# Reporting in from IFNext I

## Account of Activities from the First Year of the IFNext Project (2816PROC19)


**Prepared by**

Dr. Nils Th. Grabowski, TiHo, Hannover, Germany

Dr. Keo Sath, RUA, Phnom Penh, Cambodia

Dr. Chhay Ty, LDC (formerly CelAgrid), Phnom Penh, Cambodia

Dr. Jamlong Mitchaothai, KMITL, Bangkok, Thailand

Dr. Rachakris Lertpatarakomol, MUT, Bangkok, Thailand


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**Summary**

This is the first official report on IFNext activities, reaching from April to December 2019. We draw positive conclusions from this first year. Despite a series of administrative challenges within the participating institutions (moreover regarding finance organization and bank-based fund transfer delays), we managed to catch up, reducing delays in the different WP. Starter kits have been designed for most species, and recruitment of participating farmers is also achieved. In this way, farmers will start working with the kits at the beginning of 2020. First publications on insect farming are available in several languages for a free download. Surveys regarding the consumer preferences in terms of preserved insect-based products (PIBP) were carried out in all countries, showing clear preferences for insect powders, crackers, and snacks. New developments in this year have led to an adaption and refinement of quality parameters. The project has been present in the media, in public health authorities and the scientific community.

## Foreword

*Not everything that is faced can be changed.*
*But nothing can be changed until it is faced.*
James Baldwin (1924 -1987), American writer

Back in 2016, when the idea of IFNext was born, entomophagy and commercial insect rearing was little more than a folly idea in some Western scientists and entrepreneurs, while in South-East Asia, it was already a reality, practiced e.g. by more than 20.000 farmers in Thailand. Now, in 2019, the situation has changed. There has been a marked rise in the interest of using productive insects worldwide, and the West is fortunately catching up, learning from the expertise developed in those countries that foster a strong entomophagous tradition and are experienced in handling large amounts of insects commercially, be it by catching them from the wild and processing them as foodstuff, be it by rearing them under farming conditions. In parallel, the Western implementation of insects as productive species can only be made responding to a series of legal demands that basically are risk-oriented, aiming to keep both human and animal health and welfare at the most possible high levels. In this way, safety protocols are created from which in turn the Asian farmers and consumers can benefit, making the products safe, nutritious, and sustainable. In fact, this knowledge adds to the experience already made by them for millennia, centuries, or decades, refining and adapting ancient traditions to a modern scenario in which old solutions may not always be suitable for modern problems, a condition observed worldwide.

Whoever deals with productive insects has to learn a lesson: that progress in this field happens not in decade wise, but in weekly steps, since the amount of scientists and professionals working with them has been increasing exponentially over the last decade. On one hand, this is good, because it allows a fast progress, but also creates very complex scenarios, because particularly consumers demand a complete set of information which cannot be provided at the moment, despite the increased efforts of the worldwide scientific community. This situation is aggravated by the sheer amount of edible insect species. Basically, the approx. 50 vertebrate domestic animal species are opposing some 2000 to 3000 edible insect species, not counting those with a potential as a feedstuff or industrial (providers for certain substances) and environmental use (lending support to e.g. waste management).

To cut a long story short, performing IFNext has also been subjected to the need to adapt to change, in order to fulfil its objectives in terms of sustainability and novel product design. We as authors are honoured to present the first report of our activities.

## 1. Administrative issues

Apart from the mere scientific contents and goals of IFNext, a surprisingly high amount of administrative work had to be done to provide the suitable frame for IFNext to develop.

From this, the interaction with the funding agency was always of a very clear and cooperative kind. In fact it has been our faculties which have been facing some obstacles in dealing with this framework, leading to certain delays, particularly in terms of finances organisation and fud transfer. This also led to some delays in the actual project work, e.g. in WP 1, i.e. the establishment of the insect starter kits. However, this first year taught us some valuable lessons, and with more focus on administrative issues we are the starting this new year.

In terms of personnel involved in IFNext, there will be a change at TiHo. Dr. Birte Ahlfeld will leave us by March 2020 what we personally regret. However, in November 2019, the team was reinforced by the veterinarian Stefan Trögel. He is specialist for quality management and is finishing his doctoral thesis with us in the area of edible insects, focusing on mycotoxins.

Finally, the name of the CelAgrid institution was changed at the beginning of the project. The institution is now called Livestock Development for Community Livelihood organization (LDC), but Dr. Chhay Ty is still in charge, and we are grateful for his commitment..

## 2. WP 1: Starter kit development

The objective of this WP is to develop suitable starter kits for Thailand and Cambodia for the species reared there. "Starter kits" in this case refers to solid constructions rather than mobile boxes as used in Germany (see WP 3). Due to administrative delays (see section 1), starter kits were implemented by December 2019.

### Cambodia

In Cambodia, two species of crickets are raised, the Mediterranean (*Gryllus bimaculatus*; Fig. 1) and the Cambodian field cricket (*Teleogryllus mitratus*; Fig. 2), termed locally the "black" and the "red" cricket. In December, LDC issued a first version of a rearing manual for both species. The first version in in Khmer, the international (English) one is currently under language revision. More translations will follow, and all versions will be

published on the project's homepages[1]. The manual describes how to start an insect farm from scratch, using three-unit sets of plastic boxes or concrete tubes, as well as larger pens (Fig. 3). This three-units approach is part of an rotational breeding programme in order to reduce inbreeding. They are equipped with carton, feed and water trays as well as charcoal-filled bowls for oviposition (Fig. 4). Feeding is carried out using commercial chicken or duck feed and economic local plants (Fig. 5).

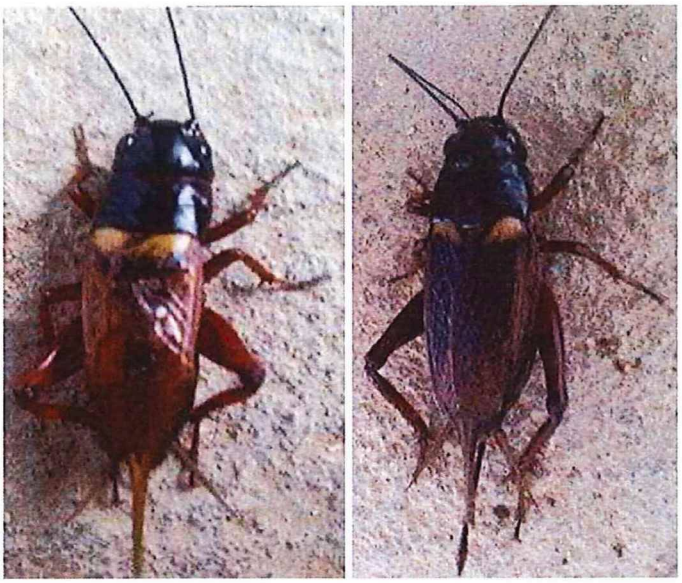


Fig., 1: Mediterranean cricket (*Gryllus bimaculatus*), male (left) and female (right)

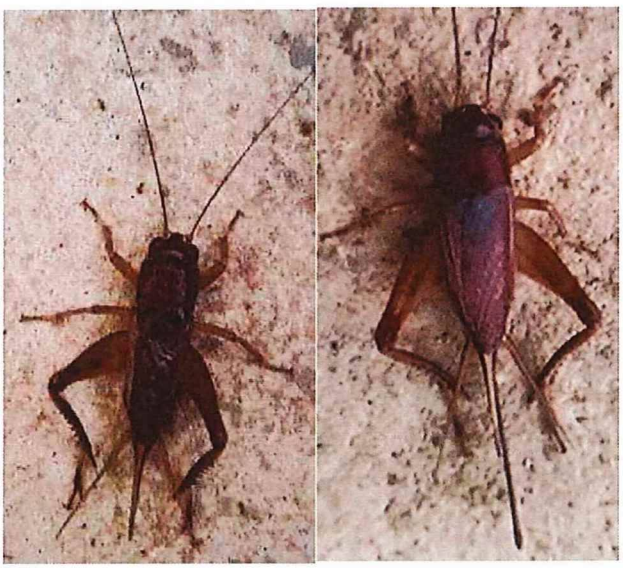


Fig. 2: Cambodian filed cricket (*Teleogryllus mitratus*), male (left) and female (right)

[1] https://www.researchgate.net/project/IFNext-bringing-insect-farming-to-the-next-level; https://www.tiho-hannover.de/kliniken-institute/institute/institut-fuer-lebensmittelqualitaet-und-sicherheit/profil/

Fig. 3: Three-units sets of plastic containers (above, left) and concrete tubes (above, right) and pens (below) used in to raise crickets in Cambodia

Fig. 4: Cricket rearing tubes, equipped with feed (left) and bowls used for oviposition (right; bowls are wrapped in plastic bags for incubation, and bags will be removed once the cricket nymphs start to hatch)

Fig. 5: Examples for cricket feed used in Cambodia, from left to right: chick feed, rice bran, cassava (*Manihot esculenta*) foliage, water spinach (*Ipomoea aquatica*)

Breeding techniques are described in detail (Fig. 6) as well as special care of cricket babies (Fig. 7), harvesting (Fig. 8), and processing (Fig. 9). It should be stressed that this is the first version of the manual that describes a status quo. Close work with the farmers as described in WP 2 is prone to lead to adaptions, also considering food safety and animal welfare issues. However, sustainability has already started to become implemented by using economic resources such as concrete tubes, local feeding plants and plant material.

Fig. 6: Handling of oviposition bowls in Cambodia

Fig. 7: Taking care of baby crickets in Cambodia: provision of water via sponges (left) or coconut rips (right)

Fig. 8: Harvesting crickets in Cambodia: patting crickets from egg cartons into a large bowl (above, left), killing them in water (above, right), and washing them afterward in clean water (below)

Fig. 9: Processing crickets in Cambodia: drip-off (left), packaging (middle), storage (right)

In terms of farm surveillance, LDC has also designed a work sheet to evaluate the economic part of cricket raising. There is a Khmer and English version, the latter is presented in Fig. 10.

Livestock Development for community livelihood organization (LDC)
Project name: IFNext (Bring insect farming to next level)

## Follow up sheet on cricket yield

Name of farmer ..... Date of cricket harvest .....
Recorder .....
Village ..... Commune .....
District .....

***Economic analysis)*** list of follow up on cricket yield which need to record every cycle and need to collect at least three times per farmer)

| Description | Unit | Quantity | Price/unit | Price | |
|---|---|---|---|---|---|
| | | | | Riel | USD |
| **Total income (A)** | | | | | |
| Cricket eggs collected | bowl | | | | |
| Amount of cricket harvest | Kg | | | | |
| **Total expend (B)** | | | | | |
| Breed (egg or cricket) | | | | | |
| Feed | | | | | |
| Concentrate feed (chicken or duck) | Kg | | | | |
| Cassava foliage | Kg | | | | |
| Agro by-product (rice bran, broken rice, corn……..) | Kg | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Grass/plant | Kg | | | | |
| Vegetable | Kg | | | | |
| Medicine and prevention | Kg | | | | |
| Cricket house | | | | | |
| Pen<br>L.....W.....H.....<br>..... | | | | | |
| Materials inside the pen | Set | | | | |
| Labor | hours | | | | |
| **Margin profit (A) – (B)** | | | | | |

***Problems or challenges during cricket rearing?*****.....**

**.....**

**.....**

**.....**

Fig. 10: LDC working sheet to evaluate the cricket yield

**Thailand**

As all project member countries, the Thai colleagues at KMITL rear the Mediterranean cricket. Production started in December 2019 using large boxes (Fig. 11). First records are generated. As an example, Tab. 1 describes the management of cricket boxes by measuring the feed intake via weighing offered and leftover feed.

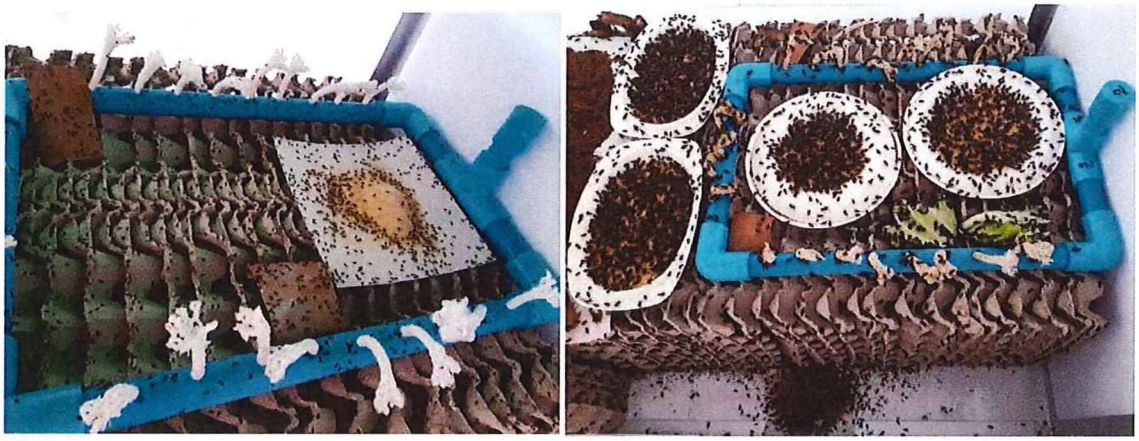


Fig. 11: Mediterranean cricket farming in Thailand

Tab. 1: First productive records of Mediterranean crickets (*Gryllus bimaculatus*) farmed at the installations of KMITL: feed consumption; all data in [g]

| Box | Week | Feed offered | Feed left over 1 | Feed left over 2 | Feed intake (g) |
|---|---|---|---|---|---|
| 1 | 1 | 500 | 195 | 20 | 285 |
| | 2 | 1.095 | 170 | - | 925 |
| 2 | 1 | 500 | 255 | 15 | 230 |
| | 2 | 1.155 | 50 | - | 1.105 |
| 3 | 1 | 500 | 220 | 30 | 250 |
| | 2 | 1.120 | 300 | - | 820 |
| 4 | 1 | 500 | 220 | 20 | 260 |
| | 2 | 1.120 | 80 | - | 1.040 |
| 5 | 1 | 500 | 280 | 10 | 210 |
| | 2 | 1.180 | 145 | - | 1.035 |
| 6 | 1 | 500 | 260 | 15 | 225 |
| | 2 | 1.160 | - | - | 1.160 |
| 7 | 1 | 500 | 210 | 25 | 265 |
| | 2 | 1.110 | 200 | - | 910 |
| 8 | 1 | 500 | 160 | 30 | 310 |
| | 2 | 1.360 | 65 | - | 1.295 |

As local species, the Thai colleagues chose the silkworm (*Bombyx mori*; Fig. 12). Silk worm farms in Chàcheongsao Provice were visited and the project plan explained to the farmers. As a preliminary study, silk pupae were sampled in cooperation with the Queen Sirikit Department of Sericulture (QSDS), their results still pending. Silk worm production will start at the beginning of 2020, and the age for each silkworm molting phase, the average weight of the silk cocoon and pupa on dry matter base will be recorded.

Fig. 12: Silk moth (*Bombyx mori*); picture copyright: Von P.gibellini - Eigenes Werk, CC0, https://commons.wikimedia.org/w/index.php?curid=15632098

Tab. 2 and 3 sum up the status of deliverables and milestones.

Tab. 2: Status of deliverables of WP 1

| Deliverable | Content | Status |
|---|---|---|
| D1.1 | Starter kit for Mediterranean field crickets in Thailand | Done |
| D1.2 | Starter kit for Mediterranean field crickets in Cambodia | Done |
| D1.3 | Starter kit für silkworms in Thailand | Not yet |
| D1.4 | Starter kit for Cambodian field cricket in Cambodia | Done |

Tab. 3: Status of milestones of WP 1

| Milestone | Content | Status | Completed on schedule |
|---|---|---|---|
| M1.1 | Ready-to-use starter kits, Cambodia | Done | Yes |
| M1.2 | Ready-to-use starter kits, Thailand | Partially | Partially |

## 3. WP 2 – Insect farming in participating rural communities

The objective of this WP is to implement insect farming in the Cambodian and Thai communities by establishing the starter kits and adapting them resp. improving their productivity according to the feedback of the farmer. LDC acts as WP leader. The progress in this WP is summarized in Tab. 4.

Tab. 4: State of the art of WP 2 lead by LDC

| Key Activities | Progress | Status |
|---|---|---|
| *1. Adapted starter kit for Mediterranean and field cricket in Cambodia* | | |
| Meeting with existing LDC's partners to selection of appropriate province | Two existing partners and two NGO's, namely "Danish Church AID (DCA) in Cambodia" and "Farmer and Nature Net (FNN)" were contacted to discuss the possibility to set up cricket farms. | Done |
| Visited cricket farming in Trang district, Takeo province | To gain more idea on cricket farming, two days visits were organized to visit cricket farms in the Takeo Province with the purpose of<br>o Understanding the cricket rearing technique by farmers<br>o Understanding the challenges for production and marketing<br>o Building relationships with DCA and FNN on cricket farmers and other stakeholders | Done |

| | | |
|---|---|---|
| Identify communes and villages | Sanlong Commune, Trang District, Takeo Province was selected to take part in cricket farming | Done |
| Identify beneficiaries | Discussion with village chiefs and visits to individual households to select participant farmers based on the following criteria:<br>o Permanent resident in selected village<br>o Interested in cricket rearing<br>o Has women represent the family<br>o Has children under 5 years-old, at least 1 in the family<br>o Used to eat and willingly continue to eat crickets and/or other relevant insects as food<br>o Willingness and necessary time to commit to the participate in the project<br>o Have some resources to buy complete feed (chicken feed) for baby crickets<br>o Have space to build cricket pen for cricket kit at least 2 or 3 set<br>o Participate in the farmer field school training<br>o Recording all expend items and income from cricket rearing for at least three productions cycles<br>o Willingness to share results with other farmers<br>o Share cricket eggs to other interested farmers<br>o Ensure the kit that provide for long term use | Done |
| Distribution starter kit for cricket rearing | The distribution starter kits are not organized yet as waiting for other consortium members | Not yet |

2. *Adapting them to improving their productivity (recording the production, feed and feeding every cycle)*

| | | |
|---|---|---|
| Develop poster on | Posters on smallholder cricket rearing was | Done |

| | | |
|---|---|---|
| smallholder cricket rearing | developed in two languages, i.e. Khmer and English | |
| Develop the recording sheet | A record sheet was developed to record cricket production, feed and feeding etc. in Khmer and English | Done* |

3. *Develop handbook on rearing Mediterranean and Cambodian field crickets in Cambodia*

| | | |
|---|---|---|
| Develop handbook on smallholder cricket rearing | Handbook on smallholder cricket rearing were develop in Khmer and English language. The outline of the handbook is<br>o Introduction<br>o Advantage of cricket rearing<br>o Potential of cricket rearing<br>o Section 1: Cricket breeds<br>o Section 2: Pen types<br>o Section 3: Feed, feeding and water<br>o Section 4: Eggs collection and incubation | Done* |

4. *Discussion and feedback on cricket production from participant farmers*

| | | |
|---|---|---|
| What school grade would you give this cycle's performance? | Not implemented as the practical part of this WP will start by early 2020 | Not yet |
| Was it better or worse than the previous one(s)? If so, what is presumed to be the reason for this change? | Not implemented as the practical part of this WP will start by early 2020 | Not yet |
| Did problems arise from using the starter kits? If so, how can they be overcome? | Not implemented as the practical part of this WP will start by early 2020 | Not yet |
| Does the starter kit need to be adapted in view of the experiences made so far? If so, can this be achieved? | Not implemented as the practical part of this WP will start by early 2020 | Not yet |

5. *Report on the starter kits to be published in peer-reviewed journals, popular magazines, and social media*

| | | |
|---|---|---|
| Develop report on cricket production from starter kit | Not implemented as the practical part of this WP will start by early 2020 | Not yet |

6. *Regular visits ensure constant contact to the farmer families and provide the necessary feedback from them*

| | | |
|---|---|---|
| The visit target village and schedule for 8 times per year | Scheduling for the year 2020 | Planned |

* = see section 2 on WP 1

For the year 2020, the following activities in the WP 2 in Cambodia are planned:

1. Distribution of starter kits for cricket rearing to 20 farmers in Sanlong Commune, Trang District, Takeo Province
2. Develop material for farmer Field School
3. Start farmer Field School: Two group of farmers will be joint in Farmer Field School
4. Discussion and feedback on cricket production from participating farmers by using the questions below
    a. What school grade would you give this cycle's performance?
    b. Was it better or worse than the previous one(s)? If so, what is presumed to be the reason for this change?
    c. Did problems arise from using the starter kits? If so, how can they be overcome?
    d. Does the starter kit need to be adapted in view of the experiences made so far? If so, can this be achieved?
5. Providing the ingredients necessary to develop preserve insect base products (PIBP)
6. Report on the starter kits to be published in peer-reviewed journals, popular magazines, and social media
7. Regular visits ensure constant contact to the farmer families and provide the necessary feedback from them

Tab. 6 and 7 sum up the status of deliverables and milestones. Most of them are not yet mandatory at this stage of the project.

Tab. 6: Status of deliverables of WP 2

| Deliverable | Content | Status |
|---|---|---|
| D2.1 | Adapted starter kit for Mediterranean field crickets in Cambodia | Not yet |
| D2.2 | Adapted starter kit for Cambodian field crickets in Cambodia | Not yet |
| D2.3 | Adapted starter kit for Mediterranean field crickets in Thailand | Not yet |

| | | |
|---|---|---|
| D2.4 | Adapted starter kit for silkworms in Thailand | Not yet |
| D2.5 | Handbook on insect rearing in Cambodia | 1st version |
| D2.6 | Handbook on insect rearing in Thailand | Not yet |
| D2.7 | Publications about the starter kits | Not yet |

Tab. 7: Status of milestones of WP 2

| Milestone | Content | Status | Completed on schedule |
|---|---|---|---|
| M2.1 | Report on insect rearing in 2020 in Cambodia | Not yet | Still in time |
| M2.2 | Report on insect rearing in 2020 in Thailand | Not yet | Still in time |
| M2.3 | Report on insect rearing in 2021 in Cambodia | Not yet | Still in time |
| M2.4 | Report on insect rearing in 2021 in Thailand | Not yet | Still in time |

**4. WP 3 – Development of preferred insect-preservation techniques as chosen in WP 5**

This WP has not started yet as the decision on which PIBP will be attended by which country has just been made. Thus, product development will commence in 2020.

However, this WP includes the rearing of insects in Germany in terms of creating the insects used for product development, and not having to rely on external sources. Initially, it was planned that cricket and mealworm rearing would take place in a rather small laboratory of the institute. However, April 2019 was also the begin of our new director, Prof. Madeleine Plötz, to come into office. She is highly interested in productive insects and has proven a strong supporter of IFNext. In this way, insect rearing was moved to a larger compound outside the institute, with larger capacities. A new department was created, the one for "Hygiene and Technology of Productive Insects". In coordination with the funding agency, a part of 2019's budget could be shifted towards a better-equipped breeding installation (Fig. 13). A special attention was also laid on operator health, since the insectarium is located in a closed building, and dust and odours cannot leave the room as if rearing would take place in the open. As we are starting from scratch, in 2019 we worked on a viable, box-based rearing system for crickets and mealworms that works in Germany. Although the basic concept could be taken over from the Thai and Cambodian colleagues (crickets) as well as for other sources (mealworms), the details are being discovered by trial and error. This is particularly

true for the mealworms that were less productive than expected and showing signs of poor pupation and wing deformities in adults during this year. A new mother colony was purchased, and animals are reared on specific mealworm trays (Fig. 14). In contrast, the crickets are performing basically well (Fig. 15), although the life cycle takes markedly longer (three to six months) than in Southeast Asia. This is also the reason why it was decided to increase the number of crickets in order to cope with the necessary amounts of animals to come.

Fig. 13: View into the insectarium of the TiHo showing cricket boxes out of transparent plastic (left side, top right side) and specialized mealworm trays (centre). Other equipment features are an air filter, a heating device, a bucket of water to keep moisture high, and an insect trap for undesired insects flying freely (top shelf, from left to right) as well as an incubator (central shelf, right side). Boxes and trays are labelled to facilitate handling and identification of lots.

Fig. 14: Mealworm rearing in Germany using special trays and measuring temperature and humidity


Fig. 15: Cricket rearing in Germany using transparent plastic boxes

As done by the Thai and Cambodian colleagues, popular communications on insect rearing are also issued by the German partner. So far, one technical note on handling insects in unwanted places was published on the project's homepages. It is currently available in English and German, with translations into Thai and Khmer being done at the moment. After, the German author will also translate these notes into Spanish, Italian, and Portuguese. More

technical notes will follow, and these documents will be merged to another manual in the future.

Apart from being home to hundreds of Mediterranean crickets and thousands of mealworms, the insectarium of the TiHo also keeps other productive insect species, i.e. several other cricket species (*Gryllus assimilis, Acheta domesticus,* and *Gryllodes sigillatus*), two darkling beetle species (*Zophobas atratus* and *Alphitobius diaperinus* [planned for 2020]) as well as the black soldier fly (*Hermetia illucens*; "BSF"). These species are kept for other research activities of the productive insect department. Expenses created by these species are not covered with IFNext funds. In fact, in terms of feeding they benefit from the same (free) source of feed, i.e. the vegetable and bakery offal from the TiHo cafeteria. Besides, the BSF colony has proven useful in handling feed waste from the other insects as well as disposing of dead crickets and mealworms; they serve as waste disposal. In 2019, free-flying insects were partially controlled by installing Indian giant mantises (*Hierodula membranacea*) in the insectarium. After their life span concluded, one female laid eggs which are currently incubated, hoping to multiply this species as natural predators for escaped animals.

## 5. WP 4 – Development of quality parameters for fresh, cooked and preserved insects

This WP has not started yet as the decision on which PIBP will be attended by which country has just been made. This WP will commence in 2020.

Changing conditions as mentioned in the beginning of the report also applies to this WP. By now, progress has been made on legislation level since during 2019, the German food safety authorities published a guideline for insect-based products, including the recommended microbiological parameters. TiHo project partners Dres. Grabowski and Ahlfeld are proud to have served in the task force engaged in writing this guideline. Tab. 8sums up the recommended microbiological analyses. Chemically, the guideline mentions the possible presence of residues and contaminants, e.g. heavy metals, mycotoxins, plant protection substances and pharmacological residues.

