The world population is predicted to increase for the next three decades and will reach more than 10 billion people. Therefore, food sources other than traditional food crops and animal livestock are being sought as a solution. Insects could be an affordable and nutritious alternative to traditional resources. Eating insect proteins instead of typical animal proteins will help to solve or mitigate many environmental problems.

Therefore, it is proposed to use the commonly available lignocellulosic biomass like wheat straw and the perennial herbaceous crop biomass (cup plant) as a potentially new source of feed for insects. Our previous results indicated that yellow mealworms fed with industrial residues demonstrated high dry larval weight and good feed conversion ratio, except for the pure willowleaf sunflower residues. It should be mentioned that willowleaf sunflower is a lignocellulosic plant and thus, contains less sugar and protein, which is metabolized by the insects compared to rapeseed cake or wheat bran. Therefore, the enzymatical pretreatment proposed in this project may liberate more metabolizable sugars from lignocellulosic (second generation (2G)) biomass and make them available for insects. Pretreatment methods such as steam explosion and the organosolv process for lignocellulosic substrates in combination with enzymatic hydrolysis used to liberate metabolizable sugars will provide a short-cut to the rearing of edible insects.

Therefore, the aim of this research is to determine the effect of pretreated lignocellulosic biomass (wheat straw and cup plant), which is usually not applicable for insect farming, on development and composition of yellow mealworm (*Tenebrio molitor* L.). This treatment allows the use of lignocellulosic residues and dedicated lignocellulosic crops for feeding insects without the use of typical feed and food crops. Moreover, the study will outlook the possibility of using residues from insect rearing as a substrate for increased biogas production. For this goal, a substrate specific enzymatic pretreatment with chitinases is intended.

A very important and innovative aspect of our research is the utilisation of lignocellulosic feedstocks. The nutrient content of animal products depends very much on the composition of the feed. This is especially true for the protein and fat content as well as the amino acid and fatty acid profiles. Therefore, the research will show, to which extent the composition of insects will depend on the quality of enzymatically hydrolysed 2G feedstocks. Moreover, our findings will also have a wide impact in disciplines such as agronomy, animal production and food science. First of all, they will allow to utilize agricultural residues and non-food crops, without, or minimal competition with food crops. Therefore, food crops will be available to feed an increasing human population.

The research is planned to be run for 36 months in years 2022-2024. The work plan will consist four main tasks. In task 1 lignocellulosic feedstocks will be enzymatically hydrolysed with and without a sample pretreatment prior to the enzymatic hydrolysis in order to achieve the maximum liberation of metabolizable sugars. Moreover, several *Trichoderma reesei* strains will be screened for their growth on different lignocellulosic feedstocks. Task 1 will be completely conducted in the research units and with research equipment of the Offenburg University of Applied Sciences (HSO). The aim of task 2 is to test enzymatically hydrolysed feedstocks obtained from Task 1, containing metabolizable sugars as a feed for yellow mealworm. The main experiment will monitor the growth and development of insects reared on pretreated wheat straw and cup plant as pure feeds and in mixtures with wheat bran (also control feed). The experiment will consist of minimum three different trials. Additionally, residues of the insect rearing will be deployed in Task 4 for biogas production. Task 2 will be completely conducted in the research units and with research equipment of the University of Warmia and Mazury in Olsztyn (UWM). Subsequently, in task 3 a composition of the lignocellulosic feedstock applied in the production of feeds, before and after the pretreatment performed by the HSO's research team will be analysed. The analyses will show the efficacy of the pretreatment and its suitability of the obtained 2G feeds for insect rearing. Moreover, in the second part of this task, larvae fed on the most promising feedstocks from the task 2 will be collected and used to assess their composition, especially related to their nutritional properties. Task 3 will be completely conducted in the research units and on the equipment of the UWM. In the last task the research hypothesis presumes that the residues from insect rearing and fractionation can be used as a substrate for biogas. Moreover, an enzymatic pretreatment of the chitin used in biogas substrate will we tested for boosting the methanization process. Task 4 will be completely conducted in the research units and with research equipment of the HSO.