some level of sustained production in times of declining insect populations, it remains important to protect existing species to maintain a healthy ecosystem. To generate economic growth while also preserving ecosystem health, the balance between cultivating self-pollinating and wasp-pollinated varieties must be found. For now, however, the Turkish fig industry relies mostly on traditional fig varieties and their pollinator, the fig wasp.

NEW! - BIOS EXPLAINS

Here you can find various biological phenomenons explained by BioS Master's students.

Molecular Details of Life: Sperm Egg Fusion

Layanne Abu-Bader

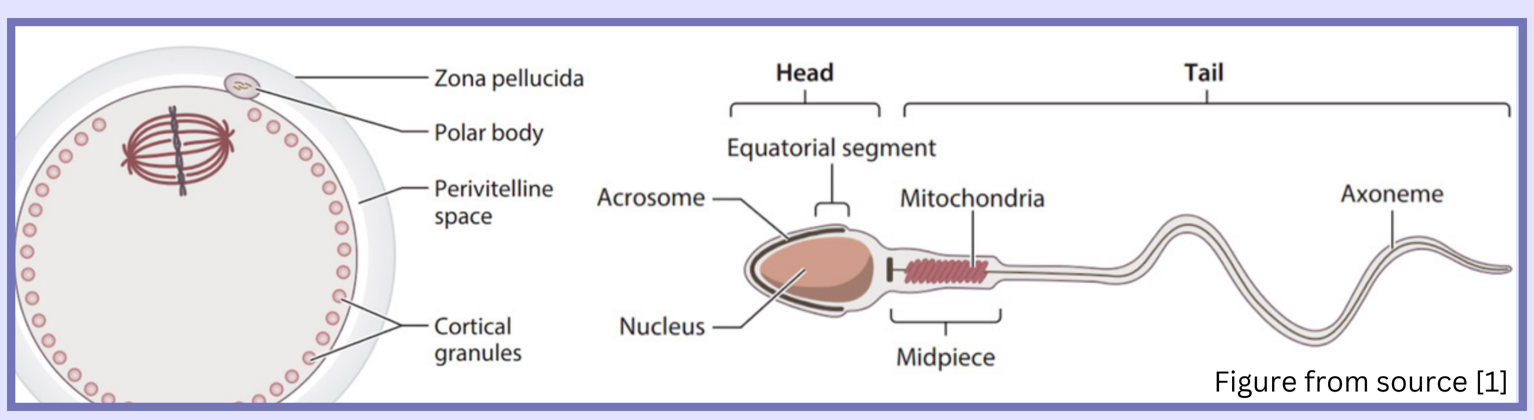


Figure from source [1]

One of the first steps in the life of a new eukaryotic organism is the fusion of a sperm and an egg cell. For all sexually reproducing organisms, the fusion of sperm and egg cell, or oocyte, follows certain steps. During ovulation in mammals, the oocyte is released from the ovary into the fallopian tube. The egg cell is arrested in Metaphase II, and can only carry on with meiosis (gamete cell division) if fertilized. A long series of important events must take place so the oocyte can be fertilized by a sperm cell.

The first interaction occurs at the zona pellucida, the outer protective layer of the oocyte [1]. When the sperm makes contact with the zona pellucida, the sperm's acrosome vesicle is released to begin digesting the zona pellucida. This process is known as the acrosomal reaction [1]. The sperm will begin to burrow into the zona pellucida as the enzymes from the acrosome continue to dissolve it. If the sperm manages to break through this tough outer layer, it will enter the perivitelline space. Here, the sperm binds and fuses with the outer membrane of the oocyte, the oolemma [1].

As of today, there is only one protein pair identified to facilitate sperm-egg binding in mammals. The two proteins are IZUMO1, a transmembrane protein in sperm, and JUNO, a GPI-anchored protein in oocytes [1,2]. IZUMO1 and JUNO bind together tightly to bring the sperm and egg extremely close together to make fusion possible. However, these proteins do not act alone. Knockout studies, in which proteins are 'turned off' to see how their absence affects cellular processes, have identified other proteins involved in the fusion process. They include two membrane proteins of the oocyte and six proteins in the sperm, five of which sit in the membrane and one protein which is secreted [1]. What these proteins do specifically is still unclear.