Tab. 8: Recommended microbiological quality parameters for PIBP for Germany

| Parameter | Unit | Product | Threshold |
|---|---|---|---|
| *Salmonella* spp. | Detected in 25 g | All products | None detected |
| *Listeria monocytogenes* | cfu/g | All products | c.f. Reg [EU] 2073/2005* |
| Total bacterial count | cfu/g | Cooked and/or deep-fried, whole insects | $10^4$ |

| | | | |
|---|---|---|---|
| | | Other products | $10^6$ |
| Enterobacteriaceae | cfu/g | All products | $10^3$ |
| *Escherichia coli* | cfu/g | All products | $10^1$ |
| Coagulase-positive staphylococci | cfu/g | All products | $10^3$ |
| *Bacillus cereus* group | cfu/g | All products | $10^3$ |

* = Annex I chapter 1 categories 1.1 to 1.3

In December 2019, the project leader was invited to a meeting of IPIFF, the European association of productive insect producers. The subject of this meeting was research and innovation focused on an increased productivity and marketing chances for insect business operators. IPIFF recognized the potential of by-products of the insect production, particularly insect frass (i.e. manure). By itself, using insect frass is no novelty as this product is sold regularly in Thailand as a fertilizer. However, composition of insect frass is prone to change markedly in relation to the reared species and the feedstuffs they are administered. This is why frass samples have been sent to analysis to the TiHo's institute for animal nutrition, with results pending

**6. WP 5 – Consumer acceptance of preserved insects**

As the WP 1 and 2 focus on insect production, WP 3 attends the subsequent step in the productive chain: processing. In order to represent a solid public opinion rather than the imagination of the participating scientists, residents in Cambodia, Thailand, and Germany were confronted with a questionnaire developed by RUA (Annex 1). It basically contains a set of general questions about the interviewed persons, then some questions about their knowledge and practice of entomophagy, and finally their opinions about the different preserved insect-based products (PIBP). The original list of PIBPs as presented in the final project draft was enlarged and is summarized in Tab. 9. They all start with using frozen insects. The category "deep-fried" is included in the list. This method is not really novel and was included as a reference to assess the popularity of a given novel product.

Tab. 9: List of preserved insect-based products

| Short term | Brief description | Examples (other foodstuffs) |
|---|---|---|
| "candied" | Insects thawed, cooked, roasted, coated in sugar, vanilla, and cinnamon | Candied almonds and nuts |
| "crackers/snacks" | Insects thawed, mashed, mixed | Krupuk (prawn chips), bamba |

| | | |
|---|---|---|
| | with tapioca, knead to a dough, rolled into sticks, steamed, cut in thin slices, deep-fried. Other snacks could also be developed, e.g. extruded and spiced | (peanut-flavoured corn extrudates) |
| "deep-fried" | Insects thawed, marinated, and deep-fried | traditional way of consuming insects in Southeast Asia |
| "fermented" | Insects thawed, heated, mashed, salted, and mixed with a starting culture, incubated | Fish/oyster/soy sauce, fish/crab/ shrimp paste |
| "home-canned" | Insects thawed and transferred to jars in saline or other culinary liquids, vegetables etc., and sterilized with lids closed with rubber bands | Home-canned vegetables (including pickles), fruits, and meat stews |
| "protein powder" | Insects thawed, boiled, dried, slightly roasted and ground to powder, used in bakery products or noodles | Whey powder, protein-enhanced bakery products, pasta, and noodles |
| "smoked whole" | Insects thawed, submitted to hot and/or cold smoking until dry | Smoked fish, shrimps, bacon, sausages, etc. |
| "smoked, ground" | See "protein powder", but using smoked insects (see "smoked, whole") | Powders of smoked (bell)peppers and chilies |

For technical reasons, the questionnaire was handed out only in the printed version, and was distributed in all three countries. Analysis is done on country base. As an example, the results from Cambodia as provided by RUA are presented subsequently. Fig. 16 to 19 refer to the general information of the interviewed persons and Fig. 19 to 28 to their attitude towards entomophagy and corresponding food habits.

It was seen that most respondents were males in their 20ies living in a rural environment, preferring *T. mitratus* over *G. bimaculatus*. They consume insects occasionally, but regularly, and most of them are unaware of the nutritional benefits of eating insects and do not consider them specifically healthy.

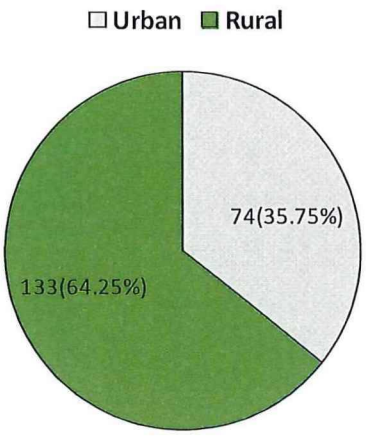



Fig.16: Area of living of respondents

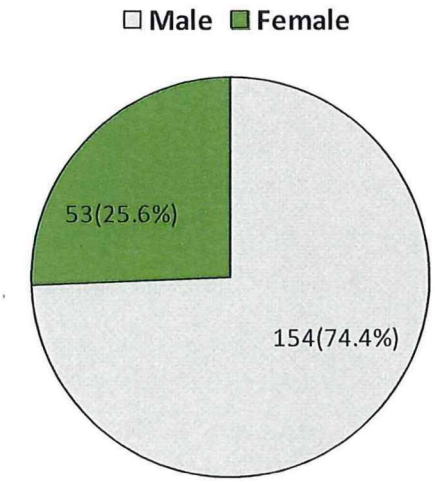



Fig. 17: Sex of respondents

They usually eat insects in groups, consuming between one to two cups of insects each. Approx. 80% of interviewed persons indicated that taste is the main reason to consume insects. The price is second in reasons, although indicated by less than 30% of respondents.

60% of tem claimed never to have suffered any health condition after consuming insects.

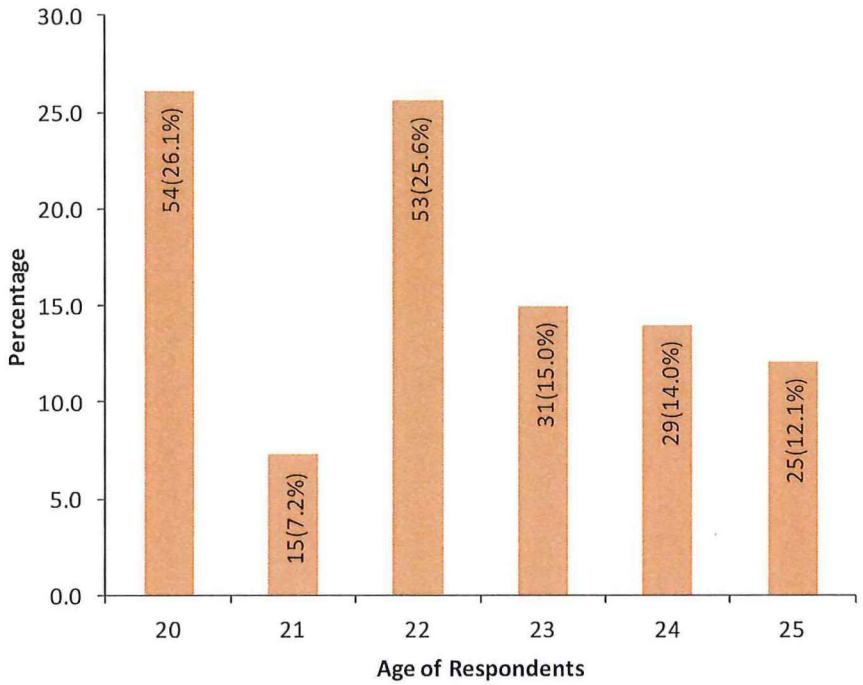



Fig. 18. Age of respondents

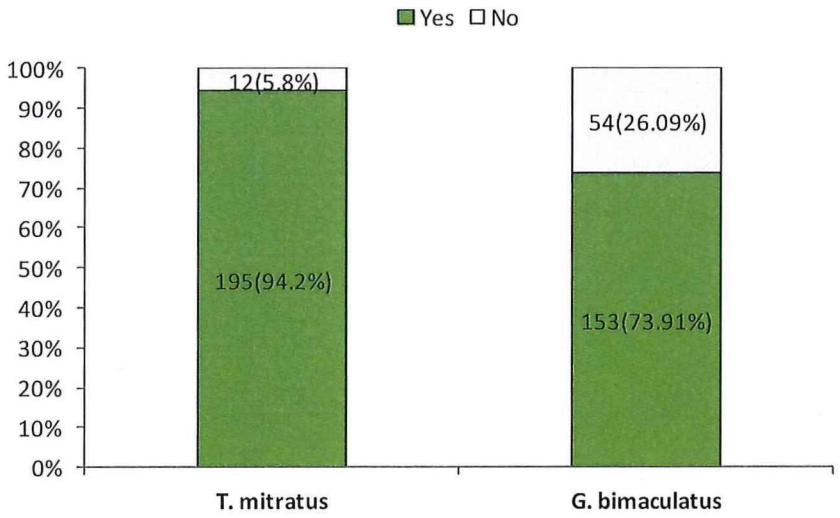



Fig. 19: Respondent's experience in consuming the crickets

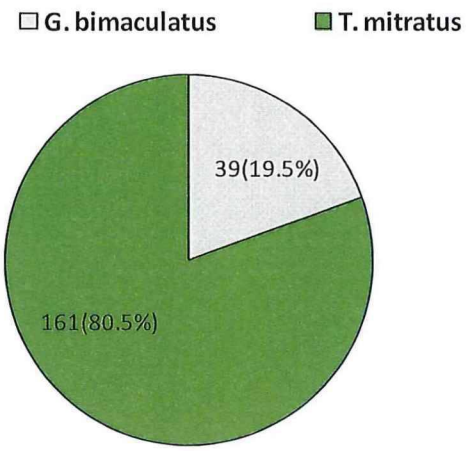



Fig. 20: Most favourite cricket species

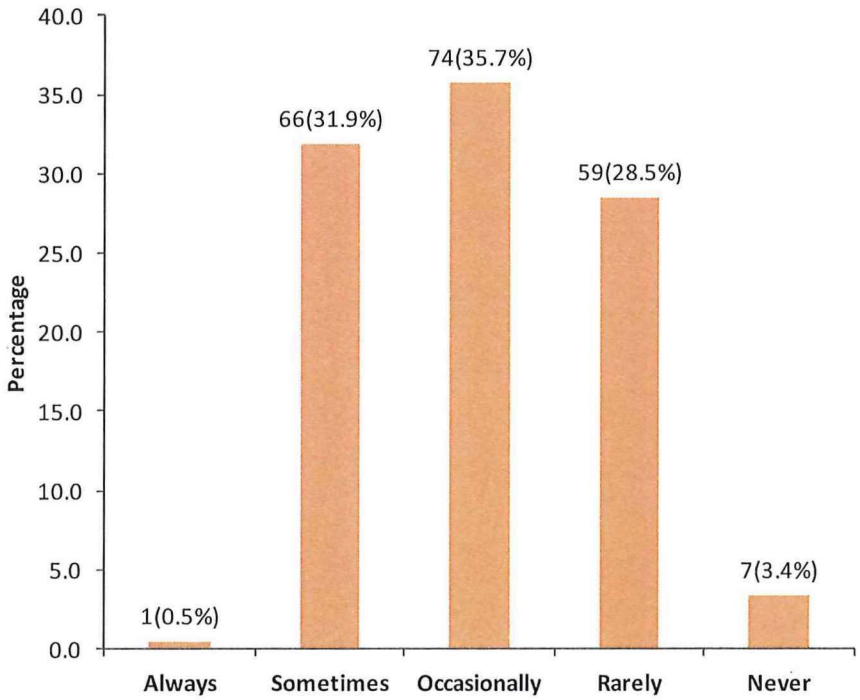



Fig. 21: Experience in eating crickets

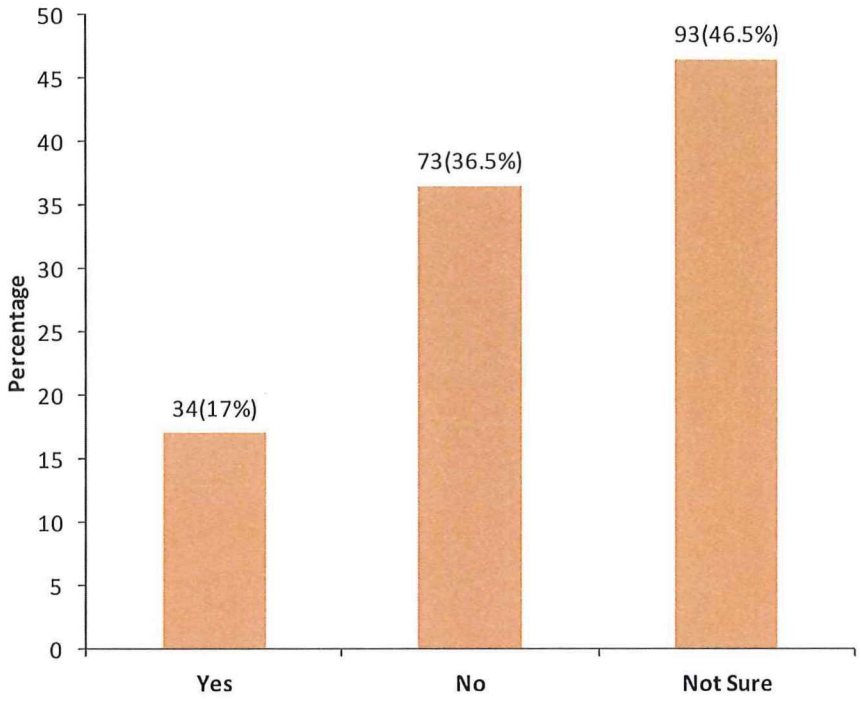



Fig. 22: Awareness of nutritional benefits of eating crickets

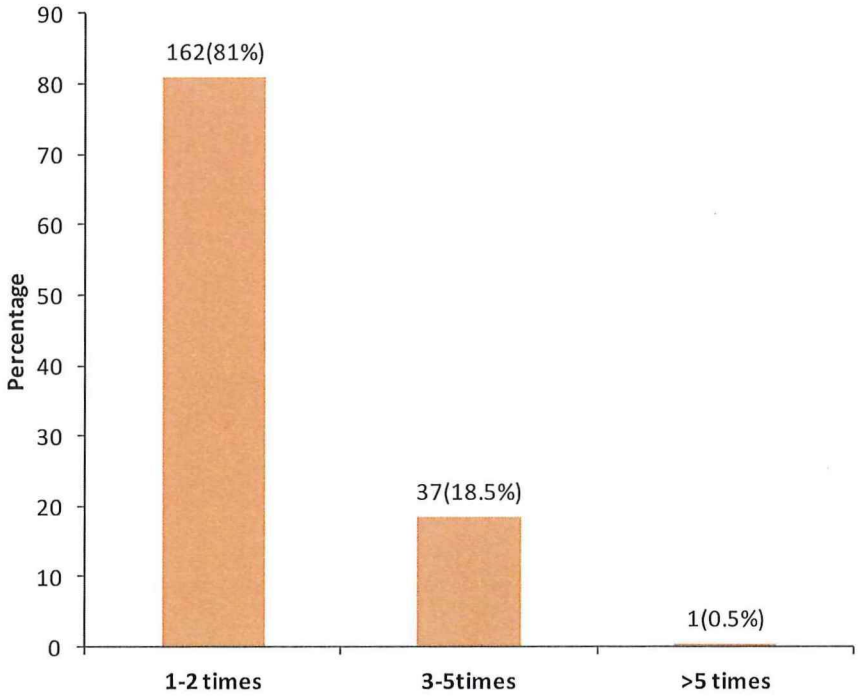



Fig. 23: Frequency of consumption of food cricket per month

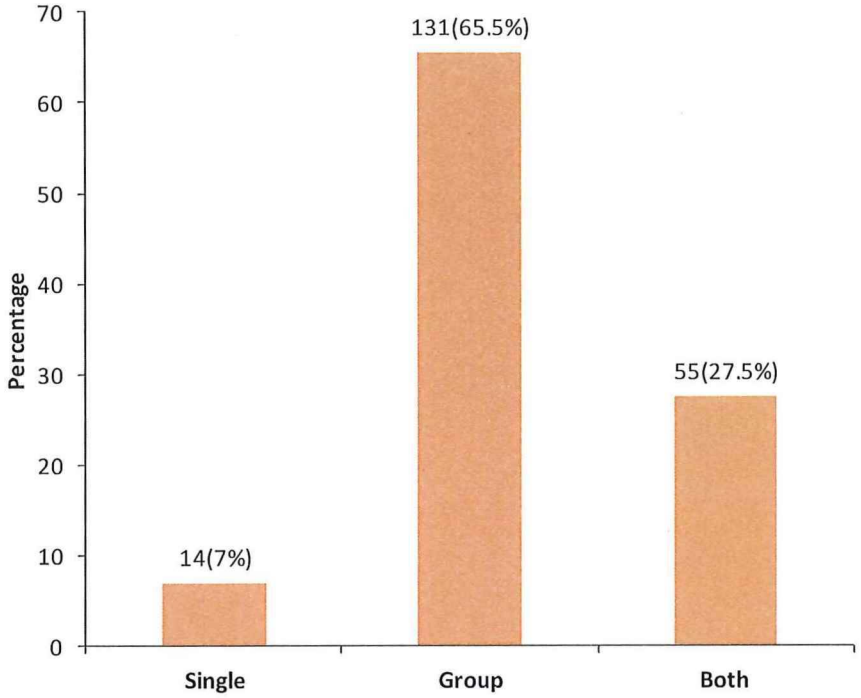



Fig. 24: Context of surroundings while respondents eat consume crickets

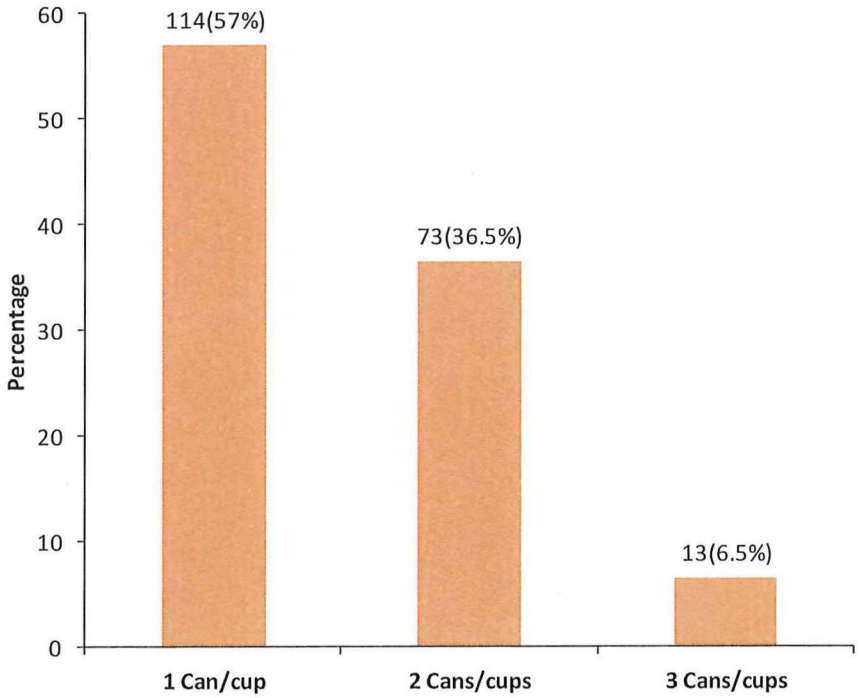



Fig. 25: Amount of consumed animals per time

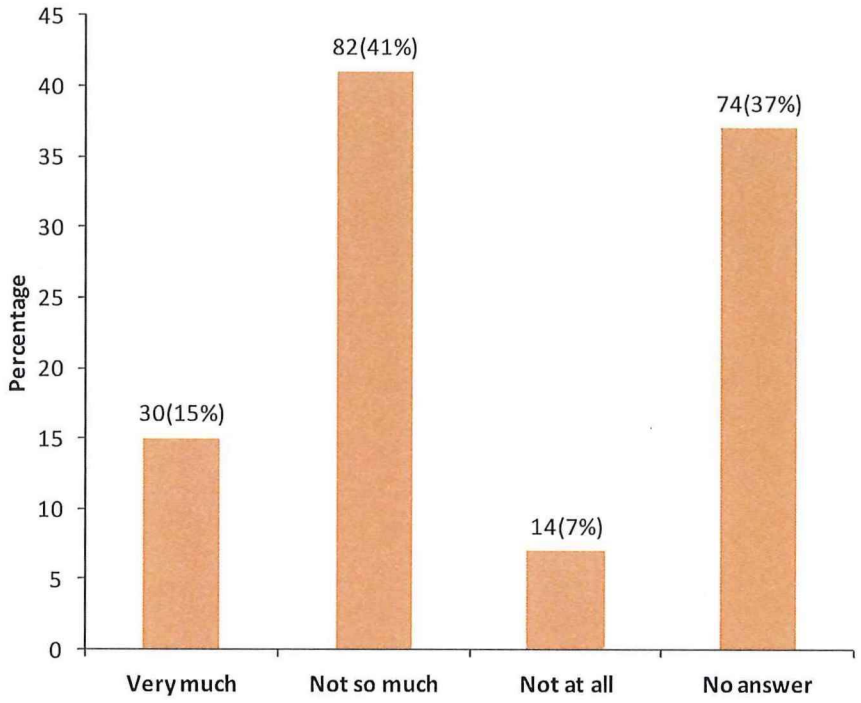



Fig. 26: Respondent considering insects as healthy foodstuffs

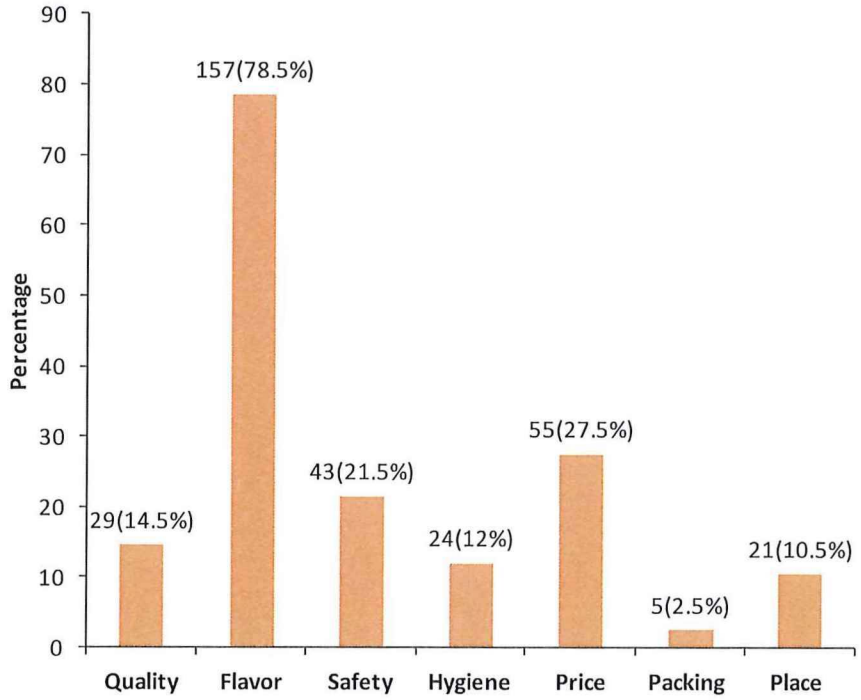



Fig. 27: Reasons to consume cooked food crickets

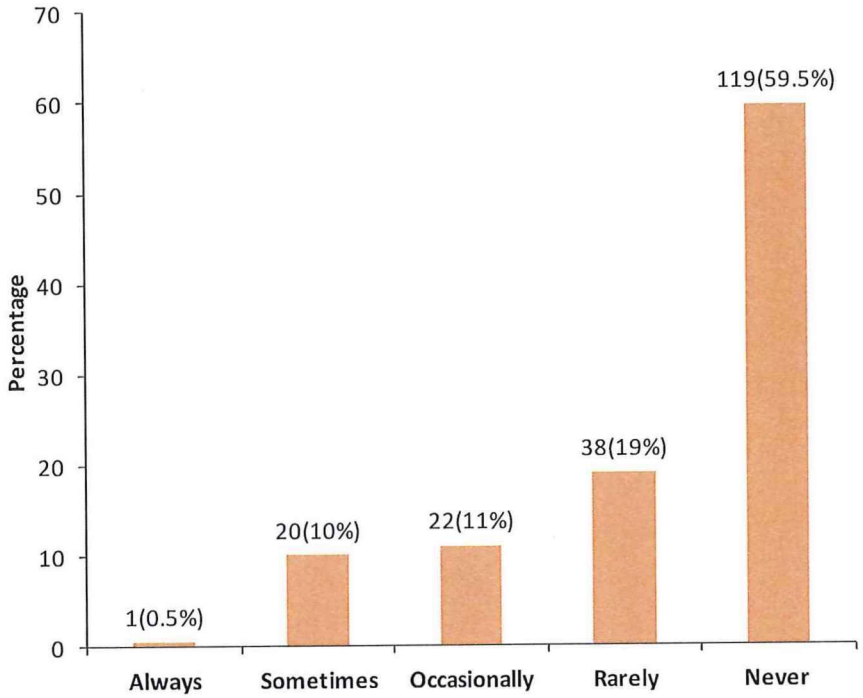



Fig. 28: Occurrence of health problems after eating cooked food crickets

Fig. 29 and 30 refer to the attitude towards the proposed PIBP's. Interview partners had to assess if a given product is a "good", a "medium" or "bad" idea. Fig.15 shows the individual values for both cricket species, and Fig. 16 the merged ones.

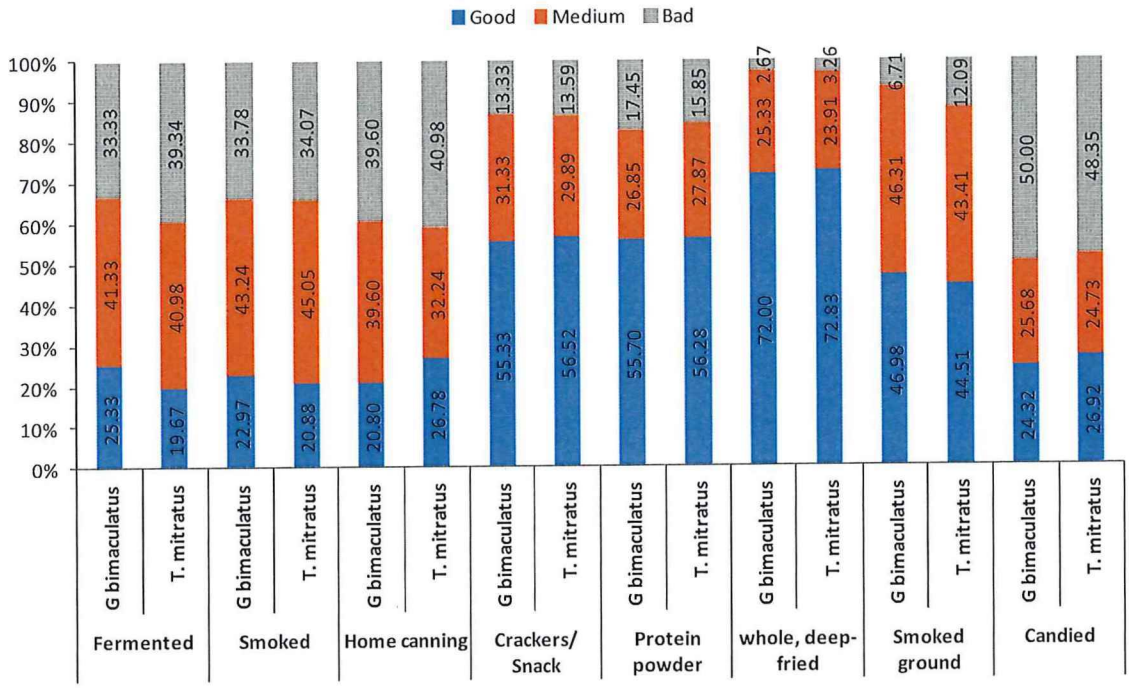



Fig. 29: Selected preservation techniques of crickets

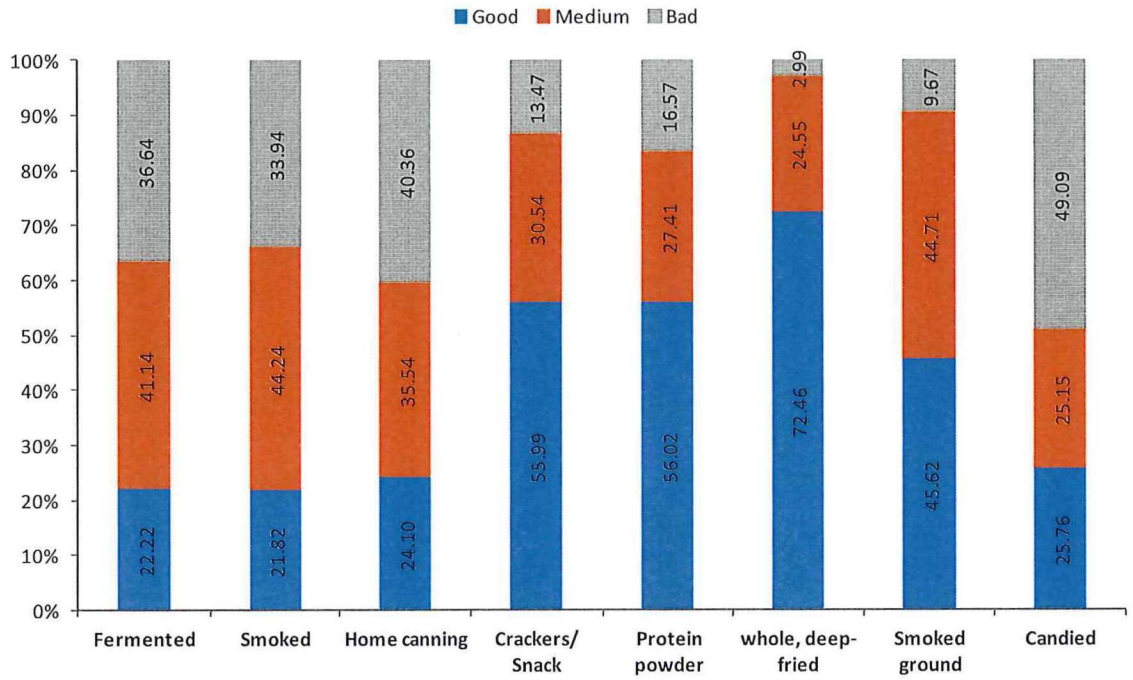



Fig. 30: Preference preservation techniques of crickets

Broadening the focus to all countries, Tab. 10 contains the ranking of the proposed PIBP in relation to species and country.

Tab. 10: Ranking of the PIBP's according to country and species

| Species | # | Thailand | Cambodia | Germany |
|---|---|---|---|---|
| *G. bimaculatus* | 1 | deep-fried | deep-fried | protein powder |
| | 2 | protein powder | protein powder | cracker/snacks |
| | 3 | cracker/snacks | cracker/snacks | deep-fried |
| | 4 | smoked, ground | smoked, ground | smoked, ground |
| | 5 | fermented | fermented | candied |
| Local species* | 1 | deep-fried | deep-fried | protein powder |
| | 2 | protein powder | cracker/snacks | cracker/snacks |
| | 3 | smoked, ground | protein powder | deep-fried |
| | 4 | cracker/snacks | smoked, ground | smoked, ground |
| | 5 | fermented | candied | smoked, whole |

* = Thailand: *Bombyx mori*, Cambodia: *Teleogryllus mitratus*, Germany: *Tenebrio molitor*

As can be seen from Tab. 10, deep-fried was typically regarded as the best option in many cases, particularly in Southeast Asia. However, this method solely served as a reference. Neglecting this option, there is strong similarity between results for the Mediterranean cricket across countries. In terms of local species, differences between the

common and local species were noted for Cambodia and Thailand which means that consumers have a good notion of the sensorial properties of the different species, being aware that they taste differently. For Germany, however, results for the mealworm largely resemble those obtained for the Mediterranean crickets, suggesting that their lack of experience (expressed in many questionnaires) leads to the assumption that all insects taste more or less the same. The complete analysis will be published as scientific paper during 2020.

Finally, Tab. 11 presents the decision of which country will produce which PIBP, fulfilling thus the deliverables of this WP.

Tab. 11: Decision on the preserved insect-based product to be developed

| Species | Cambodia | Thailand | Germany |
|---|---|---|---|
| *G. bimaculatus* | Smoked, ground | Protein powder | Cracker/snacks |
| Local species* | Protein powder | Protein powder | Cracker/snacks |

* = Thailand: *Bombyx mori*, Cambodia: *Teleogryllus mitratus*, Germany: *Tenebrio molitor*

WP 5 milestones are not due yet.

### 7. WP 6 – Project administration

This WP's objectives are to guarantee a smooth and timely development of the project and coordinate the project's outputs.

Regarding the first part, it must be admitted that presently the consortium is a little behind schedule, mostly due to administrative obstacles, particularly with relation to financing. It became apparent that none of the consortium partners was accustomed to the quarterly budgeting, and so a series of questions have been arising, and answering them takes a certain time. We have also seen that money transfer, although provided quickly from the funding agency and passed on from TiHo to the Asian partners in the same way, takes markedly long to reach the partners in Thailand and Cambodia. We observe that this system takes time to get accustomed to.

In other administrative terms, we celebrated our kick-off meeting in June 2019 (Fig. 31 and 32). Annex 2 contains the account of this meeting as written by Dr. Chhay Ty from LDC.

Fig. 31: The Thai and Cambodian delegations with the project leader in front of TiHo's insectarium; Left to right: Dr. Jamlong Mitchaothai (KMITL), Prof. Jatuporn Krajaisri (MUT), Dr. Rachakrit Lertpatarakomol (MUT), Dr. Chhay Ty (LDC), Dr. Keo Sath (RUA), Dr. Nils Th. Grabowski (TiHO)

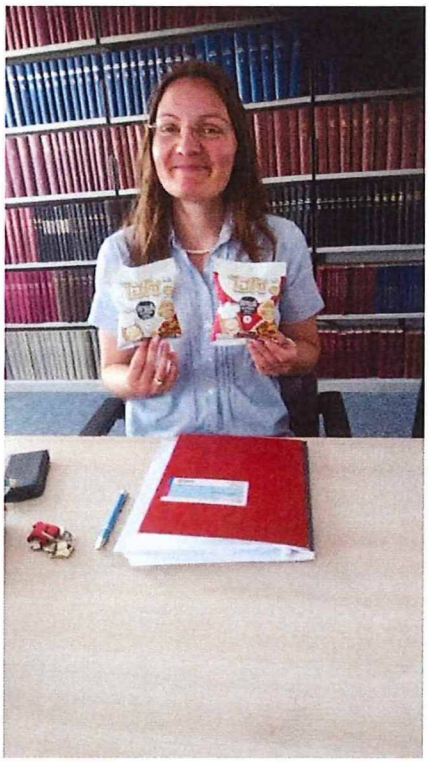


Fig. 32: The visitors provided the German colleagues (here: Dr. Birte Ahlfeld) with samples of commercial insect-based snacks

As can be seen, most of the meeting was dedicated to answer finance-related questions as this was a novel subject for all participants. Another important result was the agreement of carrying out regular online meetings, using the program "Zoom" which is very

common in Asia and can be installed in all computers and even on mobile phones. Accordingly, meetings are held on a regular, monthly base and take between 30 and 45 minutes each. They focus on an account of the status quo, upcoming events and necessary deliverables (such as budget requests and deliverables), asking for obstacles and challenges, and, if there is enough time, agreement on the next meeting.

Managing the output of the project has been centred on promoting IFNext as such. On one hand, a brief description of IFNext was presented as posters during two important congresses in Germany, i.e. the Insecta 2019 and the Meeting of the German Veterinary Association on Food Hygiene in Garmisch-Partenkirchen (Fig. 33), both events taking place in September. Posters and abstracts have been published in the abstract books of the congresses and are also on the project homepages.

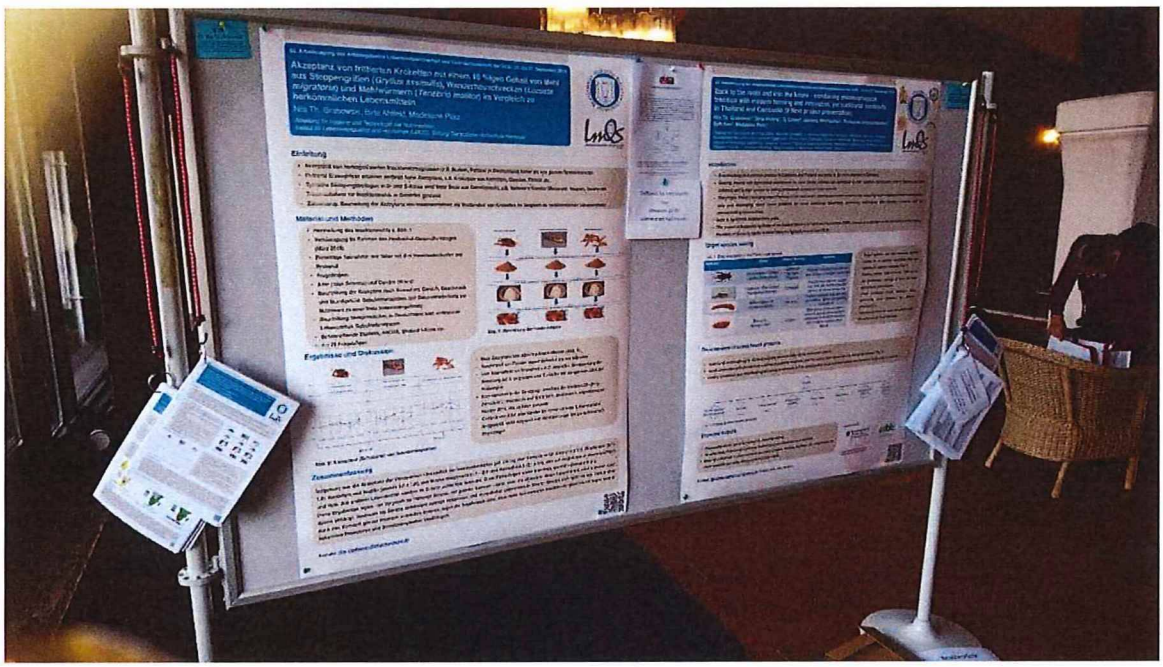


Fig. 33: Presenting IFNext at the annual meeting of food hygiene in Garmisch-Partenkirchen, September 2019. Posters could be downloaded using a QR code or taken along as a print version.

This has led to a marked interest in both the project and the subject in general. The response was such that during the Insecta 2019, a new group was created, the International Network for Productive Insects' Health and Welfare (INPIHW). With the consortium members as initial core of the network, veterinarians and associated professionals rapidly assembled, some coming from the project partners' networks, some joining because of corresponding calls issued during insect-related events the project leader assisted. INPIHW seeks to provide veterinary support to insect rearers worldwide. In this way, it disseminates the experience and knowledge created by IFNext and can also serve a reference in case doubts

and challenges in IFNext occur. Members come from Africa, the Américas, Asia, and Europe so far and each member has skills and experience in a certain kind of insect rearing system. By combining and exchanging these experiences, the proverbial wheel will not have to be re-invented for each country. INPIHW is supported by the German Veterinarian Association and the Federation of Veterinarians of Europe (FVE).

During the Insecta 2019, researchers from other BLE-funded projects met incidentally. In fact, these brief encounters also resulted in the elaboration of another insect project proposal in Southeast Asia ("AME4Safe" [proposal 22_FENV], presently under evaluation). It would be good to have a concerted action for Insecta 2020 for all BLE-funded insect-related project partners to meet.

On the other hand and apart from congresses, other events were used to promote IFNext. As the interest of public health veterinarians in edible insects has been increasing in Germany, the project leader was invited several times for advanced trainings and workshops (Fig. 34). At these occasions, a presentation of the status quo of edible insects in Europe and Germany in particular was provided, sometimes in conjunction with a practical training (insect species identification). The project IFNext was also presented during these events, so that public veterinarians from all parts of Germany are aware of it. The same is true for consumer counselling agencies and the EFSA (European Food Safety Authority), since the project leader has been given the status of *hearing expert* to the EFSA for edible insects. Tab. 12 contains a list of these events.

Tab. 12: Events attended by the project leader in which IFNext was mentioned and promoted

| Date | Location | Event | PL's* function |
|---|---|---|---|
| 20.1.2019 | Brunswick | Advanced training for public heath veterinarians and associated professions of the local food safety authority (Lower Saxony) | Lecturer, workshop leader |
| 22.1.2019 | Hannover | German veterinary congress | lecturer |
| 19.3.2019 | Göttingen | Advanced training for consumer counsellors | lecturer |
| 10.4.2019 | Hannover | Meeting of the animal welfare task force of the Lowe Saxony Chamber of Veterinarians | lecturer |
| 30.5.2019 | Nuremberg | Advanced training for public heath veterinarians and associated professions of the local food safety | lecturer |

| | | | |
|---|---|---|---|
| | | authority (Bavaria) | |
| 18.6.2019 | Dresden | Advanced training for public heath veterinarians and associated professions of the local food safety authority (Saxony) | lecturer |
| 16.7.2019 | Plauen | Advanced training for food controllers | Lecturer, workshop leader |
| 14.10.2019 | (Skype) | Meeting with the EFSA insect task force | Hearing expert for edible insects for the EFSA |
| 18.10.2019 | Munich | Congress of practicing veterinarians | In charge of the information booth |
| 1.11.2019 | (virtual) | Recording of an oral presentation on the food hygiene of edible insects for an insect congress in Brazil | Lecturer |
| 8.11.2019 | Stuttgart | Advanced training for public heath veterinarians and associated professions of the local food safety authority (Baden-Württemberg) | Lecturer |
| 26.11.2019 | Hannover | Meeting with the "Enactus" group of the University of Hannover that work with BSF in Benin and Uganda | Counsellor |
| 3.12.2019 | Brussels | IPIFF meeting | Lecturer, panellist |

*PL = project leader

These events were, as mentioned before, also used to recruit new members for the NPIHW which is as close as non-affiliated scientists and practitioners can come to the IFNext group. Special mention deserves a meeting with the Enactus group from the Leipzig University Hannover. They pursue a similar goal like IFNext, but work with black soldier flies (*Hermetia illucens*), designing a starter kit for that species for African conditions. Cooperation is planned. Enactus is connected with UN university and one possible additional benefit for IFNext could be the inclusion of the starter kits devised in IFNext to the UN technology transfer portfolio.

Regarding social media, updates of IFNext are presented regularly on the project leader's web presences of ResearchGate[2], Facebook[3], and Twitter[4], establishing the hashtag #IFNext there. The ResearchGate profile, just as the corresponding section of the institute's homepage (see section 2) contains all the output created by IFNext so far (Annex 3).

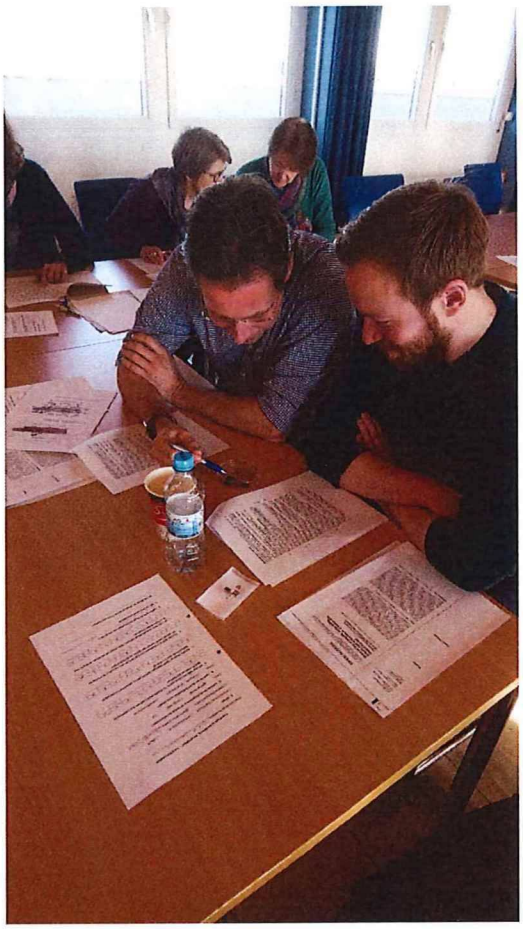


Fig. 34: Workshop guided by IFNext staff: insect species identification using simplified keys.

Finally, the project leader has been interviewed several times during year, and the articles have been resp. are being published for a broader public. The most important ones were an article published for the local gentry magazine "Nobilis" in December, and another report by "Neue Presse" (interview in December, published in January 2020). Although from the scientific point of view, the output was relatively small, the Nobils article has triggered the interest of German broadcasting corporations. In this way, SAT1 and RTL Nord have applied for the opportunity to report on IFNext and the other insect-related research carried out at our institute. RTL Nord visited us on January 8th 2020 and made a report on IFNext and insect

[2] https://www.researchgate.net/project/IFNext-bringing-insect-farming-to-the-next-level
[3] https://www.facebook.com/profile.php?id=100010174361394
[4] https://twitter.com/dr_nils?lang=de

products for the German market (Fig. 35). The program can be watched on the Facebook profile of the reporting journalist[5] from Friday, 10th 2020, 18:30 pm on.

Fig. 35: German broadcasting corporation RTL Nord visiting TiHo for a report about IFNext; pictures by Sonia von Brethorst, TiHo

Since December 2019, TiHo counts with a computer-supported stereoscopic microscope that is able to record single pictures, picture sequences, and videos. This investment was possible after checking with the funding agency and by shifting parts of the existing budget, without increasing it. There are two major uses of this tool: on one hand, the

[5] https://www.facebook.com/JanBockemuellerRTLNord/

clinical examination of animals is much more precise when it comes to detect diseases or quality flaws (Fig. 36). On the other hand, high-definition microscopic images are important features of scientific and popular publications (Fig. 37), increasing the visibility of the project.

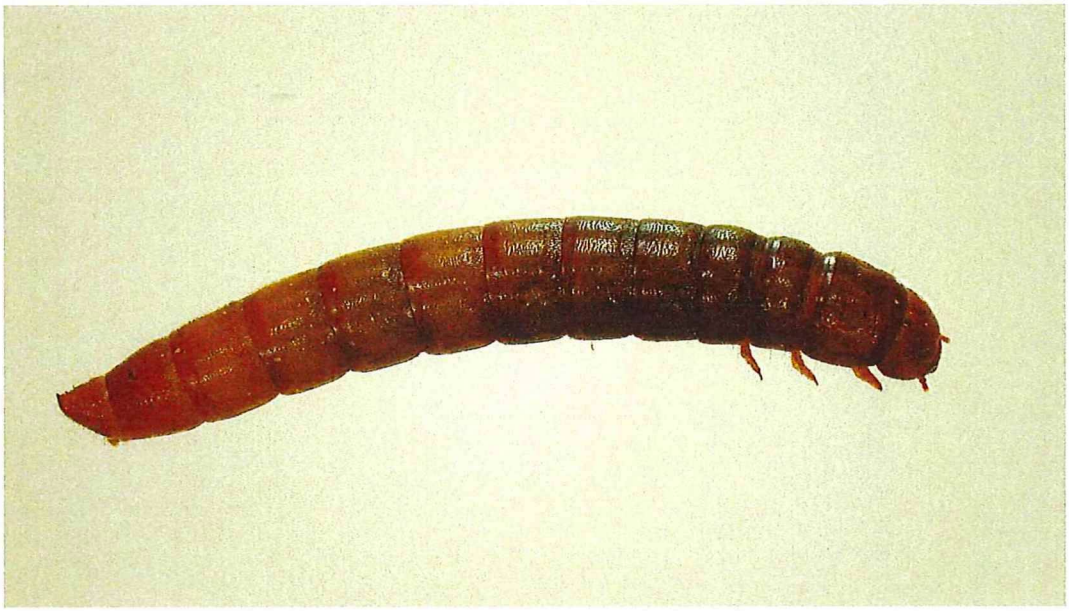


Fig. 36: Common mealworm (*Tenebrio molitor*), with a darkening of the thoracic and first three abdominal segments, commencing signs of putrefaction

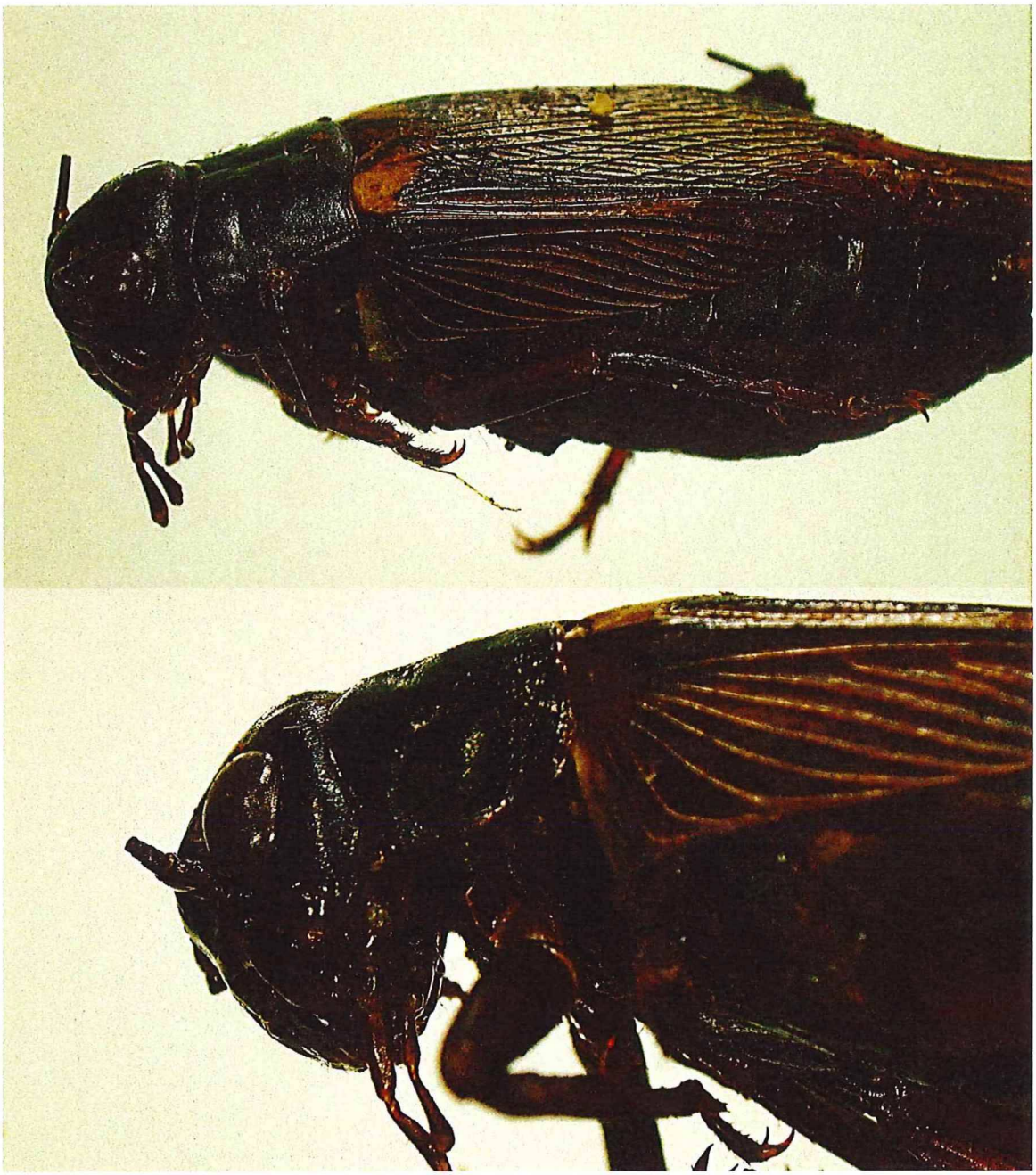


Fig. 37: Thawed Mediterranean cricket (*Gryllus bimaculatus*)

On a culinary level, insects were also offered at meetings and festivities of the TiHo food sciences institute (LMQS) resp. university. Previous studies revealed that most interviewed German consumers fancy products in which the insects were homogenized. Taking up the idea of the Enactus group (from a meeting before IFNext was granted), insect flour was combined in corn doughs. While these corn doughs are processed to porridges in East and South Africa (called locally “mealie pap”, “nshima” etc.), Mexico’s cuisine has been

working with nixtamalized[6] corn doughs for millennia. Joining ideas, a nshima-like porridge with 10% insect meal (plus salt and black pepper) was prepared, left to cool, cut and deep-fried (Fig. 38). This was done with three different insect flour types, the rest of the recipe remaining unchanged. Fritters were handed out during a health promoting along with a questionnaire in which participants were asked to rate, among others, these fritters using German school grades. The analysis's results will be published in a scientific journal. This recipe was also used for the RTL presentation and was rated as tasty by those that tried it.