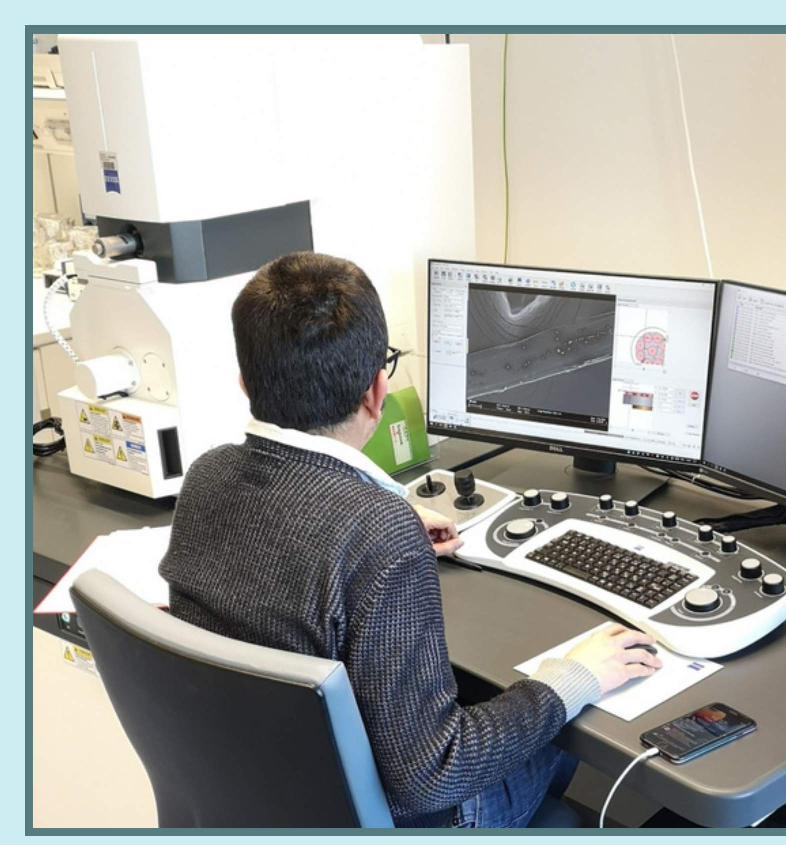
From the moment the sperm fuses with the oocyte membrane, release of the cortical granules from within the oocyte is triggered. The contents are dispersed into the perivitelline space. This process is known as the cortical reaction [1]. The cortical granules are vesicles that contain enzymes, called ovastacin. The enzymes target and cleave proteins in the zona pellucida, making it impossible for any more sperm to burrow through and reach the oolemma [3]. The cortical reaction is therefore crucial to preventing polyspermy. It also triggers the cell to resume meiosis, by beginning Anaphase II [4]. Finally, with the combination of the two haploid genomes in one cell, the process of fertilization is complete and development will begin to take place.

EXCURSIONS AND OTHER NEWS

Small insights in student's or professor's points of view, field trips, and other stuff we do.

Lab Rotation: Strong Tendons of the Grasshopper

Gabriel Pinto



Locusts and grasshoppers are characterized by their huge and powerful hind legs, source of their prodigious jumping ability: in less than 1 ms, they can propel themselves to a height of 115 times their body length. As a child, I was always fascinated by this fact: it sounded like a super-power, something that came out of comic-books or science-fiction movies. And partly because of that childish fascination, I decided to do my lab rotation in the Chitin-based Biological Materials and Biomineralization Group, led by Prof. Yael Politi.

Prof. Politi's group focuses on building bridges between biology and material science, by trying to understand how biological materials, such as the exoskeleton of arthropods or the sea urchin spines, are built and formed. With that in mind, I dove into my lab rotation with the goal to make my own tiny contribution to the understanding of the locust´s jump.

I specifically worked with the infamous migratory locust, *Locusta migratoria*, characterizing the tensor tendon of the hind legs. This tendon plays a crucial role in the jumping ability of the locust, since it is capable of holding large amounts of energy without breaking. To get a grasp of the strength of the tendon, I did a series of tests using a custom-made tensile testing machine, so I could actually measure the stress that the tendons were suffering under a certain strain. I complemented those tests with different microscopy techniques such as fluorescence emission and electron microscopy (my favorite!), to get a very precise and detailed description of the physical structure and composition of the tendons.

Even though my lab rotation was very time-demanding, the whole team made things easier, by being open to my inquiries and helping me (a lot!) with all the different issues that came up during my days there. Most importantly, my lab rotation ended up with promising results that might allow future students at the group to keep adding building blocks to the stimulating topic of bio-materials.

Published by the Master's course Biology in Society | edited by Helen Rothfuß, Nele Kheim, Layanne Abu-Bader | v.i.S.d.P. Klaus Reinhardt | ISSN 2940 - 4673