Fig. 38: Insect meal-containing nshima-porridge (above) and deep-fried fritters made from it (below)

[6] African corn doughs traditionally only include corn flour and water. The original corn flour is, however, not very nutritious as innate substances interfere with the digestibility of the porridge. In Mexico, corn is cooked in limewater and hulled, increasing its digestibility and making foods elaborated with nixtamalized corn more nutritious.

A similar product was presented at the institute's Christmas party. Tlacoyos are Mexican patties made from nixtamalized corn meal. They are like tortillas, but much thicker and can thus be filled to create a sandwich-like product. Unlike the fritters used in the previous event (that took place before IFNext commenced), we used one of the project's species (crickets) to add to the cornmeal and kneaded the tlacoyo dough. A mixture of cooked potatoes and jalapeño chillies was introduced into each raw tlacoyo, and then they were heated without fat until cooked. Once cooled, they filled with more potato/chili mixture, lettuce, sour cream and red salsa. In respect to the indigenous roots of the recipe, we called it "chinahtlaoyo" which in Nahuatl means "bug tlacoyo" (Fig. 39). For those willing to try, we also offered dried and spiced insects from external provider (Fig. 40).


Fig. 39: Chinahtlaoyos, traditional Mexican tlacoyos made with corn meal and 10 % cricket meal, offered at the institute's Christmas party

Fig. 40: Roasted and spiced whole insects (from above to below: mealworms, desert locusts, and house crickets) as snacks, offered at the institute's Christmas party

## 8. Conclusion

The first year of IFNext was characterized by the start of project-related activities sometimes hampered by administrative delays. This shows that we will have to have a closer and more foreseeing look on this aspect in the future. However, efforts were made to catch up, and most of the goals set for this year were reached. Being an area which is highly affected by changes due to constant innovation and knowledge increases, IFNext adapted to these changes and will continue to do so.

on behalf of the consortium,
Dr. Nils Th. Grabowski, TiHo

Hannover, January 10th, 2019

# Annexes

Annex 1: WP 5 questionnaire

Annex 2: Kick-off meeting report

Annex 3: IFNext publications

Annex 4: Publications about IFNext

Name of data collector: .....

Date of data collection: ....

Questionnaire code: .....

**Annex 1: IFNext Questionnaire: Consumer's preferences**

We are an international group of scientist from Cambodia, Thailand, and Germany who work with promoting edible insects in our countries. To improve the attractiveness of eating them, we want to elaborate new products from insects which have a longer shelf-life.

| Respondent information | | | | | | | |
|---|---|---|---|---|---|---|---|
| Country of Origin | | | | | | | |
| Country of Residence | | | | | | | |
| Occupation | | | | | | | |
| Area of living | Urban | | Rural | | | Other (specify.....) | |
| Gender | | | | | | | |
| Male | | Female | | | Other | | |
| Age | | | | | | | |
| Until 10 | 11 - 20 | 21 - 30 | 31 - 40 | 41 - 50 | 51 – 60 | 61 – 70 | 71+ |
| Education Background | | | | | | | |
| No education | Primary school | Secondary school | High school | University | Other (specify.....) | | |

| Preference and perception | | | | | |
|---|---|---|---|---|---|
| | Mediterranean cricket (*Gryllus bimaculatus*) | Cambodian field cricket (*Teleogryllus mitratus*) | Silkworm (*Bombyx mori*) | Mealworm (*Tenebrio molitor*) | Others (specify) |
| Which insect species have you been eating? | | | | | |
| Which insect species do you prefer most? | | | | | |

| Please refer to **your favorite insect species** (as noted down in the previous question) for the following questions: | | | | |
|---|---|---|---|---|
| How long have you been eating food insects? | | | | |
| Always | Sometimes | Occasionally | Rarely | never |

| Are you aware of the nutritional benefits from eaten cooked food insects? | | | | | | | |
|---|---|---|---|---|---|---|---|
| Yes | | No | | | Not sure | | |
| How often do you eat food insects per month? | | | | | | | |
| 1 – 2 times | | 3 – 5 times | | > 5 times | | Others (specify) | |
| How do you usually like to eat cooked food insects? | | | | | | | |
| Single, as an individual | | In a group, with friends and family | | | Both | | |
| How much amount of cooked food insects you usually purchased per time? | | | | | | | |
| 1 can/cup | 2 cans/cups | 3 cans/cups | Others (specify) | How much does it cost you? [price/can or cup in your national currency] | | | |
| Do you consider food insects as healthy foodstuffs? | | | | | | | |
| Very much | | Not so much | | Not at all | | No answer/don't know | |
| What form of food insects would you like to buy most? | | | | | | | |
| Live food insects to prepare at home | | Dead, raw food insects to prepare at home | | Prepared food insects | | Others (specify) | |
| What are your reasons to consume cooked food insects? | | | | | | | |
| Quality | Flavor | Safety | Hygiene | Price | Packing | Place | |
| Where do you usually access cooked food insects to eat? | | | | | | | |
| Mobile seller | | Restaurant/shops | | Specific cooked food insects | | Others (specify) | |
| Have you been effected any health problem after eating cooked food insects? | | | | | | | |
| Always | Sometimes | Occasionally | Rarely | Never | If so, which? | | |
| In which time of year do you mostly see food insects available on sale at your local market? | | | | | | | |
| **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** |
| What is your main reason to consume insects? | | | | | | | |
| | | | | | | | |
| What are you other opinions on eating food insects? | | | | | | | |
| | | | | | | | |

| Product | Examples/comments | Preferred preservation technique – What do think of these ways to preserve insects? | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mediterranean cricket (*Gryllus bimaculatus*) | | | Cambodian field cricket (*Teleogryllus mitratus*) | | | Silkworm (*Bombyx mori*) | | | Mealworm (*Tenebrio molitor* | | |
| | | ☺ | 😐 | ☹ | ☺ | 😐 | ☹ | ☺ | 😐 | ☹ | ☺ | 😐 | ☹ |
| Fermented | Like fish/shrimp sauce, fish/shrimp paste | | | | | | | | | | | | |
| Smoked whole | Like smoked fish, smoked ham & sausages | | | | | | | | | | | | |
| Home-canning | Like canned vegetables, fish or meat, in brine or with spices | | | | | | | | | | | | |
| Crackers / Snack | Like krupuk, crisps | | | | | | | | | | | | |
| Protein powder | Insects cooked, roasted, dried, and ground to a meal for noodles, seasoning, protein shake, protein balls, etc. | | | | | | | | | | | | |
| Deep-fried | Traditional way of preparation | | | | | | | | | | | | |
| Smoked ground | Like protein powder, but smoking included | | | | | | | | | | | | |
| Candied | Like candied almonds | | | | | | | | | | | | |
| **Your** suggestion? | | | | | | | | | | | | | |

| Any final comments? |
|---|
| |

Thank you for your support!

The IFNext Team.

**Annex 2: Kick-Off meeting report by Dr. Chhay Ty, LDC**

# Kick off meeting report

| | |
|---|---|
| Project | IFNext - bringing insect farming to the next level |
| project number | FKZ: 2816PROC19 |
| Funded by | BLE (Bundesministerium für Landwirtschaft und Ernährung) |
| Project Timeframe | February 1st, 2019 to February 28th, 2022 (4 years) |

| | |
|---|---|
| Project leader | Dr. Nils Th. Grabowski<br>Institute for Food Quality and Food Safety (LMQS)<br>Hannover University of Veterinary Medicine, Foundation<br>Bischofsholer Damm 15<br>D - 30173 Hannover, Germany<br>Tel./Fax #49 - (0)511 - 856 - 75 60<br>Nils.Grabowski@tiho-hannover.de |
| Project partners | Cambodia:<br>1. Livestock Development for Community Livelihood (LDC) formerly Center for Livestock and Agriculture Development (CelAgrid)<br>2. Faculty of Veterinary Medicine, Royal University of Agriculture (RUA)<br>Thailand:<br>3. Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang (KMITL)<br>4. Faculty of Veterinary Medicine, Mahanakorn University of Technology (MUT) |
| Prepared by | Chhay Ty, Livestock Development for Community Livelihood (LDC) |

# Contents

## *1.1 Objectives*

The main objective in kick off meeting was

- To know each other among project partners (German, Cambodia and Thai)
- To brief project activities and responsible among partners
- To share some experience on edible insect farming
- To discuss on budget and budget request among partner

## *1.2 Travel Diary*

The kick off meeting was conducted for 4 days from 25 June to 28 June 2019 at Institute for Food Quality and Food Safety (LMQS), Hannover University of Veterinary Medicine, Foundation.

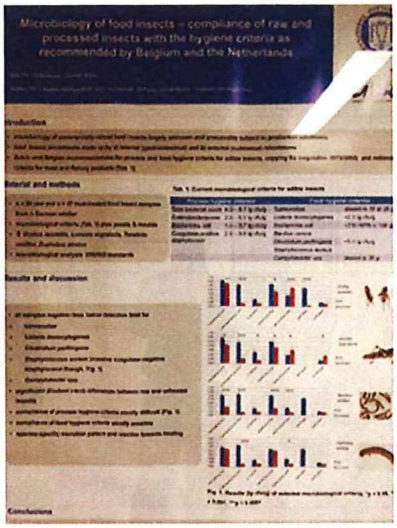
| Date | Activity |
|---|---|
| 24 June 2019 | Travel from Phnom Penh to Hannover city via Hong Kong and Helsinki (Finland) |
| 25 June 2019 | Visit edible insect rearing in room implemented by Dr. Nil<br>Started workshop with three presentation<br>- Dr Nil<br>- Dr Chhay Ty<br>- Dr Jamlong |
| 26 June 2019 | Travel to PPM company (expert on edible insect processing) |
| 27-28 June 2019 | Continue discussion on the project activities and budget |

## *1.3 Report*

### 1.3.1 Visited edible insect at University

In order to get more information and understand about edible insects in Europe, Dr Nil from the Institute for Food Quality and Food Safety (LMQS), Hannover University of Veterinary Medicine, Foundation, has conducted edible insect rearing in a room with different cricket breeds (*Acheta domesticus, Gryllodes sigillatus, Gryllus assimilis,* and *Gryllus bimaculatus*) and black soldier fly. The testing not is just only production but also breeding by selected colony and some will be tested for certain bacteria.

**Photo 1:** Cricket rear in room



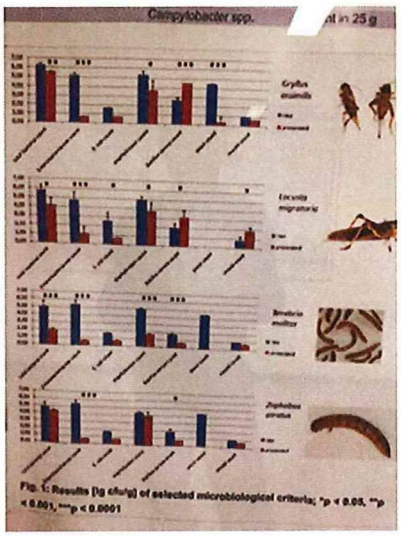




**Photo 2**: Poster on microbiology of insects

## 1.3.2 Self-introduction among participants

All participants were asked to introduce themselves including name, current position and background of education and field work. There were 8 participants came from three countries (Germany, Cambodia and Thailand) join in this meeting. Name of participants are

- Prof. Dr. Madeleine Plötz, Director of Institute for Food Quality and Food Safety (LMQS)
- Dr. Nils Th. Grabowski: IFNext project leader and head of the department of hygiene and technology of productive insects, Institute for Food Quality and Food Safety (LMQS)
- Dr. Birte Ahlfeld, IFNext project member from LMQS
- Dr. Chhay Ty, Livestock Development and Community Livelihood Organization (LDC)
- Dr. Keo Sath, Faculty of Veterinary Medicine (FVM), Royal University of Agriculture (RUA)
- Dr. Jamlong Mitchaothai, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang (KMITL)
- Dr. Rachakris Lertpatarakomol, Faculty of Veterinary Medicine, Mahanakorn University of Technology (MUT)
- Dr. Jatuporn Krajaisri, Dean of Faculty of Veterinary Medicine (FVM)

**Photo 3:** Dr Nil introduce edible insect rearing in his room condition

**Photo 4:** Introduction by Director of Institute for Food Quality and Food Safety (LMQS)

## 1.3.3 Presentation

### 1.3.3.1 Dr. Nils Th. Grabowski

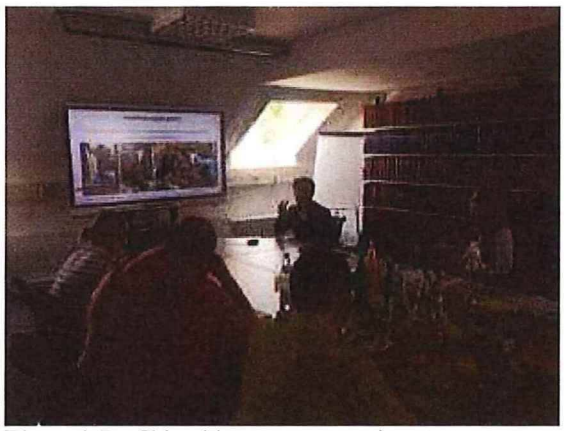
Dr Nils gave a brief project activities presentation which focus on six work packages (WP) as one or more WP has responsible by project partner.

**Photo 5:** Dr Nil gave presentation

### 1.3.3.2 Dr. Chhay Ty

Dr Chhay Ty gave a presentation on cricket farming for smallholders in Cambodia, the layout of the presentation was

- Introduction
- Objective
- Crickets as human food?
- Wild harvest is quick cash but faces some problems
- Using light for traps wild cricket
- Why cricket farming?
- Cricket production and market network
- Previous project activities implemented by CelAgrid/LDC
- Lesson learnt from the project



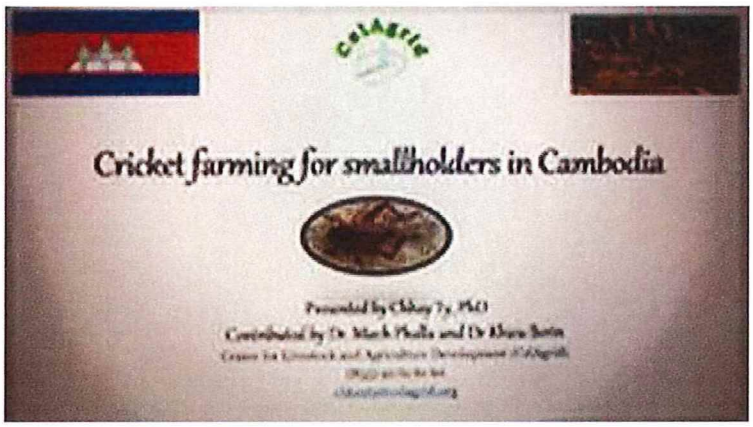
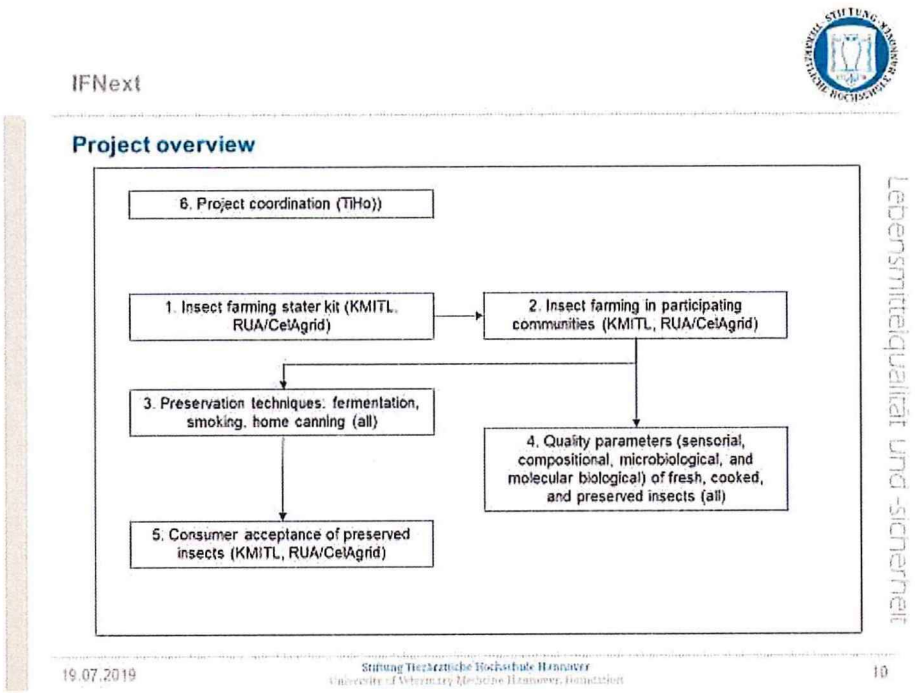



**Photo 6:** Dr Chhay Ty gave presentation

### 1.3.3.3 Dr. Jamlong Mitchaothai

Dr Jamlong gave a brief project activities presentation which focus on the work plan of the six work packages (WP).




### 1.3.4 Travel to PPM company (experts on edible insect processing)

Insect production and use as food in Europe are important and need to ensure that those products are safety both human and animal. PPM company is located in Magdeburg (about 100km from Hannover city), and this company has much experience to process different edible insect especially extract the oil from edible insect and used dry edible insect as human food.

### 1.3.5 Continue discussion on the project activities and budget

To make sure every partner's well understanding, Dr Nil as project leader lead the discussion on the project activities and budget. Budget request/fund request needs to be done every quarter of a year. In year 2019, there are only three quarter that can be do the fund request such as Q2 (April-June), Q3 (July-Sept) and Q4 (Oct-Dec).

Template sheet fund request was distributed to all partners to do exercise and make sure that the request follows the funding agency's requirements. However, during the exercise, there were some questions and Dr Bystry is financial secretary gave us the explanation via phone call.

### 1.3.6 Zoom call meeting

Zoom call is a one program that everyone can communication and can see face to face of joining person during the call meeting. Dr Nil will lead zoom call meeting to refresh and discussion any issue related to the project.

## *1.4 Conclusions*

There appears to be appropriate results from the kick off meeting, especially project activities, budget and budget request, however, meetings and discussion via zoon call need to be done very often to make sure all partners are in the same stage.

Annex 3.1



# Combining entomophagous tradition with modern farming and innovative, yet traditional foodstuffs in Thailand and Cambodia (IFNext project presentation)

Nils Th. Grabowski[1], Birte Ahlfeld[1], Ty Chhay[2], Jamlong Mitchaothai[3], Rachakris Lertpatarakomol[4], Sath Keo[5], Madeleine Plötz[1]

[1] *Institute for Food Quality and Food Safety, Hannover University of Veterinary Medicine, Foundation, Hannover, Germany*
[2] *Centre for Livestock and Agricultural Development, Phnom Penh, Cambodia*
[3] *Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand*
[4] *Faculty of Veterinary Medicine, Mahanakorn University of Technology, Bangkok, Thailand*
[5] *Faculty of Veterinary Medicine, Royal University of Agriculture, Phnom Penh, Cambodia*

*Corresponding author: Nils.Grabowski@tiho-hannover.de*

Traditional entomophagy includes insect collecting, processing, consumption, and preservation. The latter is typically practiced in dry and warm areas. In humid, tropical regions, this is not the case, possibly because many species may be obtained always fresh. Still, there is a long history of preserving foodstuffs in regions where, drying is not an option.

Cambodia and Thailand are affected by malnutrition, particularly of mothers and children in rural areas. IFNext ("Bringing insect farming to the next level") is a project that started in 2019 and seeks to improve the nutrition of mothers and children in those countries by designing insect farming starter kits so that families may rear their own insects, consume them, and sell surpluses on local markets. During the project, kits will be adapted to the specific needs of the farmers. The consortium agreed on the Mediterranean field cricket (*Gryllus bimaculatus*) to be reared by everybody, and another species with local importance, i.e. the silk worm (*Bombyx mori*) for Thailand, the Cambodian field cricket (*Teleogryllus mitratus*) for Cambodia, and the mealworm (*Tenebrio molitor*) for Germany. Farmers will be involved directly when choosing a novel preserved insect product, using traditional, low-energy techniques, e.g. fermenting, smoking, krupuk-style crackers, and home canning. Products will be developed and their compositional, microbiological, and sensorial quality monitored. Results will be published in scientific and popular magazines and on social media in English, Khmer, Thai, and German.

The project is supported by funds of the Federal Ministry of Food and Agriculture (BMEL) based on a decision of the Parliament of the Federal Republic of Germany via the Federal Office for Agriculture and Food (BLE).

# Combining entomophagous tradition with modern farming and innovative, yet traditional foodstuffs in Thailand and Cambodia (IFNext project presentation)

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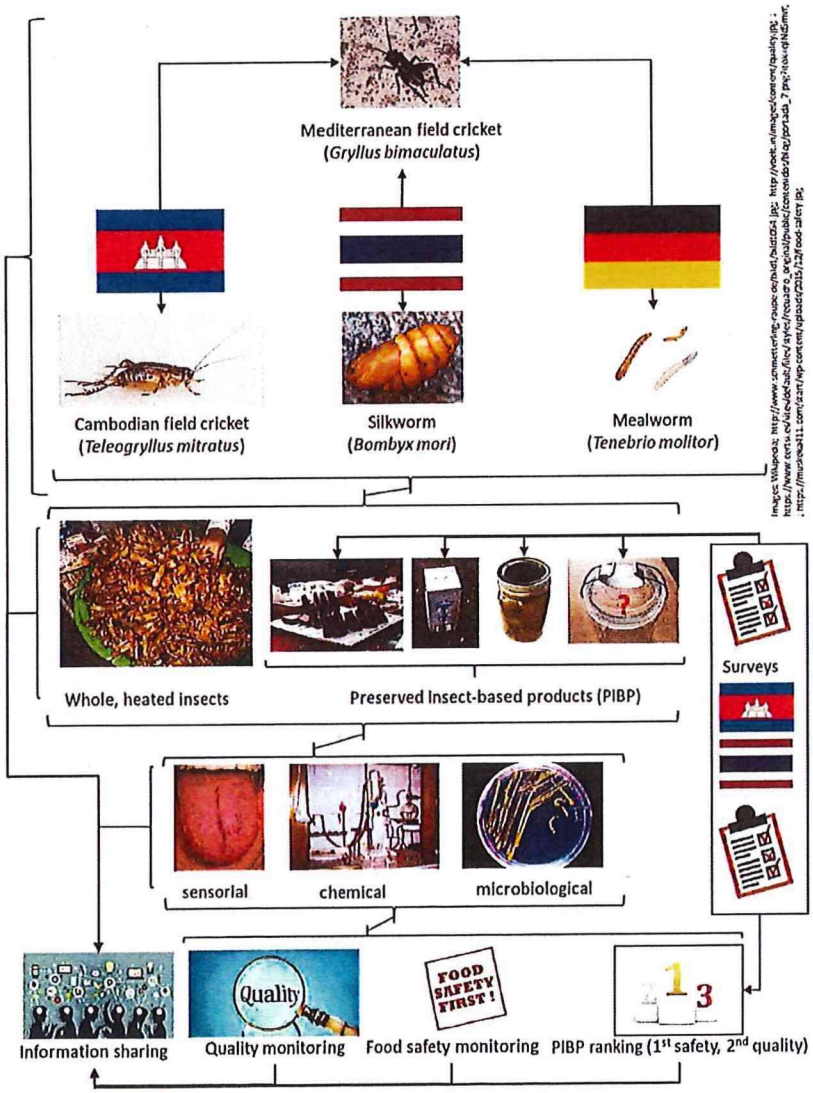
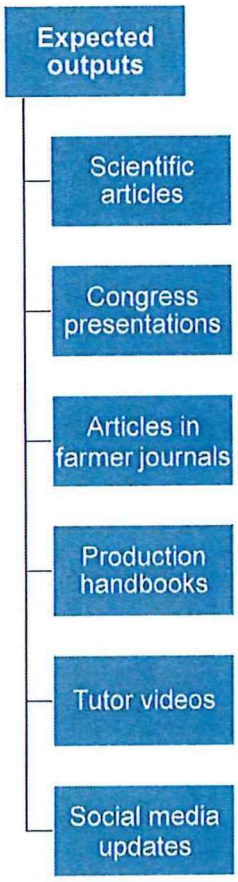
## Introduction

- Entomophagy is common practice in Cambodian and Thailand and starts to get more attention in Germany.
- Rearing insects with agricultural sidestreams by small farmer families can contribute to their nutrition (particularly that of mothers and their children) and to their income by selling (processed) surplus on local markets.
- The project IFNext contributes to this condition by designing locally-adapted insect rearing starter sets and developing novel insect products by using traditional low-energy preserving techniques after having consulted with the corresponding communities.
- Start in April 2019, duration three years
- The project is supported by funds of the Federal Ministry of Food and Agriculture (BMEL) based on a decision of the Parliament of the Federal Republic of Germany via the Federal Office for Agriculture and Food (BLE).

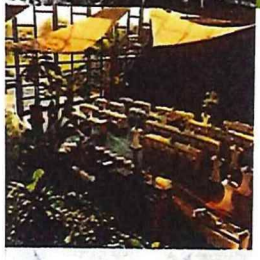
## Material and methods

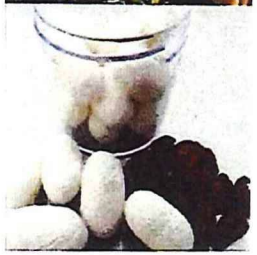



Gefördert durch:
Bundesministerium für Ernährung und Landwirtschaft
aufgrund eines Beschlusses des Deutschen Bundestages

Contact: Nils.Grabowski@tiho-hannover.de; Twitter: @dr_nils, #IFNext





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# INSECTA 2019

## International Conference

## Book of Abstracts

05th – 06th September 2019
Potsdam, Germany

INSECTA 2019

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Heft 103
Potsdam 2019

Annex 3.2



[1]Institute for Food Quality and Food Safety (LMQS), Hannover University of Veterinary Medicine, Foundation, Hannover, Germany
[2]Centre for Livestock and Agricultural Development (CelAgrid), Phnom Penh, Cambodia
[3]Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Ladkrabang/Bangkok, Thailand
[4]Faculty of Veterinary Medicine, Mahanakorn University of Technology, Nong Chok/Bangkok, Thailand
[5]Faculty of Veterinary Medicine, Royal University of Agriculture, Phnom Penh, Cambodia.

## Back to the roots and into the future – combining entomophagous tradition with modern farming and innovative, yet traditional foodstuffs in Thailand and Cambodia (IFNext project presentation)

N.T. Grabowski[1], B. Ahlfeld[1], T. Chhay[2], J. Mitchaothai [3], R. Lertpatarakomol[4], S. Keo[5], M. Plötz[1]

Entomophagy is a common food habit for approx. 2.8 billion people worldwide. Traditional entomophagy is based on insect collecting, processing, consumption, and, in some cases, preservation. The latter is typically practiced in relatively dry and warm climate areas, e.g. in the Latin American highlands or East Africa. In humid, tropical regions, no major need to preserve insects seems to have risen, possibly because many species are available in most parts of the year and may be obtained relatively easily. Still, there is long history of preserving effectively animal-based foodstuffs in regions where, because of the climate, drying is not an option.

Cambodia and Thailand are both affected by malnutrition, particularly of mothers and children in rural areas. IFNext ("Bringing insect farming to the next level") is a project that started in 2019 and seeks to improve

the nutritional status of mothers and children in those countries by designing insect farming starter kits so that farmer families may rear their own insects, consume them, and sell surpluses on local markets. During the duration of the project, these kits will be adapted to the specific needs of the farmers. Regarding insect species, the consortium agreed on the Mediterranean field cricket (Gryllus bimaculatus) to be reared by everybody, and an additional species with a promising local importance, i.e. the silk worm (Bombyx mori) for Thailand, the Cambodian field cricket (Teleogryllus mitratus) for Cambodia, and the mealworm (Tenebrio molitor) for Germany. The farmers will be involved directly by the consortium when choosing a novel preserved insect-based product, using traditional, low-energy techniques. Among the options are fermenting (cf. shrimp paste, fish paste, fish sauce, etc.), smoking (like shrimps in Western Africa), krupuk-style crackers, and home canning. These products will be developed and their compositional, microbiological, and sensorial quality monitored closely. Results will be published in both scientific and popular magazines, along with social media, in several languages, among them English, Khmer, Thai, and German.

The project is supported by funds of the Federal Ministry of Food and Agriculture (BMEL) based on a decision of the Parliament of the Federal Republic of Germany via the Federal Office for Agriculture and Food (BLE).

## CORRESPONDING AUTHOR

Dr. Nils Th. Grabowski
Institut für Lebensmittelqualität und –sicherheit (LMQS)
Stiftung Tierärztliche Hochschule Hannover
Bischofsholer Damm 15
30173 Hannover
E-Mail: Nils.Grabowski@tiho-hannover.de

Deutsche
Veterinärmedizinische
Gesellschaft

# 60. Arbeitstagung des Arbeitsgebietes Lebensmittelsicherheit und Verbraucherschutz

**24. - 27. September 2019**
**in Garmisch-Partenkirchen**

Annex 3.3

# ការចិញ្ចឹមចង្រិតជាលក្ខណៈគ្រួសារ

រៀបចំដោយ

**បណ្ឌិត ម្យៀច ផល្លា និង បណ្ឌិត តាយ ឌី**

**អង្គការអភិវឌ្ឍន៍ការចិញ្ចឹមសត្វដើម្បីជីវភាពសហគមន៍**

**អតីត**

**មជ្ឈមណ្ឌលអភិវឌ្ឍន៍ការចិញ្ចឹមសត្វ និងកសិកម្ម (សែលអាត្រត)**

# មាតិការអត្ថបទ

# មាតិការូបភាព

## សេចក្តីផ្តើម

ការចិញ្ចឹមចង្រិតជាលក្ខណៈគ្រួសារមានការចាប់អារម្មណ៍យ៉ាងខ្លាំងក្នុងប្រទេសកម្ពុជា និងជាជម្រើសមួយដ៏ល្អសម្រាប់បន្ថែមប្រាក់ចំណូលក្រៅពីការងារកសិកម្ម និងចិញ្ចឹមសត្វ។ ម្យ៉ាងទៀតការចិញ្ចឹមចង្រិតអាចផលិតអាហារសម្រាប់ផ្តល់អាហារជីវជាតិ/ប្រូតេអ៊ីនប្រចាំថ្ងៃដល់កុមារតូចៗដែលមានអាយុក្រោម៥ឆ្នាំ ដែលពួកគាត់នៅមានទម្ងន់ក្រោមស្តង់ដា និងសម្រាប់ស្ត្រីដែលមានអាយុចាប់ពី ១៥-៤៩ឆ្នាំ។ ការបរិភោគអាហារប្រចាំថ្ងៃមិនបានគ្រប់គ្រាន់ និងកង្វះអាហាររូបត្ថម្ភ ជាពិសេសផលិតផលសាច់ដែលមានប្រភពពីសត្វ និងសត្វល្អិត (ចង្រិត)ធ្វើអោយមានបញ្ហាជាច្រើនកើតឡើងចំពោះកុមារ និងស្ត្រី។

អត្ថបទនេះបានមកពីការសិក្សាស្រាវជ្រាវ និងការអនុវត្តន៍ជាក់ស្តែងលើការចិញ្ចឹមចង្រិតជាលក្ខណៈគ្រួសាររបស់ បណ្ឌិត មៀច ផល្លា នាយកនៃមជ្ឈមណ្ឌលអភិវឌ្ឍន៍ការចិញ្ចឹមសត្វ និងកសិកម្ម (សែលអាគ្រីត)។ អត្ថបទនេះនឹងផ្តល់ពត៌មានចាំបាច់ជាមូលដ្ឋាន អំពីរបៀបចិញ្ចឹមចង្រិតជាលក្ខណៈគ្រួសារដែលមានភាពសាមញ្ញ ដែលអាចអោយកសិកររនៅតំបន់ជនបទអាចអនុវត្តបាន ព្រោះសម្ភារៈ និងចំណីភាគច្រើនកសិករអាចរកបានក្នុងតំបន់ដែលពួកគាត់រស់នៅ។

## ផលប្រយោជន៍ នៃការចិញ្ចឹមចង្រិត

ការចិញ្ចឹមចង្រិតផ្តល់អត្ថប្រយោជន៍ជាច្រើន ពិសេសប្រាក់ចំណូល និងអាហាររូបត្ថម្ភ ក្នុងគ្រួសារ ដូចជា៖

- ចិញ្ចឹមបានពេញមួយឆ្នាំ (មានវដ្តផលិតកម្មខ្លី ប្រមូលផលបានក្នុងរយៈពេល ៣០-៤៥ថ្ងៃ
- បំលែងចំណីយ៉ាងមានប្រសិទ្ធភាព (ស៊ីចំណីតិច តែកើនទំងន់បានច្រើន)
- ត្រូវការបរិមាណទឹកតិចតួច និងទឹកន្លែងតូចសម្រាប់រស់នៅ
- ចង្រិតស៊ីចំណីមិនរើស
- មិនសូវប៉ះពាល់ដល់បរិស្ថាន និងជំងឺឆ្លងទៅមនុស្សដូចសត្វចិញ្ចឹមដ៏ទៃទៀត
- សំបុរជីវជាតិអាហាររូបត្ថម្ភ ពិសេសប្រូតេអ៊ីន វីតាមីន ជាតុរ៉ែ និងអាស៊ីតខ្លាញ់
- ផ្តល់លាមក និងកាកសំណល់ពីការចិញ្ចឹមសម្រាប់ធ្វើជីធម្មជាតិ
- កាត់បន្ថយការប្រមូលផលចង្រិតពីធម្មជាតិ ដែលអាចប៉ះពាល់ដល់អេកូឡូស៊ីសត្វល្អិតក្នុងធម្មជាតិ

## សក្តានុពលសម្រាប់ចិញ្ចឹមចង្រិតតាមសហគមន៍ជនបទ

- មានពូជចង្រិតធម្មជាតិ នៅក្នុងស្រុកដែលអាចរកបាន និងងាយផ្សាំ
- សម្បូរចំណីក្នុងស្រុកសម្រាប់ចង្រិត ដូចជា រុក្ខជាតិ អនុផលកសិកម្ម
- សម្ភារៈសម្រាប់ប្រើក្នុងអាង មាននៅក្នុងស្រុក ដែលមានតម្លៃថោក និងអាចរកបាន
- ងាយស្រួលចិញ្ចឹម បើប្រៀបធៀបនឹងសត្វចិញ្ចឹមដ៏ទៃទៀត ទាំងការថែទាំ បង្កាត់ពូជ និងអនាម័យ
- ត្រូវការទុនតិចតួចសម្រាប់ការចាប់ផ្តើម
- មានអ្នកចូលចិត្តបរិភោគចង្រិតច្រើន និងតម្រូវការទីផ្សារ ទាំងក្នុងស្រុក និងនាំចេញ

## ជំពូកទី១៖ ពូជចង្រិត

ពូជចង្រិតមានច្រើន ប៉ុន្តែពូជដែលមានសក្តានុពលសំរាប់ចិញ្ចឹមជាលក្ខណៈគ្រួសារ គឺពូជក្នុងស្រុក មានដូចជាពូជចង្រិតក្រហម និងពូជចង្រិតខ្មៅ។

### *ហេតុអ្វីត្រូវរើសរើសពូជក្នុងស្រុកសម្រាប់ចិញ្ចឹម?*

- ពូជក្នុងស្រុកសម្បូរ ងាយរកបានក្នុងធម្មជាតិ
- ងាយស្រួលក្នុងការបង្កាត់ពូជ
- ធន់នឹងជំងឺ
- មានភាពសុំនឹងបរិយាកាសក្នុងតំបន់
- ចំណាយតិច (បើប្រៀបធៀបនឹងពូជនាំចូល)
- និរន្តរភាពសម្រាប់ការចិញ្ចឹមចម្រុះ ព្រោះមានពូជចម្រុះជំនួស ភ្លាមៗ ពេលចម្រុះដែលចិញ្ចឹមមានបញ្ហា (ក្នុងករណីចម្រុះងាប់ ១០០%)

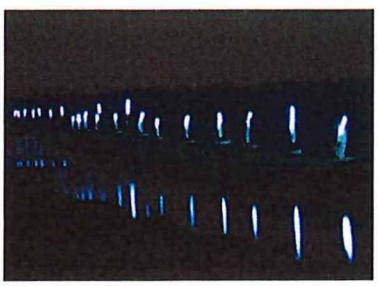
### *តើត្រូវធ្វើដូចម្តេច ដើម្បីបានចម្រុះពូជក្នុងស្រុកមកចិញ្ចឹម?*

ពូជចម្រុះក្នុងស្រុក ដូចជាពូជចម្រុះក្រហម និងពូជចម្រុះខ្មៅត្រូវបានចាប់ទាំងរស់ពីធម្មជាតិ ដោយប្រើអន្ទាក់ភ្លើងនៅពេលយប់ ដែលអាចទាក់ទាញសត្វល្អិតផ្សេងៗ ជាពិសេសចម្រុះ យកមកផ្សាំងក្នុងកសិដ្ឋានចិញ្ចឹមៗ ដូចនេះ ដើម្បីបានពូជចម្រុះក្នុងស្រុកយកមកចិញ្ចឹមត្រូវ៖

- ចាប់ចម្រុះពីធម្មជាតិដោយខ្លួនឯង នៅតាមទីវាល ស្រែ ឬចំការ តាមគំនរសំរាម ក្រោមកំទេចកំទីស្លឹកឈើ/ស្លឹកស្មៅត ឬគំនរឈើងាប់ ក្នុងតំបន់ជនបទយកមកផ្សាំងចិញ្ចឹមក្នុងអាង ដែលអាចពង្រីកពូជបានដោយខ្លួនឯង
- ចាប់ដោយប្រើអន្ទាក់ភ្លើងនៅពេលយប់
- ទិញពូជចម្រុះក្នុងស្រុកដែលបានផ្សាំងរួចពីកសិករនៅតំបន់ផ្សេងៗ

**តារាងទី១៖** ប្រភេទពូជចម្រុះ ដែលអាចប្រមូលផលពីធម្មជាតិ ដោយប្រើអន្ទាក់ភ្លើងនៅពេលយប់

| **ប្រភេទពូជចម្រុះ** | **ឈ្មោះវិទ្យាសាស្ត្រ** |
|---|---|
| ចម្រុះស (ចម្រុះទឹកឃ្មុំ) | *Achetatestacea/ Acheta domesticus* |
| ចម្រុះក្រហម (ចម្រុះស្វា, ចម្រុះចុះ) | *TeleogryllusTestaceus* |
| ចម្រុះខ្មៅ (ចម្រុះប៉ារ៉ា, ចម្រុះដែក) | *Gryllusbimaculatus* |
| ចម្រុះដូង | *Brachytrupesportensosus* |
| ខ្ទុល | *Gryllotalpa Africana* |



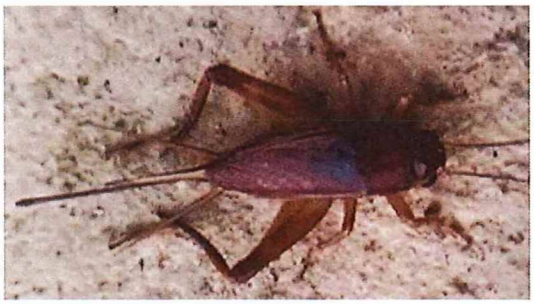
រូបភាពទី១៖ ការដាក់ភ្លើងចាប់ចង្រិតពេលយប់ រូបភាពទី២៖ ការរើសចង្រិតពីធម្មជាតិ

## ១.១.ពូជចង្រិតក្នុងស្រុក ឬចង្រិតធម្មជាតិ

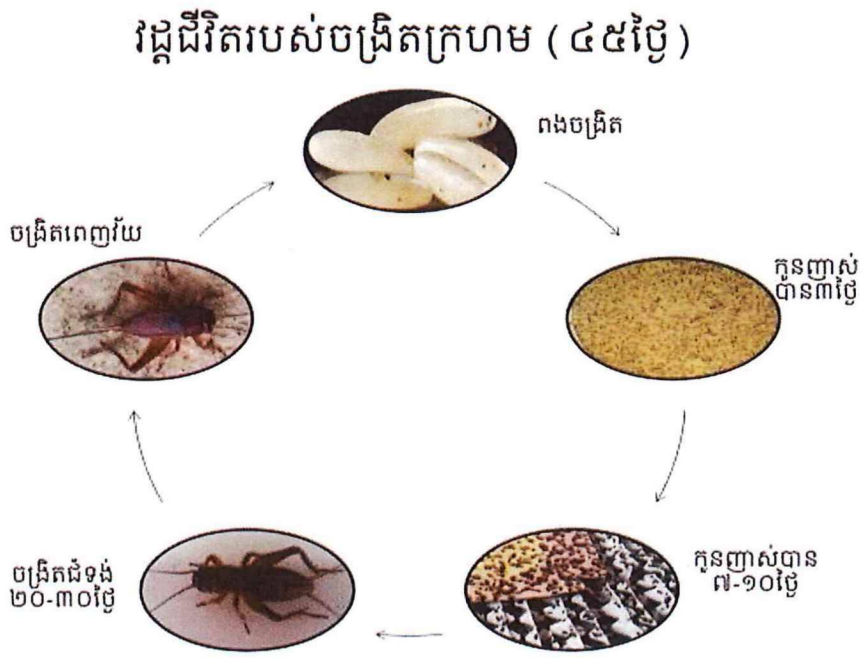
### ១.១.១.ចង្រិតក្រហម

ចង្រិតក្រហម ជាប្រភេទចង្រិតដែលមានមាឌមធ្យម និងអាចប្រមូលផលបាននៅអាយុ ៤០-៥០ថ្ងៃ (មធ្យម៤៥ ថ្ងៃ)បន្ទាប់ពីញាស់។ ពេលពេញវ័យមានទម្ងន់ខ្លួនជាមធ្យម ០,៩ ក្រាម (នៅពេលប្រមូលផល)។ ចង្រិតក្រហម ចូលចិត្តរស់នៅតាមទីវាល (ស្រែ ចំការ)។ ចង្រិតក្រហម មានភាពធន់មធ្យម ជាមួយនឹងជំងឺឆ្លង ភាពមិនស្អាតក្នុងអាងចិញ្ចឹម និងមានអត្រារស់ខ្ពស់។ ចង្រិតក្រហមអាចចិញ្ចឹមក្នុងអាងដែលមានដង់ស៊ីតេខ្ពស់ មានទីផ្សារក្នុងស្រុក សម្រាប់លក់ចង្រិតស្រស់ ជាមធ្យមលក់បាន ៣ដុល្លា ក្នុងមួយគីឡូក្រាម។ ដោយហេតុនេះហើយ បានជាមានអ្នកចិញ្ចឹមចង្រិតក្រហមជាច្រើនទទួលបានជោគជ័យ។

រូបភាពទី៣៖ ចង្រិតក្រហម (ឈ្មោល)



រូបភាពទី៤៖ ចង្រិតក្រហម (ញី)




រូបភាពទី៥៖ វដ្តផលិតកម្មរបស់ចង្រិតពូជក្រហម

### ១.១.២. ចង្រិតខ្មៅ

ចង្រិតខ្មៅ ជាប្រភេទចង្រិតដែលមានមាឌធំ (បើប្រៀបនឹងចង្រិតក្រហម) ពេលពេញវ័យមានទម្ងន់ខ្លួនជាមធ្យម ១,១៣ ក្រាម (នៅពេលប្រមូលផល) និងអាចប្រមូលផលបាននៅអាយុ ៣០-៤០ថ្ងៃ (មធ្យម៣៥ថ្ងៃ)បន្ទាប់ពីញាស់កូន។ ចង្រិតខ្មៅចូលចិត្តរស់នៅតាមទីវាល (ស្រែ ចំការ)។ ចង្រិតខ្មៅអាចចិញ្ចឹមក្នុងអាងដែលមានដង់ស៊ីតេខ្ពស់ មានតម្រូវទីផ្សារក្នុងស្រុកសម្រាប់លក់ចង្រិតស្រស់ខ្ពស់ ជាមធ្យមលក់បាន ៤ដុល្លា ក្នុងមួយគីឡូក្រាម។ ប៉ុន្តែចង្រិត

ខ្មៅ មិនសូវមានភាពធន់នឹងជំងឺឆ្លងទេ ហើយមានអត្រារស់ទាប (អត្រាងាប់ អាចដល់ ១០០%)។ រោគសញ្ញានៃជំងឺ គឺចង្រិតមានពោះធំ ដែលពេញដោយទឹក ធ្វើសកម្មភាពយឺតៗ មិនស៊ីចំណី។ ជំងឺនេះអាចបណ្តាលអោយចង្រិតក្នុងអាងងាប់ (១០០%) តែក្នុងរយៈពេល ៣-៥ថ្ងៃប៉ុណ្ណោះ។ ដោយហេតុនេះហើយ បានជាមានអ្នកចិញ្ចឹមចង្រិតខ្មៅជាច្រើនទទួលបរាជ័យ បន្ទាប់ពីចិញ្ចឹមបានរយៈពេល ១-២ឆ្នាំ យ៉ាងយូរ។

រូបភាពទី៦៖ ចង្រិតខ្មៅ (ឈ្មោល)

រូបភាពទី៧៖ ចង្រិតខ្មៅ (ញី)


រូបភាពទី៨៖ វដ្តផលិតកម្មរបស់ចង្រិតពូជខ្មៅ

**តារាងទី២៖** គុណសម្បត្តិ និងគុណវិបត្តិ នៃប្រភេទពូជចង្រិតក្នុងស្រុកដែលចិញ្ចឹម

| ពូជចង្រិត | ចង្រិតខ្មៅ | ចង្រិតក្រហម |
|---|---|---|
| គុណសម្បត្តិ | • ធាប់បានប្រមូលផល<br>• ទំហំខ្លួនធំ<br>• តម្រូវការទីផ្សារខ្ពស់<br>• លក់បានថ្លៃ<br>• ពូកែពង<br>• ពងធំ ហើយញាស់ច្រើន | • ធន់នឹងជំងឺ<br>• ធន់នឹងលក្ខខណ្ឌចិញ្ចឹម<br>• ទំហំខ្លួនមធ្យម<br>• តម្រូវការទីផ្សារខ្ពស់ |

| | | |
|---|---|---|
| គុណវិបត្តិ | • មិនសូវធន់នឹងជំងឺ<br>• មិនសូវសម្បូរក្នុងធម្មជាតិ<br>• ពិបាករក្សាពូជ | • លក់មិនសូវបានថ្លៃ |

**តារាងទី៣៖** វដ្តផលិតកម្មរបស់ចង្រិតពូជក្រហម និងពូជខ្មៅ

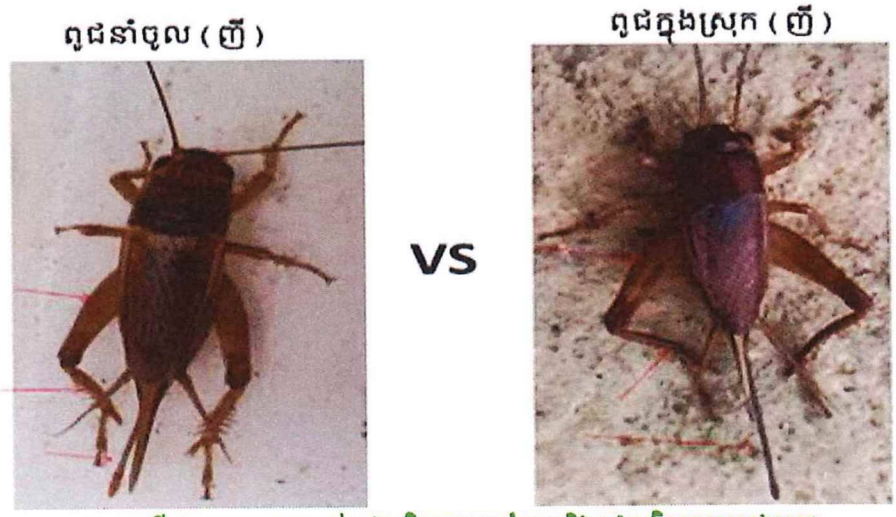
| ពូជ | ចង្រិតក្រហម | ចង្រិតខ្មៅ |
|---|---|---|
| វដ្តផលិតកម្ម | ៤០-៥០ថ្ងៃ | ៣០-៤០ថ្ងៃ |
| ទំងន់ស្រស់/ចង្រិត (មធ្យមពេលប្រមូលផល) | ០,៩ក្រាម | ១,១៣ក្រាម |
| ភាពធន់នឹងជំងឺ | ធន់មធ្យម | មិនសូវធន់ |
| អត្រារស់ក្នុងវដ្តផលិតកម្ម | ៥០% | ៤០% |
| ទីផ្សារ | តំរូវការមធ្យម | តំរូវការខ្ពស់ |

## ១.២. ពូជចង្រិតនាំចូល

ពូជចង្រិតចិញ្ចឹមតាមកសិដ្ឋាន នៅកម្ពុជាមានប្រភពមកពី ប្រទេសថៃ និងប្រទេសវៀតណាម និងបានមកពីការចែកចាយបន្តគ្នាពីកសិដ្ឋានមួយ ទៅកសិដ្ឋានមួយទៀត តាមរយៈនៃការលក់ពងចង្រិត។ ក្នុងការអនុវត្តន៍ជាក់ស្តែង ការទិញចង្រិតរស់សម្រាប់យកមកធ្វើពូជ គឺកំរណាស់។ ចង្រិតចិញ្ចឹមត្រូវបាននាំចូលមកប្រទេសកម្ពុជា ក្នុងសណ្ឋានជាពង ព្រោះងាយស្រួលក្នុងការដឹកជញ្ជូន។ ពូជនាំចូលទាំងនោះរួមមាន ពូជចង្រិតស ចង្រិតក្រហម និងពូជចង្រិតខ្មៅ។

**តារាងទី៤៖** ភាពខុសគ្នាពូជចង្រិតក្រហមក្នុងស្រុក និងពូជចង្រិតក្រហមនាំចូល

| ចង្រិតក្រហមមេពូជក្នុងស្រុក (ធម្មជាតិ) | ចង្រិតក្រហមមេពូជនាំចូល (ពូជចិញ្ចឹមក្នុងអាង) |
|---|---|
| • អត្រាជាន់ឈាមទាប<br>• រហ័សរហួន<br>• អត្រាញាស់របស់ពងខ្ពស់<br>• អត្រារស់ពីញាស់ ដល់ពេញវ័យខ្ពស់<br>• ជើងក្រោយរបស់ចង្រិតធំ ហើយវែង<br>• ដងខ្លួនធំ<br>• ធន់នឹងការប្រែប្រួលសីតុណ្ហភាព និងសំណើម<br>• ចង្រិតញីមានបំពង់បង្ហូរពងវែង | • អត្រាជាន់ឈាមខ្ពស់<br>• មិនសូវរហ័សរហួន<br>• អត្រាញាស់របស់ពងទាប<br>• អត្រារស់ពីញាស់ ដល់ពេញវ័យទាប<br>• ជើងក្រោយរបស់ចង្រិតតូច ហើយខ្លី<br>• ដងខ្លួនតូច<br>• មិនសូវធន់នឹងការប្រែប្រួលសីតុណ្ហភាព និងសំណើម<br>• ចង្រិតញីមានបំពង់បង្ហូរពងខ្លី |




**រូបភាពទី៩៖ ភាពខុសគ្នារបស់ពូជចង្រិតក្រហមនាំចូល និងពូជចង្រិតក្រហមក្នុងស្រុក**

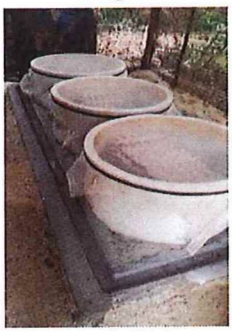
### ១.៣. ការបង្កាត់ពូជ

ពូជចង្រិតដែលចិញ្ចឹមក្នុងអាងលូស៊ីម៉ង់ត៍៣កង់ អាចយកពងចិញ្ចឹមបន្តបាន ៣-៤ដង ត្រូវដូរពូជ (បើមិនបានអនុវត្តតាមគោលការណ៍បង្កាត់ពូជទេ) ឬត្រូវទិញពូជថ្មីពីកសិដ្ឋានចិញ្ចឹមចង្រិត ដែលអាចទុកចិត្តបាន សម្រាប់យកមកចិញ្ចឹមបន្ត

- ការបង្កាត់ពូជមានសារៈសំខាន់ សម្រាប់ការចិញ្ចឹម យូអង្វែងជៀសវាងការជាន់ឈាម
- កសិដ្ឋានខ្នាតមធ្យម (ក្នុងអាងធំៗ) ពងចង្រិតអាចបន្តយកពង ជាច្រើនលើកឬ ច្រើនសារ រហូតដល់២ឆ្នាំ
- សម្រាប់កសិករដែលចិញ្ចឹម ក្នុងអាងតូចៗ ការយកពងចង្រិត មិនបានយូរដូចកសិដ្ឋានដែលមានអាងធំៗឡើយ គឺអាចយកពងបាន ៣-៤សារ (ដង) ប៉ុណ្ណោះ

**ជម្រើសមួយចំនួនអាចរក្សាពូជចង្រិតចិញ្ចឹមរបស់កសិកររអោយបានយូ**

- **ជម្រើសទី១**-គោលការណ៍បង្កាត់ពូជ រវាងពូជចង្រិតចិញ្ចឹមក្នុងអាង



ជំនាន់ទី ១៖ ពងអាង**ក** អាង**ខ** និងអាង**គ**

ជំនាន់ទី ២៖ ពងក្នុងអាង**ក** ដាក់លាយពងអាង**ខ**

ជំនាន់ទី ៣៖ ពងក្នុងអាង**ក** ដាក់លាយពងអាង**គ**

ជំនាន់ទី ៤៖ ពងក្នុងអាង**ខ** ដាក់លាយពងអាង**គ**

ជំនាន់ទី ៥៖ ពងក្នុងអាង **ក ខ គ** ដាក់លាយពងពីអ្នកចិញ្ចឹមផ្សេងៗ ក្នុងភូមិ

- **ជម្រើសទី២**-គោលការណ៍បង្កាត់ពូជ " ការបង្កាត់ពូជចង្រិតចិញ្ចឹម ជាមួយពូជចង្រិតក្នុងស្រុក (ពូជចង្រិតចាប់ពីធម្មជាតិ)"

កសិករអាចដាក់អន្ទាក់ ដោយប្រើភ្លើងអគ្គិសនីនៅពេលយប់ សម្រាប់ចាប់ចង្រិតធម្មជាតិ រួចយកចង្រិតមេបាដែលនៅរស់ ទៅដាក់ក្នុងអាងចង្រិតចិញ្ចឹមដែលពេញវ័យដូចគ្នាដើម្បីបង្កាត់គ្នា៖

- ឬ អាចដាក់ចង្រិតមេបាដែលនៅរស់ ដាក់ក្នុងអាងដាច់ដោយឡែកតែឯងដើម្បីយកពង (ពូជចង្រិតធម្មជាតិសុទ្ធ)
- ឬ ការបង្កាត់ គឺគ្រាន់តែយកចានពងរបស់ចង្រិតពូជបានមកពីធម្មជាតិ ដាក់ក្នុងអាងចិញ្ចឹមជាមួយចានពងរបស់ចង្រិតចិញ្ចឹមក្នុងអាង ជាការស្រេច

### ១.៤. ការជាន់ឈាម

ការជាន់ឈាមជាហានិភ័យមួយទៀតរបស់អ្នកចិញ្ចឹមចង្រិតដែលប្រើពូជពីមេបាដដែលៗ។ ការជាន់ឈាមធ្វើឲ្យចង្រិតខ្សោយសកម្មភាព លូតលាស់យឺត។ ការជាន់ឈាមអាចកើតមានឡើងបន្ទាប់ពីការប្រមូលផលចង្រិតបាន ៣ដង។ ដូចច្នេះអ្នកចិញ្ចឹមគួរតែដូរមេបាចង្រិតបន្ទាប់ពីការចិញ្ចឹមប្រមូលផលបាន ៣ដង (ការដូរមេបាចង្រិត អាចមានការប្រឈមដដែល បើមិនបានដឹងពីប្រភពរបស់កសិដ្ឋានចង្រិតដែលត្រូវទិញពូជចង្រិតនោះទេ)

### ១.៥. ការវិវឌ្ឍន៍របស់ចង្រិតពីពងរហូតពេញវ័យ

#### ១.៥.១. ពងចង្រិត

- មេចង្រិត១ក្បាល អាចពងបានចំនួន: ១២០០-១៥០០គ្រាប់ ក្នុងលក្ខខណ្ឌសីតុណ្ហភាព៣៥អង្សាសេ ក្នុង រយៈពេលមួយខែ
- ចង្រិតញីពង រយៈពេល ២-៣ ថ្ងៃបានចំនួន
  - ៥០-១០០គ្រាប់ (ចង្រិតស)
  - ១៥០-៤០០គ្រាប់ (ចង្រិតក្រហម)

រូបភាពទី១០៖ ចានប្លាស្ទិក ប្រើសម្រាប់ដាក់ធ្យូងអង្កាមឲ្យចង្រិតពង

រូបភាពទី១១៖ ពងចង្រិត ក្នុងធ្យូងអង្កាម

#### ១.៥.២. ការភ្ញាស់ពងចង្រិត

ការញាស់របស់ពងចង្រិតមានការប្រែប្រួលតាមរយៈ

- សំណើម: ពងញាស់បានល្អនៅកំរិតសំណើម ពី៨០-៩០%
- សីតុណ្ហភាព: ពងចង្រិតសញ្ញាស់ក្នុងរយៈពេល ៧-១៥ថ្ងៃ គឺប្រែប្រួលតាមកំរិតសីតុណ្ហភាព
  - ៣០ °C ញាស់ក្នុងរយៈពេល១៣ថ្ងៃ
  - ២៣,៣ °C ញាស់ក្នុងរយៈពេល២៣ថ្ងៃ
- អាយុរបស់មេបា: អត្រាញាស់របស់ពងប្រែប្រួលតាមវ័យរបស់មេចង្រិត ដែលមានអត្រាញាស់ពី៥៥-៦៨%


រូបភាពទី១២៖ ការរៀបចំពងចង្រិតសម្រាប់ភ្ញាស់

### ១.៥.៣. កូនចង្រិត និងសក

ការវិឌ្ឍន៍ពីកូនចង្រិត ទៅជាចង្រិតពេញវ័យត្រូវការពេល ៦ សប្តាហ៍ ក្នុងសីតុណ្ហភាពជាមធ្យម ២៨,៨-៣០ ºC។ ការ **សក** របស់កូនចង្រិត គឺប្រែប្រួលតាមកំរិតសីតុណ្ហភាពចាប់ពីពេលញាស់រហូតដល់ពេញវ័យ ប៉ុន្តែពេលពេញវ័យចង្រិតមិនសកទៀតឡើយ។

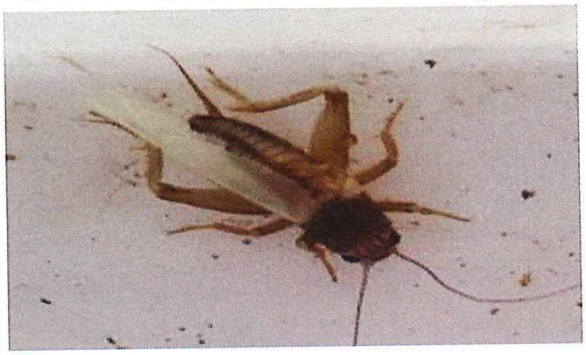
- ៣០ អង្សាសេ: **សក** ៨-៩ដង
- ២៣,៣ អង្សាសេ: **សក** ១០ដង

កូនចង្រិតមានស្បែកថ្មីបន្ទាប់ពីសក និងមានដងខ្លួនទន់ ពណ៌សដូចទឹកដោះគោ ហើយពណ៌ស នឹងប្រែទៅជាពណ៌ធម្មតាវិញក្នុងរយៈពេលតិចជាង ២៤ម៉ោង

ចំពោះចង្រិតមេ (ចង្រិតញី) គេអាចមើលឃើញពន្លកស្លាបតូចខ្លី និងបំពង់បង្ហូរពង បន្ទាប់ពីការសកលើកចុងក្រោយ ដែលខុសពីចង្រិតឈ្មោល ពុំមានបំពង់បង្ហូរពងទេ

រូបភាពទី១៣៖ កូនចង្រិតញី សក (មានបំពង់បង្ហូរពង)

រូបភាពទី១៤៖កូនចង្រិតឈ្មោល សក (គ្មានបំពង់បង្ហូរពង)



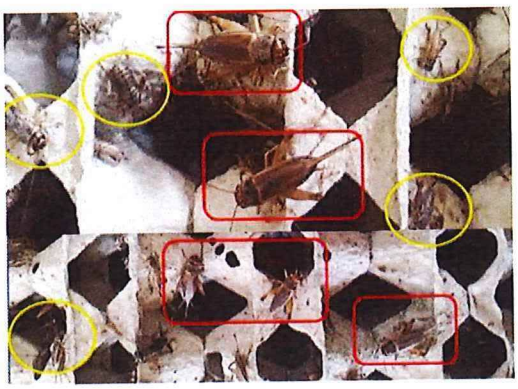
រូបភាពទី១៥៖ ចង្រិតក្រហមសកនៅដំណាក់កាលលូតលាស់ចុងក្រោយ (មុនពេញវ័យនៅអាយុ ៤០ ថ្ងៃ)

### ១.៥.៤. ចង្រិតពេញវ័យ

ដំណាក់កាលពេញវ័យ គឺជាដំណាក់កាលសម្រាប់បន្តពូជ។ ចង្រិតពេញវ័យអាចរស់បានចន្លោះពី ២-៣ខែ និងអាចពាក់គ្នាដើម្បីបន្តពូជ ហើយចង្រិតខ្លះបានងាប់បន្ទាប់ពីការពាក់គ្នា។ ចង្រិតពេញវ័យ (ញី ឬឈ្មោល) អាចហើរបានធ្ងាយតែក្នុងរយៈពេល២ថ្ងៃដំបូង បន្ទាប់ពីការសកចុងក្រោយប៉ុណ្ណោះ បន្ទាប់មកវាមិនអាចហើរបានធ្ងាយទៀតទេ

- ចង្រិតមេ (ញី) មិនពងទេ បើអត់បានពាក់គ្នា ឬក៏អត់មានកន្លែងសមស្របសម្រាប់ពងដាក់
- ចង្រិតមេពាក់គ្នានៅថ្ងៃទី៣ និងថ្ងៃទី៤ បន្ទាប់ពីថ្ងៃសកចុងក្រោយ ហើយពងនៅថ្ងៃទី៨-១០បន្ទាប់

រូបភាពទី១៦៖ ចង្រិតខ្មៅពេញវ័យ



រូបភាពទី១៧៖ ចង្រិតក្រហមពេញវ័យ

## ជំពូកទី២៖ ប្រភេទអាងសម្រាប់ចិញ្ចឹមចង្រិត

មានអាង ពីរប្រភេទសម្រាប់ការចិញ្ចឹមចង្រិតជាលក្ខណៈគ្រួសារ ដែលធ្លាប់បានអនុវត្តន៍កន្លងមកប្រកបដោយជោគជ័យ ១). ធុងដំរ ចំណុះ (១៤០ លីត្រ) និង ២). បំពង់លូស៊ីម៉ង់ត៍ (អង្កត់ផ្ចឹត ០,៨ម)។ អាងចិញ្ចឹមដែលមានរាងចតុកោណសមស្របសម្រាប់ការចិញ្ចឹមចង្រិតខ្នាតធំ។

### ២.១. ប្រភេទធុងដំរ

- ធុងដំរ (១៤០ លីត្រ) ចំនួន ៣ធុង
- ធុងនីមួយៗ ដាក់តំរៀបគ្នាលើជើងទំរ
- ផលិតបានចង្រិត (៤ គ.ក្រ/ធុង x ៣ធុង)
- ប្រសិទ្ធភាពទិន្នផល (គ.ក្រ)/ទំហំផ្ទៃក្រឡា (ម$^{២}$) គឺ ៤,០ (គ.ក្រ)/(ម$^{២}$)

រូបភាពទី១៨៖ប្រភេទធុងដំរ

### ២.២. ប្រភេទបំពង់លូ

- បំពង់លូ ៣កង់
- អង្កត់ផ្ចិត (១ម x ៣កង់)
- កំពស់ ០,៥ ម
- ផលិតបានចង្រិត (៤ គ.ក្រ/កង់ x ៣កង់)
- ប្រសិទ្ធភាពទិន្នផល (គ.ក្រ)/ទំហំផ្ទៃក្រឡា (ម២) គឺ ៤,០ (គ.ក្រ)/(ម២)

រូបភាពទី១៩៖ប្រភេទបំពង់លូ

**សំគាល់៖** ប្រភេទអាងចិញ្ចឹមមិនប៉ះពាល់ដល់ទិន្នផលស្រស់របស់ចង្រិតនៅពេលប្រមូលផលទេ តែអ្វីដែលប៉ះពាល់ខ្លាំងដល់ទិន្នផលចង្រិត គឺកត្តាអាកាសធាតុ (សីតុណ្ហភាព និងសំណើម) កត្តាចំណី និងចំនួនផ្លា/ម៉ែត្រដែលប្រើសម្រាប់ការរស់នៅរបស់ចង្រិត។

### ២.៣. សម្ភារៈត្រូវការសម្រាប់អាងចិញ្ចឹម លូ៣កង់

**តារាងទី៥៖** សម្ភារៈ និងការគម្លើងអាចចិញ្ចឹមចង្រិតលូ៣កង់

| **សម្ភារៈសម្រាប់ចិញ្ចឹមក្នុងលូ៣កង់** | **ការគម្លើងអាងចិញ្ចឹមចង្រិត លូ៣កង់** |
|---|---|
| • បំពង់លូស៊ីម៉ង់៣កង់ អង្កត់ផ្ចឹត ០,៨ម ឬ១ម<br>• ខ្សាច់ ១ម៉ែក ឬ០,៥ម៉ែត្រគូប | • ចាក់ខ្សាច់ទ្រាប់បាត កាយអោយស្មើកម្រាស់ ៥សម ដែលមានទំហំ ១,៤ម x ៣,៥ម សម្រាប់លូ ១ម |

- ស៊ីម៉ង់ត៍ ១បេឬ៥០គ.ក្រ
- ក្រដាស់កាតុងដាក់ពងមាន់ (ផ្លា) ចំនួន៖
  - ៧២បន្ទះ សម្រាប់លូ ០,៨ម
  - ៩៩បន្ទះ សម្រាប់លូ ១ម
- គម្របធុងប៉េត្រូ ២ (សម្រាប់ដាក់ទឹក១ និងដាក់ចំណី១)
- ពោះវៀនម៉ូតូចាស់ចំនួន ១ សម្រាប់ចងស្បៃគ្របមាត់លូ
- សំណាញ់/ស្បៃប្លាស្ទិក ១ផ្ទាំង ទំហំ៖
  - ១ម x ៣ម សម្រាប់លូ ០,៨ម
  - ១,២ម x ៣,៦ម សម្រាប់លូ ១ម

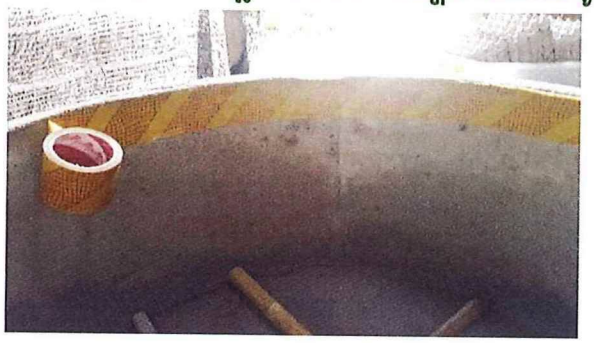
- ដាក់លូលើខ្សាច់ ដោយទុកចន្លោះ ៥សម ពីលូនិមួយៗ
- លាយស៊ីម៉ង់ និងខ្សាច់ចាក់ក្នុងលូទាំង៣កង់អោយបានកម្រាស់ ២សង់ទីម៉ែត្រ
- ធ្វើចង្កូរទឹកព័ទ្ធជុំវិញលូទាំង ៣កង់

**ជំហាននៃការបំពាក់សម្ភារៈក្នុងលូចិញ្ចឹមចង្រិត**

- បិទស្កុតមាត់លូ
- រៀបកំណល់ឈើទ្រប់ក្រដាស់កាតុងស៊ុតមាន់
- រៀបក្រដាស់ដាក់ស៊ុតមាន់លើកំណល់ឈើ
- ដាក់ថាសទឹក និងថាសចំណី
- ដាក់ចានពងចូលដើម្បីភ្ញាស់
- ដាក់គម្របស្បៃ/សំណាញ់ប្លាស្ទិកគ្របមាត់លូ ដោយទាញអោយបានស្មើល្អ

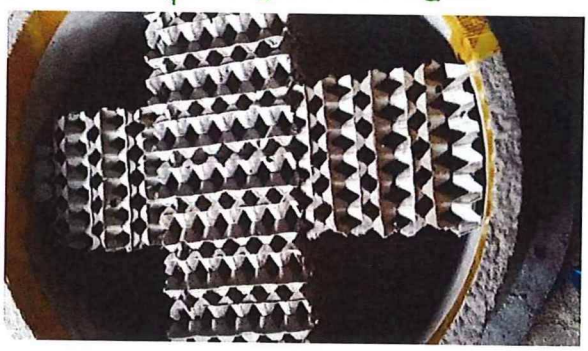
Hier Text eingeben

## ២.៤. ការតម្លើង និងបំពាក់សម្ភារៈតាមរយៈរូបភាព

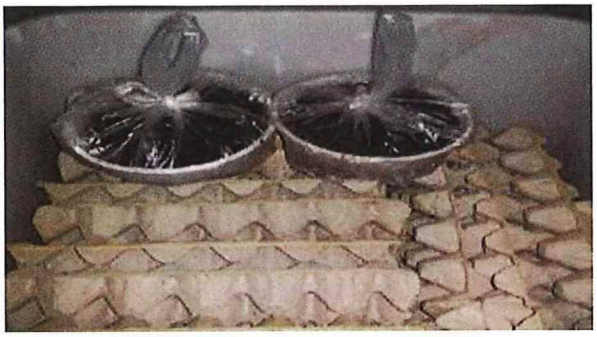


រូបភាពទី២០៖បិទស្កុតមាត់លូការចង្រិតវាចេញពីលូ

រូបភាព២១៖ បិទស្កុតថែមកន្លែងដែលមានប៉ោង ឬហើប



រូបភាព២២៖ រៀបកំណល់ឈើទ្រប់ក្រដាស់កាតុងស៊ុតមាន់



រូបភាព២៣៖ រៀបក្រដាស់ដាក់ស៊ុតមាន់លើកំណល់ឈើ

រូបភាព២៤៖ ដាក់ចានពងចូលជើម្បីភ្ញាស់

រូបភាព២៥៖ ដាក់ថាសទឹក និងថាសចំណី

រូបភាព២៦៖ ដាក់កៅស៊ូពោះវៀនម៉ូតូ និងការតម្លើងរួចរាល់

## ២.៥. លក្ខណៈបច្ចេកទេសនៃការចិញ្ចឹមចង្រិតដោយប្រើ លូ៣កង់

ចង្រិតចិញ្ចឹមក្នុងអាងលូស៊ីម៉ង់ត៍ (អង្កត់ផ្ចឹត ១ម x កំពស់ ០,៥០ម) ដែលមានលូ៣កង់

- ពូជចង្រិតក្រហម: ប្រើពង ៤ចាន ក្នុងមួយអាង
- ប្រើផ្ទាំងក្រដាស់កាតុងដាក់ស៊ុតមាន់/ទា (ផ្លា) សម្រាប់ឲ្យចង្រិតលាក់ខ្លួន និងស្នាក់នៅ
- ចំណីមានច្រើនជម្រើស ដែលអាចរកបាននៅក្នុងតំបន់ចិញ្ចឹម
- លាយគ្នា ចំណីមាន់/ចំណីទាពង និងស្លឹកដំឡូងមី
- ប្រមូលផល ៣៥-៤៥ថ្ងៃ ចាប់ពីញាស់
- ផលដែលប្រមូលបាន ២-៤គ.ក្រ (ទំងន់ស្រស់) ក្នុងមួយអាង

# ជំពូកទី៣៖ ចំណី ការផ្តល់ចំណី និងទឹក

## ៣.១. ប្រភេទចំណី

ចង្រិតជាសត្វស៊ីចំណីមិនរើស ដែលផ្តល់ភាពងាយស្រួលដល់អ្នកចិញ្ចឹមក្នុងការស្វែងរកប្រភេទចំណីសម្រាប់ចង្រិតដែលខ្លួនចិញ្ចឹម។ ចំណីផ្សំសម្រាប់ មាន់ ទា ឬជ្រូក ត្រូវបានគេយកមកប្រើជាទូទៅសម្រាប់ចិញ្ចឹមចង្រិត។ ប៉ុន្តែបើគេប្រើចំណីទាំងនោះ ១០០% សម្រាប់ចិញ្ចឹមចង្រិត អាចប្រឈមនឹងការខាតបង់ ព្រោះចំណីទាំងនោះត្រូវទិញពីក្រុមហ៊ុនផលិតចំណីសត្វ ដែលមានតម្លៃថ្លៃ។ ក្រៅពីចំណីផ្សំ អ្នកចិញ្ចឹមចង្រិតមានជម្រើសច្រើន ក្នុងការជ្រើសរើសចំណីដែលមានតម្លៃថោក ឬជាប្រភេទចំណីដែលអាចរកបាន ដូចជា:

- ពួករុក្ខជាតិដែលមានដុះក្នុងស្រែ ក្នុងដំណាំចំការ ឬពួករុក្ខជាតិដែលមានដុះតាមដងផ្លូវ ទីទួល ប្រឡាយ ទំនប់ វាលស្មៅ ។ល។
- ពួកបន្លែ ផ្លែឈើ និងមើមរុក្ខជាតិនានា
- សាច់សត្វ សំណល់ពីសត្វ
- សំណល់ពីកសិកម្ម ឬអនុផលកសិកម្ម (ស្លឹកដំឡូងមី កន្ទក់ ។ល។)

### ៣.១.១. ប្រភេទចំណីផ្សំ និងអនុផលកសិកម្ម

រូបភាព២៧៖ ចំណីកូនមាន់

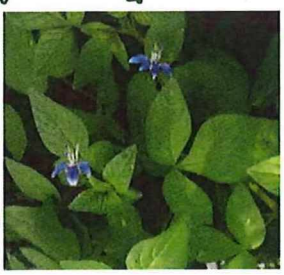
រូបភាព២៨៖ កន្ទក់

រូបភាព២៩៖ ត្រួយដំឡូងមី

រូបភាព៣០៖ ត្រកួន

### ៣.១.២. ពួករុក្ខជាតិស្លឹកធំ និងស្មៅ

រូបភាព៣១៖ មមាញខ្មោចផ្កាលឿង



រូបភាព៣២៖ មមាញខ្មោចផ្កាក្រហម

រូបភាព៣៣៖ ផ្តីបន្លា

រូបភាព៣៤៖ ស្មៅជើងបង្កង

រូបភាព៣៥៖ ស្លែទឹក/ស្លែគោក

រូបភាព៣៦៖ ស្លាបទា

រូបភាព៣៧៖ ផ្តីឬ

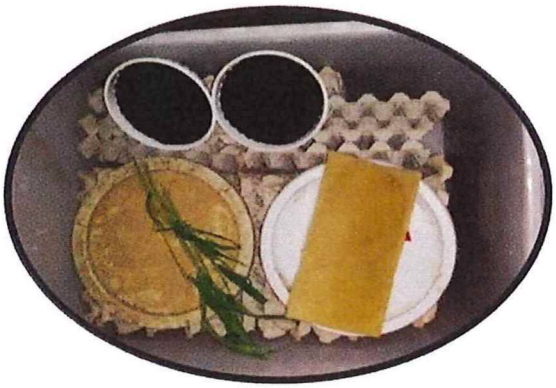
រូបភាព៣៨៖ ស្មៅចិញ្ចៀន

### ៣.២. ការផ្តល់ចំណី

ការផ្តល់ចំណីជារុក្ខជាតិស្រស់ ត្រូវផ្តល់រៀងរាល់ថ្ងៃ ដោយមានបរិមាណគ្រប់គ្រាន់ និងលាយរុក្ខជាតិ ប្រភេទផ្សេងៗគ្នា ដើម្បីអោយចង្រិតទទួលបានជីវជាតិ អាហារូបត្ថម្ភគ្រប់គ្រាន់។ ដោយឡែកការផ្តល់ចំណីជាប្រភេទចំណីផ្សំ ឬក៏ចំណីទាំងឡាយណាដែលមានសារធាតុស្ងួតច្រើនជាង ៨០% ត្រូវផ្តល់ ២ថ្ងៃម្តង ដោយមានបរិមាណគ្រប់គ្រាន់។ អ្នកចិញ្ចឹមខ្លះយកចំណីផ្សំទៅផ្សើមដោយទឹក មុនដាក់អោយចង្រិតស៊ី ហើយអ្នកខ្លះដាក់ចំណីផ្សំក្នុងស្ថានភាពស្ងួត។ ការផ្តល់ចំណី ត្រូវដាក់ចំណីក្នុងថាសចំណី ជាពិសេសចំពោះចំណីសើម។

### ៣.២.១. ការផ្តល់ចំណីដល់កូនចង្រិត

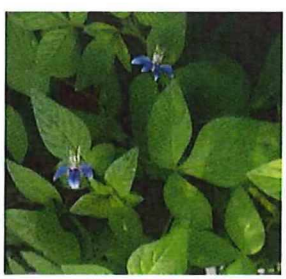
នៅថ្ងៃដំបូងពេលញាស់យើងត្រូវរៀបចំដាក់ថាសចំណីរាក់ៗ ដូចជា គម្របធុងប៉េត្រូ ក្រដាស់ឡាំងរឹង ឬសំបកបាវស៊ីម៉ង់ត៍។ ចំណីត្រូវដាក់លើថាសចំណីរាក់ៗទាំងនោះ ដែលអាចអោយកូនចង្រិតគួចៗឡើងស៊ីចំណីបានស្រួល។ ជាទូទៅគេផ្តល់ចំណីកូនមាន់ដែលមានជាតិសាច់ (ប្រូតេអ៊ីន) ២១% ឬ អាចបន្ថែមស្លឹកដំឡូងមី ត្រកួនជាដើមដល់កូនចង្រិតដែលមានអាយុក្រោម ២០ថ្ងៃ ប៉ុន្តែអ្នកចិញ្ចឹមចង្រិតខ្លះទៀតផ្តល់ចំណីទាំងដល់កូនចង្រិតតាំងពីថ្ងៃដំបូងនៃការញាស់មកម្លេះ។




**រូបភាពទី៣៩៖ អេប៉ុងសម្រាប់ជាក់ទឹកអោយកូនចង្រិតផឹក**

### ៣.២.២. ការផ្តល់ចំណីដល់ចង្រិតធំ

ការផ្តល់ចំណីសម្រាប់ចង្រិតធំ ក៏មិនខុសគ្នាជាមួយការផ្តល់ចំណីដល់កូនចង្រិតដែរ។ គេលាយចំណីកូនមាន់ដែលមានកំរិតជាតិសាច់ (ប្រូតេអ៊ីន) ២១% និងចំណីសម្រាប់មាន់ធំដែលមានកំរិតជាតិសាច់ (ប្រូតេអ៊ីន) ១៤% បញ្ចូលគ្នា សម្រាប់ចង្រិតចិញ្ចឹមក្នុងអាងដែលមានអាយុច្រើនជាង ២០ថ្ងៃ។ អ្នកចិញ្ចឹមចង្រិតខ្លះ ប្រើរមេចំណីសម្រាប់ជ្រួកលាយជាមួយកន្ទក់ (១ភាគរមេចំណីលាយ៣ភាគកន្ទក់ម៉ត់) សម្រាប់ផ្តល់ដល់ចង្រិតធំ (អាយុច្រើនជាង ២០ថ្ងៃ)។ ចំពោះចំណីប្រភេទរុក្ខជាតិវិញ ត្រូវដាក់ចំរុះគ្នា អោយបានច្រើនមុខ សម្រាប់ការលូតលាស់របស់ចង្រិត.

ត្រួយដំឡូងមី　　មមាញខ្មោចផ្កាក្រហម　　មមាញខ្មោចផ្កាលឿង　　ស្លែទឹក/ស្លែគោក

**តើត្រូវដាក់ចំណីប៉ុន្មាន ដងក្នុង១ថ្ងៃ៖**

ចំណីត្រូវបន្ថែមរៀងរាល់ពេលជិតអស់ ឬអស់ ពីថាសចំណី។ មិនអាចកំណត់ចំនួនប៉ុន្មានដែលត្រូវដាក់ទេ ប៉ុន្តែត្រូវដាក់រាល់ពេលជិតអស់ ឬពេលអស់ចំណី ពីក្នុងថាសចំណី។

ចង្រិតពេញស៊ី (ស៊ីចំណីច្រើន) នៅអាយុ:

- ២០-២៥ថ្ងៃ ចំពោះចង្រិតខ្មៅ
- ២៥-៣០ថ្ងៃ ចំពោះចង្រិតក្រហម

រូបភាពទី៤០៖ ការផ្តល់មមាញខ្មោចផ្កាក្រហមដាក់លើថាសចំណី

រូបភាពទី៤១៖ ការផ្តល់ត្រួយដំឡូងមី ដាក់លើថាសចំណី

រូបភាពទី៤២៖ ការផ្តល់ដំឡូងមី ដាក់នៅបាតអាងធំៗ

រូបភាពទី៤៣៖ ដំឡូងមីពេលចង្រិតស៊ីអស់

រូបភាព៤៤៖ ការផ្តល់ចំណីមាន់ ដាក់លើសំបកការុងស៊ីម៉ង់ត៍ ឬក្រដាស់កាតុងរឹង៖

## ៣.២.៣. ការផ្តល់ចំណី មុនពេលប្រមូលផល

ការប្តូរចំណីរបស់ចង្រិតចិញ្ចឹមមុនពេលប្រមូលផល មានសារៈសំខាន់ណាស់ ដើម្បីផ្តល់ទំនុកចិត្តដល់អ្នកហូបចង្រិតបានចិញ្ចឹម។ ចំណីផ្តល់មុនពេលប្រមូលផលមានច្រើនជម្រើស អាស្រ័យលទ្ធភាពរបស់អ្នកចិញ្ចឹម និងងាយរកបាន

ក្នុងតំបន់ដែលរស់នៅ។ ការប្តូរចំណីក្នុងរយៈពេល ២៤-៤៨ម៉ោង មុនពេលប្រមូលផលចង្រិតចិញ្ចឹម មានគោលបំណងសំខាន់ពីរ គឺ:

- ធានាបាននូវគុណភាពចង្រិត និងជីវជាតិពិសេសប្រូតេអ៊ីន
- ធានាបាននូវសុវត្ថិភាព ដែលមិនបះពាល់ដល់សុខភាពអ្នកហូប ព្រោះចំណីដែលផ្តល់អោយចង្រិត (ដូចជាចំណីមាន់ ឬចំណីទាពងជាដើម) ត្រូវបានលាងសំអាត ដោយការប្តូរចំណីដែលមានគុណភាពខ្ពស់ ដូចជាបន្លែ ផ្លែឈើ មើមរុក្ខជាតិ។ល។


ល្មៅ


ល្អុង


ឪឡឹក


ការ៉ុត


ស្លឹក/ត្រួយកន្ទុំថេត

### ៣.៣. ការផ្តល់ទឹក

#### ៣.៣.១.ការផ្តល់ទឹកដល់កូនចង្រិតទើបញាស់

ការផ្តល់ទឹកអោយកូនចង្រិតទើបញាស់គួរប្រើអេប៉ុង ឬស្រកីដូងទុំដោយជ្រលក់ទឹកអោយ "សើមល្មម" រួចហើយយកអេប៉ុងទៅដាក់ក្នុងថាសទឹកក្នុងកន្លែងចិញ្ចឹម។


**រូបភាពទី៤៥៖ អេប៉ុងត្រូវបានជ្រលក់ទឹកអោយកូនចង្រិតទើបញាស់ផឹក**


**រូបភាពទី៤៦៖រូបភាពស្រកីដូងទុំ អាចប្រើជំនួសអេប៉ុង**


**រូបភាពទី៤៧៖ កូនចង្រិតបឺតជញ្ជក់ទឹកពីក្នុងអេប៉ុង**


**រូបភាពទី៤៨៖ ហាមដាក់ទឹកសើមខ្លាំងពេកអាចឲ្យកូនចង្រិតងាប់**

ក្នុងមួយថ្ងៃត្រូវបាញ់ទឹកផ្សើម អេប៉ុង ឬស្រកីដូង ២ដង (ព្រឹកម្តង និងល្ងាចម្តង ឬនៅពេលណាយើងស្ទាបទៅមិនសើម)



**រូបភាពទី៤៩៖ កំទេចថ្មអាចប្រើជំនួសអេប៉ុង ឬស្រកីដូង សម្រាប់ផ្តល់ទឹកអោយកូនចង្រិតអាយុក្រោម ២០ថ្ងៃ**

## ៣.៣.២. ការផ្តល់ទឹកដល់ចង្រិតជំទង់ និងពេញវ័យ

ចង្រិតធំ ដែលមានអាយុលើស២០ថ្ងៃ គេអាចប្រើគម្របធុងប្រ៉ៃត្រូ ឬកំទេចថ្មដាក់ក្នុងថាសទឹកបាន ដើម្បីងាយស្រួលក្នុងការលាងសំអាតថាសទឹក ដោយដាក់ទឹកផ្ងារល់ក្នុងថាសទឹកតែម្តង ដែលមានជម្រៅរាក់ជាង ១ស.ម។


គម្របធុងប្រ៉ៃត្រូប្រើសម្រាប់ដាក់ទឹក ការបន្ថែមទឹកចូលក្នុងគ្រាប់ថ្មសំរាប់ចង្រិតធឹក ថាសដាក់ទឹកត្រូវស្អាតជានិច្ច

# ជំពូកទី៤៖ វិធីសាស្ត្រប្រមូល និងភ្ញាស់ពងចង្រិត

## ៤.១ ការប្រមូលពងចង្រិត

ការប្រមូលពងចង្រិត គឺត្រូវធ្វើឡើងមុនពេលប្រមូលមេចង្រិតសម្រាប់លក់ ឬធ្វើម្ហូប និងនៅពេលដែលសង្កេតឃើញចង្រិតមេមានពោះធំៗ និងចង្រិតឈ្មោលយំស្រុះគ្នា ហើយមានសំលេងខ្លាំងៗ។ ដើម្បីអោយពងចង្រិតញាស់ដំណាលគ្នាល្អ ការប្រមូលពងត្រូវធ្វើឡើងក្នុងរយៈពេលពី ២៤-៤៨ម៉ោង អាស្រ័យលើដង់ស៊ីតេចង្រិតមេបា ក្នុងអាងចិញ្ចឹម។ ការប្រមូលពងចង្រិតសម្រាប់ទុកធ្វើពូជបន្ត មានជំហានដូចខាងក្រោម៖

រៀបចំសម្ភារៈដូចជា ធ្យូងអង្កាម ចានដំរ និងថង់ប្លាស្ទិក (ថង់ ៣ គ.ក្រ.)

រូបភាពទី៥០៖ ធ្យូងអង្កាម

រូបភាពទី៥១៖រូបភាពចានដំរ

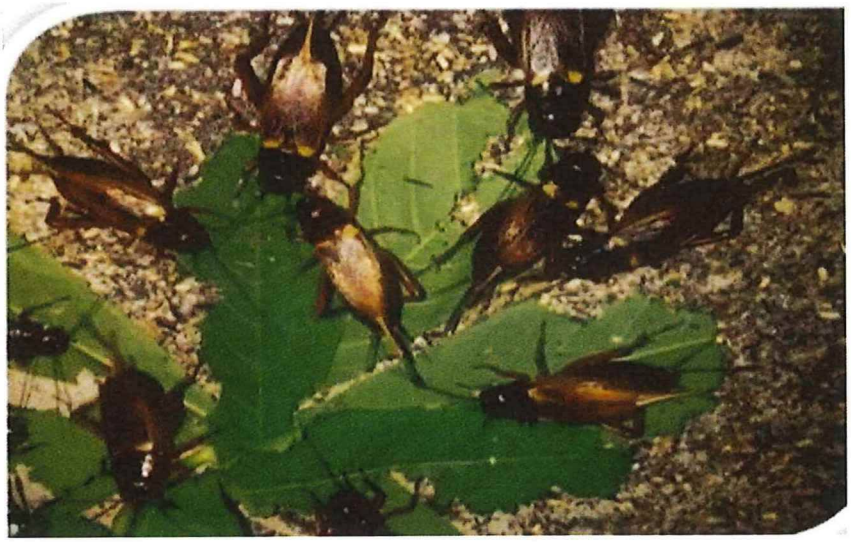
ចាក់ទឹកចូលក្នុងធ្យូងអង្កាម លាយអោយសើមល្មម មិនសូតពេក ឬសើមពេកទេ ហើយស្របល់ លាយគ្នាអោយបានសើមសព្វល្អ

ធ្យូងអង្កាម ដែលផ្សើមដោយទឹក (សំណើម ៨០%)

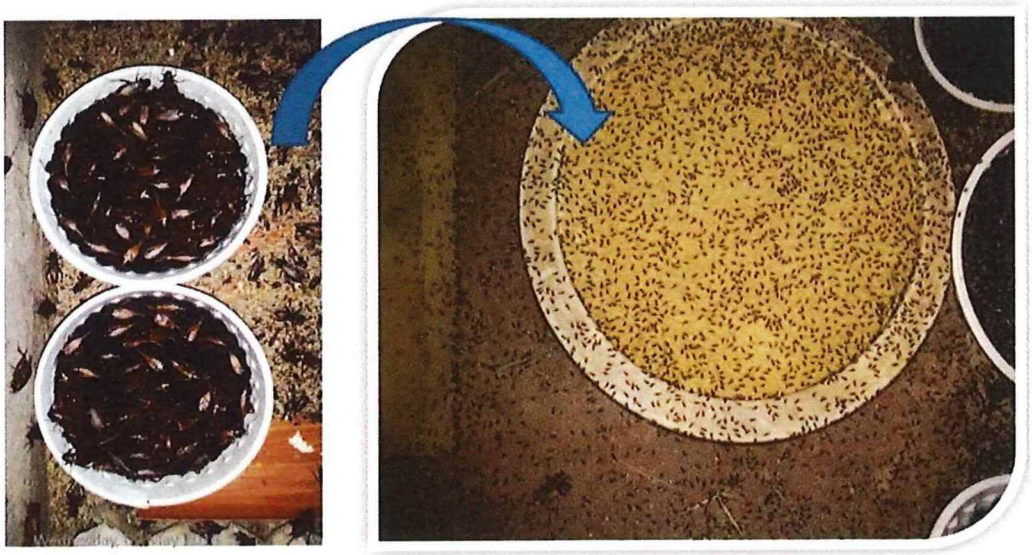
ធ្យូងអង្កាម ដែលផ្សើមដោយទឹកដាក់ចូលក្នុងចាន ត្រឹមបីភាគបួន

**រូបភាព៥២៖ ចានមានធ្យូងអង្កាមសើមតំរៀបគ្នានៅក្នុងអាងចង្រិត ដើម្បីអោយចង្រិតពង**

មេចង្រិតដែលអាចយកពងបាន គឺនៅអាយុចន្លោះពី ៣៨-៤៥ថ្ងៃ ឬពេលដែលវាដុះស្លាប ឬវាយំស្រុះគ្នាច្រើន ឬអាចសំគាល់បានដោយមើលពោះរបស់មេ (ចង្រិតញី) ចង្រិតឡើងប៉ោង។



ដើម្បីអោយកូនចង្រិតញាស់មកមានអាយុប្រហាក់ប្រហែលគ្នា យើងត្រូវដាក់ចានយកពងតែរយៈ ២៤ ម៉ោង ឬ យ៉ាងយូរ ៤៨ម៉ោង



**រូបភាព៥៣៖ ដាក់ចានយកពង ២៤ម៉ោង ពងចង្រិតញាស់ស្មើគ្នាល្អ**

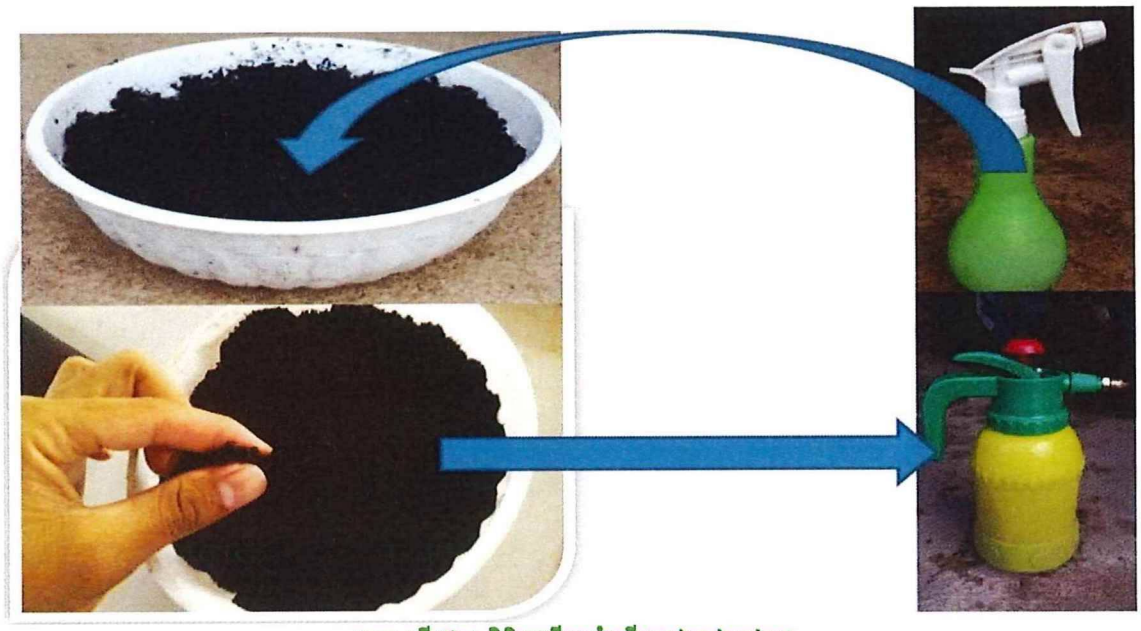
ចានពងចង្រិតដែលមានរយៈពេល ២៤ម៉ោង ត្រូវយកចេញពីអាង សម្រាប់ការភ្ញាស់ ហើយដាក់ចានដែលមានធ្យូងអង្កាមសើមថ្មី សម្រាប់ការប្រមូលពងចង្រិតបន្ត បើត្រូវការច្រើន


រូបភាព៥៤៖ ការយកពងចង្រិតដាក់ក្នុងថង់ប្លាស្ទិកសម្រាប់ភ្ញាស់


រូបភាពទី៥៥៖ ដាក់ចាន់ថ្មីសម្រាប់យកពងបន្ត

## ៤.២. ការភ្ញាស់ពងចង្រិត

ត្រូវពិនិត្យមើលធ្យូងអង្កាមក្នុងចានសើម ឬស្ងួត បើស្ងួតពេកពងមិនអាចញាស់បានទេ ហើយត្រូវបាញ់ទឹកថែមអោយសើមល្មម



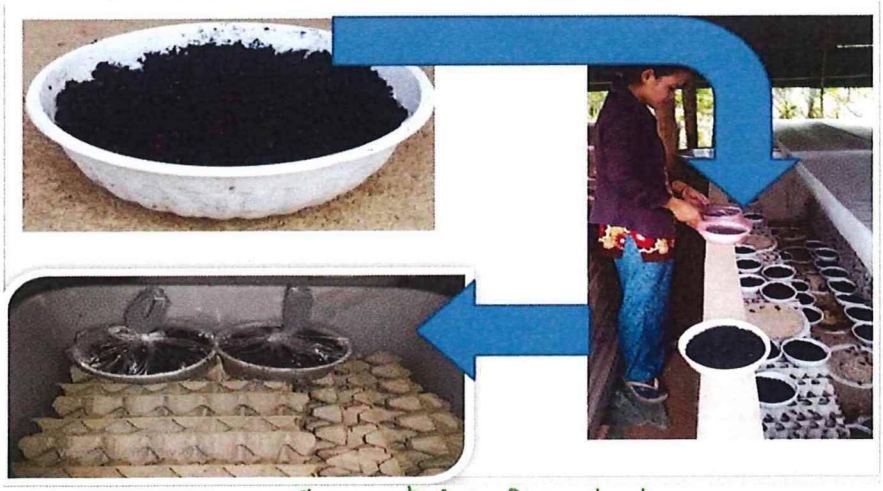
រូបភាពទី៤៦៖ ពិនិត្យមើលសំណើមក្នុងធ្យូងអង្រាម

**ចំណាំ៖** កំរិតសើមនៃធ្យូងអង្កាមក្នុងចានពងមានសារៈសំខាន់ណាស់។ បើស្ងួតខ្លាំងពេក ពងមិនអាចញាស់បាន តែបើសើមខ្លាំងពេក នឹងបណ្តាលអោយ៖

- អត្រាញាស់របស់ពងថយចុះ
- មានសត្វល្អិត (មមង់) ចូលពងដាក់ក្នុងចានពងចង្រិត ហើយបំផ្លាញពងចង្រិតតែម្តង។ មម៉ងអាចធ្វើអោយពងចង្រិតស្អុយអស់ មិនអាចញាស់បានទេ ព្រោះដង្កូវតូចៗ ដែលជាកូនញាស់របស់សត្វមម៉ង នឹងស៊ីពងចង្រិតនៅក្នុងចានអស់
- មានញើស (តំណក់ទឹក) ច្រើននៅក្នុងថង់ប្លាស្ទិក ដែលបណ្តាលកូនចង្រិតទើបញាស់ថ្មីៗលង់ ក្នុងទឹក (ញើស/សន្សើម) ងាប់អស់មុនពេលស្រាយមាត់ថង់ យកចានពងចេញពីថង់

### ៤.២.១. ដំណើរការភ្ញាស់ពងចង្រិត៖

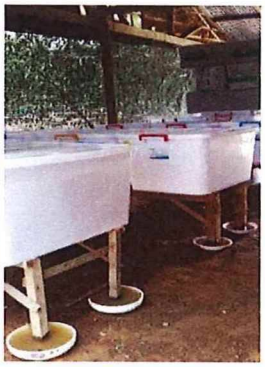
ច្រកចានពងដែលប្រមូលបាន (រយៈពេល ២៤-៤៨ម៉ោង) ចូលក្នុងថង់ប្លាស្ទិក (ថង់ ៣គ.ក្រ) រួចចងមាត់ថង់អោយជិតល្អមិនអោយមានខ្យល់ចេញចូលមុនពេលយកទៅភ្ញាស់



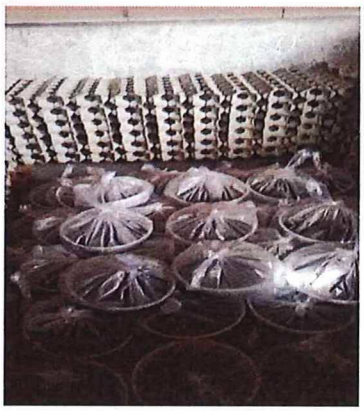
រូបភាពទី៤៧៖ ការរៀបចំពងចង្រិតសម្រាប់ភ្ញាស់

ត្រូវដាក់ចានពងសម្រាប់ភ្ញាស់ នៅកន្លែងម្លប់ មិនអោយត្រូវកម្តៅថ្ងៃ និងមានសុវត្ថិភាពពីសត្វល្អិតផ្សេងទៀតបំផ្លាញ ដូចជាស្រមោច និងមមង់ ឬរុយ



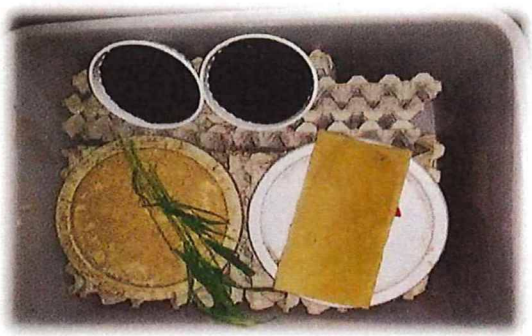


រូបភាពទី៥៨៖ ពងចង្រិតត្រូវបានដាក់ក្នុងអាងចិញ្ចឹម




រូបភាពទី៥៩៖ កន្លែងសមស្របសម្រាប់ដាក់ពងចង្រិត គឺនៅក្នុងអាងចិញ្ចឹម ដែលមានប្រព័ន្ធការពារសុវត្ថិភាព

នៅចន្លោះរយៈពេល ៧ ទៅ ១៣ថ្ងៃ ពងចង្រិត និងញាស់ ក្រោយពេលឃើញចង្រិតញាស់ត្រូវប្រញាប់ស្រាយយកចង់ចេញ ហើយត្រូវដាក់ចានអោយផ្អៀងដើម្បីអោយកូនចង្រិតតូចៗចុះចេញពីចានមកស៊ីចំណីបាន




រូបភាពទី៦០៖ ដាក់ចានអោយផ្អៀងដើម្បីអោយកូនចង្រិតតូចៗចុះចេញពីចាន

ក្រោយពេលកូនចង្រិតញាស់យើងត្រូវរៀបចំដាក់ទឹកអោយចង្រិតផឹកដោយយកអេប៉ុង ឬស្រកីដូងទៅជ្រលក់ទឹកអោយសើមល្មម រួចហើយយកទៅដាក់ក្នុងថាសទឹក រយៈពេល ៧ថ្ងៃដំបូងបន្ទាប់ពីញាស់។ គេអាចប្រើតំទេចថ្មដាក់ក្នុងថាសទឹក សម្រាប់ចង្រិតដែលមានអាយុ ពី ៧-២៥ថ្ងៃ។

**រូបភាពទី៦១៖ កូនចង្រិតផឹកទឹកពីអេប៉ុង**

## ៤.៣. ការប្រមូលផលចង្រិត

ចាប់លើកផ្លាក្រដាស់ ដែលចង្រិតកំពុងស្នាក់នៅ និងលាក់ខ្លួន ម្តងមួយគូ ហើយគោះថ្នមៗអោយធ្លាក់ចង្រិតចូលក្នុងចានដែក ឬចានដំរែធំល្មម ដែលពុំទាន់ដាក់ទឹក។

**រូបភាពទី៦២៖ ការប្រមូលផលចង្រិត**

ចាក់ផ្ទៃចង្រិតក្នុងចានដែក ឬចានដំរែ ចូលក្នុងធុង ឬចានដែកមួយផ្សេងទៀត ដែលមានទឹកស្អាតក្នុងនោះ មិនអោយធ្លាក់កាកសំណល់ផ្សេងៗចូល ដូចជាអាចម៍ចង្រិត កំទេចកំទីចំណី ដើម្បីលាងសំអាត

**រូបភាពទី៦៣៖ ចង្រិតដាក់ក្នុងទឹក**

ចង្រិតត្រូវដាក់ត្រាំទឹកទុក ប្រហែល ១-២ម៉ោង រហូតដល់ចង្រិតងាប់អស់ និងលាងសំអាត ៣-៤ដង អោយបានស្អាតល្អ

រូបភាពទី៦៤៖ ចង្រិតត្រាំក្នុងទឹក

ដាក់ចង្រិត ដែលបានលាងសំអាតរួចក្នុងកញ្រែងមានប្រហោងតូចៗ ១-២ម៉ោង អោយបានស្រស់ទឹក ស្អុតល្អ រួចខ្ចប់ និងរក្សាទុក

រូបភាពទី៦៥៖ ចង្រិតបានសំដិលក្នុងកញ្រែង

## ៤.៤. ការរក្សាទុក (សម្រាប់ធ្វើម្ហូប និងលក់)

ថ្លឹង-ចង់ដឹងទម្ងន់ចង្រិតស្រស់ដែលប្រមូលផលបាន រួចខ្ចប់ដាក់ថង់ប្លាស្ទិក ដែលមួយថង់មានទម្ងន់ ពី ២-៥គ.ក្រ. រួចរក្សាទុកក្នុងទូក្លាសេ ឬចែកចាយសម្រាប់លក់ ឬទុកហូបក្នុងគ្រួសារ។ ចង្រិតបន្ទាប់ពីលាងសំអាត ហើយដាក់ក្នុងកញ្រែងប្រហោងតូចៗ រយៈពេល ១-២ម៉ោង អាចរក្សាទុក ក្នុងទូរក្លាស នៅសីតុណ្ហភាព ៨-១០ អង្សាសេ បាន ១-២ខែ។


**រូបភាពទី៦៦៖ ចង្រិតច្រកជាក់ថង់ និងក្លាស្សេ**

ក្លាសេទឹកកកប្រសិនបើយកទៅផ្ទាយរក្សាទុកសម្រាប់ ២-៣ថ្ងៃ។ ប្រសិនបើក្លាសេនៅសីតុណ្ហភាព -១៨ ទៅ -២០ អង្សាសេ អាចរក្សាទុកបានរយៈពេល១ឆ្នាំ

ការភ្លក់ចង្រិតបានពីការចិញ្ចឹមចង្រិតរបស់កសិករក្នុងខេតពោធិសាត់ក្នុងពិធីប្រមូលផលចង្រិត។ កសិករចូលចិត្តចំអិនចង្រិតតាមការបំពងដោយយកចង្រិតលាយជាមួយគ្រឿងផ្សំមុនពេលបំពង។

# សេចក្តីថ្លែងអំណរគុណ

សៀវភៅនេះ ត្រូវបានចងក្រងឡើងដោយ៖

- បណ្ឌិត មៀច ផល្លា ដែលអនុវត្តផ្ទាល់ទៅការពិសោធន៍អំពីបច្ចេកទេសក្នុងការចិញ្ចឹមចង្រិតជាលក្ខណៈគ្រួសារសម្រាប់សារណាបទថ្នាក់បណ្ឌិត ក្រោមការដឹកនាំរបស់ Prof. Anna Jansson ក្នុងមហាវិទ្យាល័យកាយវិភាគវិទ្យា សរីរវិទ្យា និងជីវគីមីវិទ្យា នៃសាកលវិទ្យាល័យវិទ្យាសាស្ត្រកសិកម្ម នៃប្រទេសស៊ុយអែត (SLU) និងមានការឧបត្ថម្ភជាថវិការពី ភ្នាក់ងារសហប្រតិបត្តិការអភិវឌ្ឍន៍អន្តរជាតិ នៃប្រទេសស៊ុយអែត (Sida) តាមរយៈគម្រោង "បណ្តាញស្រាវជ្រាវលើប្រព័ន្ធនៃការចិញ្ចឹមសត្វខ្នាតតូច ក្នុងតំបន់ទន្លេមេគង្គក្រោម (MEKARN II, ២០១៣-២០១៨)" ។
- ការចូលរួមជាស្មារតី ពីសំណាក់អ្នកសិក្សាស្រាវជ្រាវវិទ្យាសាស្ត្រ នៃមជ្ឈមណ្ឌលអភិវឌ្ឍន៍ការចិញ្ចឹមសត្វ និងកសិកម្ម (សែលអាគ្រីត) បច្ចុប្បន្នអង្គការអភិវឌ្ឍន៍ការចិញ្ចឹមសត្វ និងជីវភាពសហគមន៍

និងសូមថ្លែងអំណរគុណដល់៖

- គម្រោង Orskov foundation ដែលបានផ្តល់ថវិការសម្រាប់អនុវត្តស្តីពី ចង្រិត - ជាអាហារសម្រាប់កសិករក្នុងខេត្តពោធិសាត់
- បសុសត្វ និងនិរន្តរភាពកសិកម្មក្នុងអាងទន្លេមេគង្គក្រោម (MEKARN II) ដែលបានផ្តល់ថវិកាដើម្បីអនុវត្តការស្រាវជ្រាវផ្នែកវិទ្យាសាស្ត្រនៅមជ្ឈមណ្ឌលអភិវឌ្ឍន៍ចិញ្ចឹមនិងកសិកម្ម(សែលអាគ្រីត)
- IFNext - bringing insect farming to the next level project
- សមាគមសន្សំគ្រួសារក្រីក្រសម្រាប់ការអភិវឌ្ឍន៍ ក្នុងខេត្តពោធិ៍សាត់ដែលបានសម្របសម្រួលជាមួយកសិករចូលរួមជាមួយគម្រោង។
- អ្នកសិក្សាស្រាវជ្រាវវិទ្យាសាស្ត្រទាំងឡាយ ដែលបានសិក្សាជ្រាវជ្រាវលើការចិញ្ចឹមសត្វល្អិតពិសេសគឺចង្រិត ហើយបានចងក្រងជាឯកសារដ៏មានសារៈសំខាន់ ដែលត្រូវប្រើធ្វើជាឯកសារយោង សម្រាប់អ្នកដែលចាប់អារម្មណ៍ក្នុងការស្វែងរកពត៌មានបន្ថែមអំពីចង្រិត និងត្រូវបានដកស្រង់ទិន្នន័យ និងពត៌មានសំខាន់ៗ ដើម្បីចងក្រងជាសៀវភៅ "ការចិញ្ចឹមចង្រិតជាលក្ខណៈគ្រួសារ" នេះឡើងជាប្រយោជន៍ដល់ កសិករដែលជាអ្នកចិញ្ចឹមចង្រិតខ្នាតតូចនៅកម្ពុជា ។
- កសិកររគោលដៅទាំងអស់ ក្នុងខេត្តតាកែវ កំពង់ស្ពឺ ពោធិ៍សាត់ និងស្វាយរៀង ដែលបានចូលរួមជាមួយសកម្មភាពគម្រោងចិញ្ចឹមចង្រិតជាលក្ខណៈគ្រួសារ។

Annex 3.4

## IFNext Practical Tips

# 1. Biosecurity: Management of misplaced insects (escapes and incursions) in closed farms (version 1.0)

*December 2019*

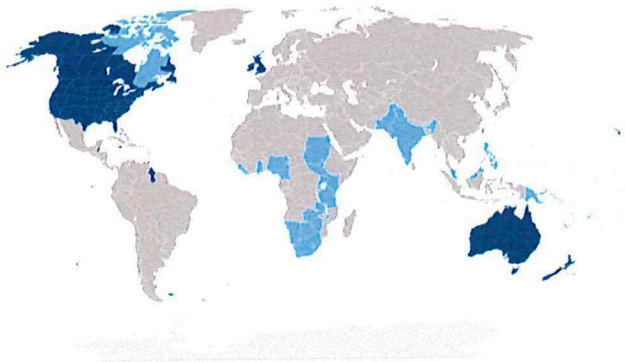
**Dr. Nils Th. Grabowski**

Department of Hygiene and Technology of Productive Insects

Institute for Food Quality and Food Safety

Hannover University of Veterinary Medicine

Language: **English**



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Projektträger Bundesanstalt für Landwirtschaft und Ernährung

aufgrund eines Beschlusses des Deutschen Bundestages

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## 1. Introduction

As in every animal-keeping facility, the farmer seeks to control the flow of animals into and out of the rearing installations. "Misplaced" in this sense refers to farmed insects outside their enclosures and wild insects entering the rearing facilities alike.

Some animal species may be conditioned to come back to their owners, e.g. dogs, cats, and some birds. In this way, the animal has recognized the benefits of living in human custody. Most species, however, have not mad this step and therefore, precautions must be undertaken to prevent their escape.

Escaping can never be prevented fully, regardless what lifeform escapes. This is true for zoo animals, pets, livestock, and also for productive insects (Fig. 1). However, precautions must be taken to minimize the risk and to keep the impact of the escape at a minimum.

Fig. 1: Male Jamaican flied cricket (*Gryllus assimilis*), just escaped from his box. Image by N.T. Grabowski

## 2. Impact of misplaced insects

The impact of escaping productive insects can be economically and/or ecologically. On one hand, escaping insects mean an economic loss, be it that some esteemed breeds or strains are lost, be it that a large amount of animals escapes. Besides, getting them back may also cause costs, let aside the payment of damages caused by the escaped insects. On the other hand, there can an ecological impact. Most of the currently-reared species are known to be pests. In fact, this habit is what recommended them to be reared in the first place. This is particularly true for locusts and mealworms, but also for crickets, which are the most common productive insects worldwide. Non-European countries have been experimenting with other pest species, e.g. weevils, fruit flies and moths and butterflies. An escape of a large number from a farm may have a significant impact on the

surroundings. My personal horror scenario is a truck full of living locusts that crashes on the road and releases thousands of them into the wild. This is why it is so important to kill the animals on the farm. If this thought is already disturbing, the situation would become even more aggravated if the reared species is not native to the rearer's country, and a neozoa problem may be created. This is why local legislation, particularly in terms of nature conservation and management of neozoa should be consulted before rearing a foreign species is attempted.

Insects entering the rearing facility must also be controlled, but incursions will be just as unavoidable as trying to keep the farmed ones inside. For vertebrate livestock, wild insects may act as vectors for pathogens and feed on the diet intended for the lifestock. A similar situation also exists when the farmed animals are insects. However, as there are more entomopathogens than pathogens for which the insects act as vectors, the risk of introducing a disease that may affect the colonies is greater than with ordinary lifestock.

## 3. Control measures

Managing the escape of productive insects is therefore centred on avoiding that the farmed insects leave the installations they are reared in. Of course it's best to have them in containers that fit tight. However, sealed containers do not allow a proper circulation o fair and may favour the development of moulds in the enclosure. Besides, one has to open them to feed and handle the animals, and they can escape in that occasion. This is why the escape of animals must be managed at each door that lies between the insects and the environment.

A series of measures are listed in Tab. 1. The farmer will possibly use a combination of these methods to manage the incursion and escape of animals.

Tab. 1: Measures to control the incursion and escape of animals to an insect farm

| Measure | Target animals | Advantages | Disadvantages |
|---|---|---|---|
| Anti-insect lamps | Flying insects | Little labour intensive | Requires electricity |
| Chemical attractant taps | Fruit flies, moths, according to the model | Economic, easy to handle and to exchange | Not applicable to all pest species; also attract productive insects |
| Glue strips around doors (double-sided tape) | Crawling insects | Economic | Not handled that easily; visitors typically step onto the tape; frequent renewal |
| Hanging glue traps | Flies, moths | Economic, easy to handle and to exchange | May hamper routine work if positioned in one's way |
| Insect curtains for doors | All animals markedly larger than the mesh dimensions | Economic and easy to handle, depending on the model | Provides no full protection as the curtains swings open while passing; when combined with glue strips around the door, there must be a suiting distance between strips and curtains so that the curtain may not serve as a stairway |
| Insect screens for windows | All animals markedly larger than the mesh | Economic and easy to handle, depending on the model | Smaller instars may pass the mesh, particularly fly larvae and moths |

| | | | |
|---|---|---|---|
| | dimensions | | caterpillars that squeeze through |
| Manual catching (hands, containers, fly swats, vacuum cleaners, brooms) | Operator's choice | Good for catching a specific insect type | Very labour intensive; when using a vacuum cleaner, ensure to kill the animals by freezing |
| Predatory arthropods (mantises, spiders) | According the prey preferences of the predator | Little labour intensive | Animal welfare regulation, possible neozoa; ensure to prevent the escape of the predator |
| Traps for rodents | Rodents | Effective | Observe animal welfare regulations; do not use any poisons! |

Although definitely a method to enhance one's reflexes and touch delicacy, **catching the animals by hand** is time-consuming when larger amounts of insects have escaped. Sweeping them together with a large broom and collecting them in a dustpan with a long handle that closes when lifted is helpful when crawling insects are to be recovered. Valuable specimens can be collected in containers, also from furniture, walls, or from the ground.

Using a **vacuum cleaner** may be an efficient method if insects hide in poorly accessible areas, e.g. on the ceiling, high walls, in corners or below furniture. However, one must aware that many models are strong, and insect may be hurt or even killed. If the individuals are to be caught and returned to their containers, a model with less power should be used, e.g. a hand-held model. However, their power also varies with the model, and shop clerks should be consulted. If the insects are to be destroyed anyway, the vacuum clear bag should be placed in the freezer right after usage to avoid any suffering.

**Glue traps** or anti-insect lamps do not discriminate between farm stock and entering pest species, even if they are sold as being specific to some insect type (Fig. 2 and 3).

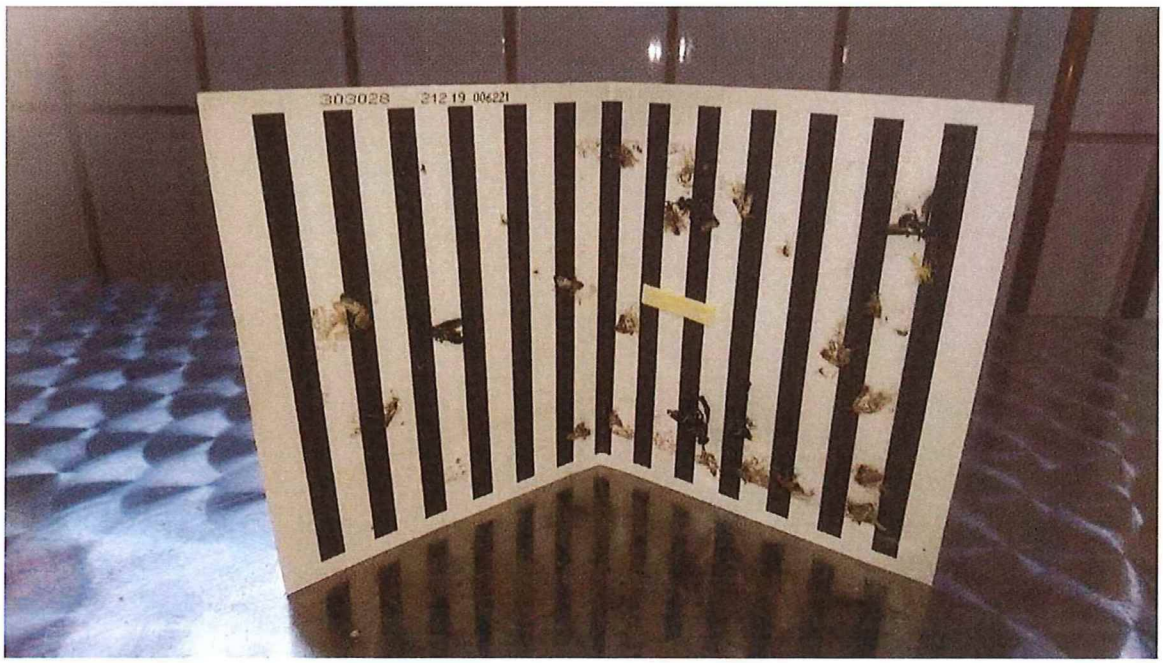


Fig. 2: Commercial insect trap specific for pyralid flour moths; apart from the target species, it catches several others including black soldier flies reared in the facility. Image by N.T. Grabowski

Fig. 3: Commercial insect trap specific for fruit flies (opened); apart from the target species, it catches several others (e.g. flour moths) including black soldier flies reared in the facility. Image by N.T. Grabowski

**Anti-insect lamps** attract the animals because of their light, electrocuting them when they touch the wires. This can be effective to control larger or constant escapes resp. incursions (Fig. 4), but the animal welfare issue will have to be dealt with in the future.

Fig. 3: Escaped black soldier flies trapped in an anti-insect lamp. Image by N.T. Grabowski

Arthropod **predators** seem an interesting option to control insects. Local spider species will find their way into the farm anyway. Where there are species that also represent a health risk to the operators

(spiders, scorpions, centipedes etc.), these animals should be eliminated. Vertebrate predators such as reptiles, amphibians or birds must be controlled so that they do not have free access to the farmed insects that are kept in their containers. Somewhat "fancy" is rearing arthropod predators in the rooms where insect rearing containers are kept, so that they can take of escapees or undesired free-ranging insects, e.g. mantises (Fig. 5). In the future, this practice may be debated in terms of animal welfare[1]. In any way, rearing predatory insects on misplaced insects and selling them afterwards may be another income for the insect farmer. However, extreme care must be taken that these predators do not enter the production and processing cycles of the farmed insects.

Fig. 4: Giant Indian mantis (*Hierodula membranacea*) housed in the rearing room to control misplaced insects. Image by N.T. Grabowski

Apart from actively catching the insects, measures to prevent them to leave or enter a building are mandatory. **Insect screens** in front of windows and doors keep many animals where they are supposed to be, although there is no complete guarantee. **Nets** covering enclosures like containers should also be checked critically and periodically. On one hand, many larvae, moreover soft-bodied ones as fly larvae or moth caterpillars may squeeze through meshes that would retain the harder-bodied instars. We tried to establish a colony of wax moths (*Galleria mellonella*) but were confronted with a high degree of escapes, even through the tiniest holes and the ordinary insect meshes. After using a metal mesh and keeping the rearing box in another box that could be sealed tightly, we decided to discontinue this species.

On the other hand, farming insect may simply chew holes in the mesh and escape this way. We have observed this in crickets and wax moths.

Finally, escaped insects may leave a building by simply clinging to the staff's clothes. Therefore, a close check before leaving the room is a good practice. Special clothes used for working inside the installation (overalls, lab coats, caps, etc.) that remain inside the facility also help reducing this risk.

Not mentioned in Tab. 1, the use of **insecticides** is decidedly discouraged in routine management practices. Neither are they selective, nor can it be excluded that the insecticides remain the harvested insects, posing thus a risk for the product quality. The only use we can see is to decontaminate a room that is not destined for insect rearing.

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[1] On one hand, insects preying on other insects display a natural behaviour, and pet owners rearing these animals naturally feed the insects to the predators, particularly the common feed insects which basically are also edible for humans. On the other hand, some animal welfare legislations forbid to "chivy" one animal onto the other. This is, of course, focused on vertebrate animals and refers to dog fights or cockfights, but may be extrapolated to invertebrates.

## 4. Conclusion

As with other life forms, a total control of specimens is impossible and cannot be guaranteed. But there are ways to reduce the risk. In our experience, managing misplaced insects is a constant learning process of trial and error in which the best combination of methods will be found individually. As with other biological systems, the situation regarding misplaced insects will change over the time, making it necessary to constantly re-evaluate and adapt the measures.

Annex 3.5

## IFNext Praktische Tipps

# 1. Biosicherheit: Handhabung "deplatzierter" Insekten in geschlossenen Zuchtsystem

## (Version 1.0)

*Dezember 2019*

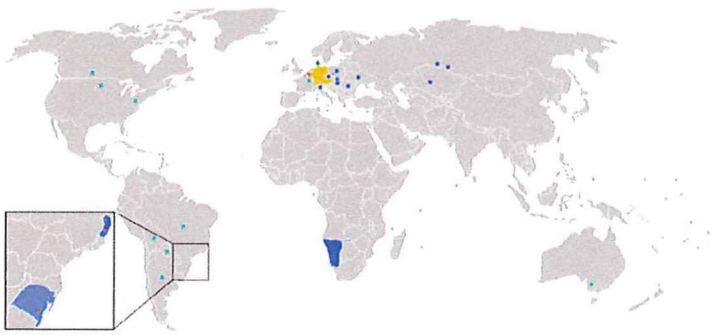
**Dr. Nils Th. Grabowski**

Abteilung Hygiene und Technologie der Nutzinsekten

Institut für Lebensmittelqualität und -sicherheit

Stiftung Tierärztliche Hochschule Hannover

Sprache: **Deutsch**



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## 1. Einführung

Wie in jeder Tierhaltung ist der Halter bestrebt, den Fluss von Tieren zu und aus den Örtlichkeiten zu kontrollieren. "Deplatziert" in diesem Sinne bezieht sich auf gezüchtete Insekten außerhalb ihrer Gehege und auf wild lebende Insekten, die in die Aufzuchtanlagen eindringen.

Einige Tierarten können darauf trainiert werden, zu ihren Besitzern zurückzukehren, z.B. Hunde, Katzen und einige Vögel. Hier hat das Tier die Vorteile des Lebens in menschlicher Obhut erkannt. Die meisten Arten haben diesen Schritt jedoch nicht bewusst vollzogen, und deshalb müssen Vorkehrungen getroffen werden, um ihr Entkommen zu verhindern.

Das Entkommen kann niemals vollständig verhindert werden, unabhängig davon, welche Lebensform entweicht. Dies gilt für Zootiere, Haustiere, Nutztiere und auch für Nutzinsekten (Abb. 1). Es müssen jedoch Vorkehrungen getroffen werden, um das Risiko zu minimieren und die Auswirkung der Flucht auf ein Minimum zu beschränken.

Abb. 1: Männliche Steppengrille (*Gryllus assimilis*), gerade ihrer Box entwichen. Foto: N.T. Grabowski

## 2. Auswirkungen deplatzierter Insekten

Die Auswirkungen von entweichenden Nutzinsekten können wirtschaftlicher und ökologischer Natur sein. Einerseits bedeuten entweichende Insekten einen wirtschaftlichen Verlust, sei es, weil einige geschätzte Rassen oder Stämme verloren gehen, sei es, weil eine große Menge von Tieren entweicht. Außerdem kann das Einfangen auch Kosten verursachen, ganz abgesehen von der Zahlung von Schäden, die durch die entkommenen Insekten verursacht wurden. Zum anderen kann es zu ökologischen Auswirkungen kommen. Die meisten der derzeit gehaltenen Arten sind auch als Schädlinge bekannt. Tatsächlich begünstigte dieser Umstand erst die kommerzielle Zucht dieser

Arten. Dies gilt insbesondere für Heuschrecken und Mehlwürmer, aber auch für Grillen, die weltweit die häufigsten Nutzinsekten sind. Nichteuropäische Länder haben mit anderen Schädlingsarten experimentiert, z.B. Rüsselkäfern, Fruchtfliegen sowie Schmetterlingen. Eine Flucht einer großen Anzahl von Individuen von einem Hof kann erhebliche Auswirkungen auf die Umgebung haben. Mein persönliches Horrorszenario ist ein Lastwagen voller lebender Heuschrecken, der auf der Straße verunfällt und Tausende von ihnen in die Wildnis entlässt. Deshalb ist es so wichtig, die Tiere auf dem Hof zu töten. Wenn dieser Gedanke bereits beunruhigend ist, würde sich die Situation noch verschärfen, wenn die aufgezogene Art nicht im Land des Züchters beheimatet ist und ein Neozoenproblem entstehen könnte. Aus diesem Grund sollten die örtlichen Rechtsvorschriften, insbesondere in Bezug auf Naturschutz und Bewirtschaftung von Neozoen, konsultiert werden, bevor versucht wird, eine fremde Art zu züchten.

Insekten, die in die Aufzuchtanlage eindringen, müssen ebenfalls kontrolliert werden, aber das Eindringen ist genauso unvermeidlich wie der Versuch, die Zuchtbetriebe im Inneren zu halten. Bei Wirbeltieren können Wildinsekten als Überträger für Krankheitserreger fungieren und sich von der für den Lebensstil bestimmten Nahrung ernähren. Eine ähnliche Situation besteht auch, wenn die Nutztiere Insekten sind. Da es jedoch mehr Entomopathogene als Pathogene gibt, für die die Insekten als Überträger fungieren, ist das Risiko der Einschleppung einer Krankheit, die die Kolonien befallen kann, größer als bei herkömmlichen Nutztieren.

## 3. Kontrollmaßnahmen

Bei der Kontrolle der Flucht von Nutzinsekten ist es daher wichtig zu vermeiden, dass die gezüchteten Insekten die Einrichtungen verlassen, in denen sie aufgezogen werden. Natürlich ist es am besten, sie in Behältern zu haben, die dicht verschlossen sind. Diese Behälter erlauben jedoch keinen angemessenen Luftaustausch und können die Entwicklung von Schimmelpilzen im Inneren begünstigen. Außerdem muss man die Behälter ohnehin öffnen, um die Tiere zu füttern und zu handhaben, und sie können bei dieser Gelegenheit fliehen. Deshalb muss die Flucht der Tiere an jeder Tür, die zwischen Insekten und Umwelt liegt, bedacht werden.

Eine Reihe von Maßnahmen sind in Tab. 1 aufgeführt. 1. Der Betreiber wird möglicherweise eine Kombination dieser Methoden anwenden, um den Ein- und Ausstieg von Tieren zu steuern.

Tab. 1: Maßnahmen zur Kontrolle des Ein- und Austrages von Tieren in eine Insektenfarm

| Maßahme | Zielarten | Vorteile | Nachteile |
|---|---|---|---|
| Chemische Fallen | Fruchtfliegen, Motten | Günstig, leichte Handhabung und Austausch | Nicht für alle Schädlinge geeignet; ziehen auch Nutzinsekten an |
| Insektengitter vor Fenstern | Alle Tiere, die deutlich größer als die Maschen-weite sind | Günstig und leicht zu handhaben, je nach Modell | Kleinere Instare können durchschlüpfen, insbesondere Fliegenlarven und Raupen. |
| Insektenvernichter | Fluginsekten | Wenig Aufwand | Benötigt Strom |
| Insektenvorhänge vor Türen | Alle Tiere, die deutlich größer als die Maschen-weite sind | Günstig und leicht zu handhaben, je nach Modell | Kein voller Schutz, da die Vorhänge auf- und zuschwingen; wenn mit Klebestreifen kombiniert ist darauf zu achten, ausreichend Abstand |

| | | | |
|---|---|---|---|
| | | | zwischen Streifen und Vorhang zu lassen, damit der Vorhang nicht zur Kletterhilfe wird. |
| Klebefallen | Fluginsekten | Günstig, leichte Handhabung und Austausch | Können die Routinearbeiten beeinträchtigen, wenn sie im Weg hängen |
| Klebestreifen um Türen und Fenster (doppelseitiges Klebeband) | Laufende Insekten | Wirtschaftlich | Nicht so einfach zu handhaben; Besucher treten of auf den Klebestreifen; häufiges Erneuern notwendig |
| Manueller Fang (Hände, Behälter, Fliegenklatschen, Staubsauger, Besen) | Eigene Entscheidung | Gut zum Fang ausgesuchter Insekten | Sehr aufwändig; wenn mit einem starken Staubsauger gefangen, die Tötung per Einfrieren veranlassen |
| Nagerfallen | Nagetiere | Effizient | Tierschutz-Richtlinien beachten; keine Gifte verwenden! |
| Räuberische Gliederfüßer (Spinnen, Gottesanbeterinnen) | Beuteschema des Räubers | Wenig aufwändig | Tierschutz-Richtlinien beachten; ggf. Neozoenproblematik; Entweichen des Räubers verhindern |

Obwohl sie definitiv eine Methode ist, um die Reflexe und die Berührungsempfindlichkeit zu verbessern, ist das **Fangen** der Tiere **mit der Hand** zeitaufwändig, wenn größere Mengen von Insekten entkommen sind. Das Zusammenfegen mit einem großen Besen und Sammeln in einer Kehrschaufel mit einem langen Griff, die sich beim Anheben schließt, ist hilfreich, wenn kriechende Insekten geborgen werden sollen. Wertvolle Exemplare können in Behältern gesammelt werden, auch von Möbeln, Wänden oder vom Boden aus.

Die Verwendung eines **Staubsaugers** kann eine effiziente Methode sein, wenn sich Insekten in schwer zugänglichen Bereichen verstecken, z.B. an der Decke, hohen Wänden, in Ecken oder unter Möbeln. Man muss sich jedoch bewusst sein, dass viele Modelle leistungsstark sind und Insekten verletzt oder sogar getötet werden können. Wenn die Individuen gefangen und in ihre Container zurückgebracht werden sollen, sollte ein Modell mit weniger Leistung verwendet werden, z. ein Handstaubsauger. Ihre Leistung variiert jedoch ebenfalls je nach Modell, und hier lohnt eine Beratung durch das Verkaufspersonal. Wenn die Insekten dennoch vernichtet werden sollen, sollte der Staubsaugerbeutel unmittelbar nach dem Gebrauch in den Gefrierschrank gestellt werden, um Leiden zu vermeiden.

**Klebefallen** oder Insektenvernichter unterscheiden nicht zwischen landwirtschaftlichen Beständen und eingeschleppten Schädlingsarten, auch wenn sie als spezifisch für einen Insektentyp verkauft werden (Abb. 2 und 3).

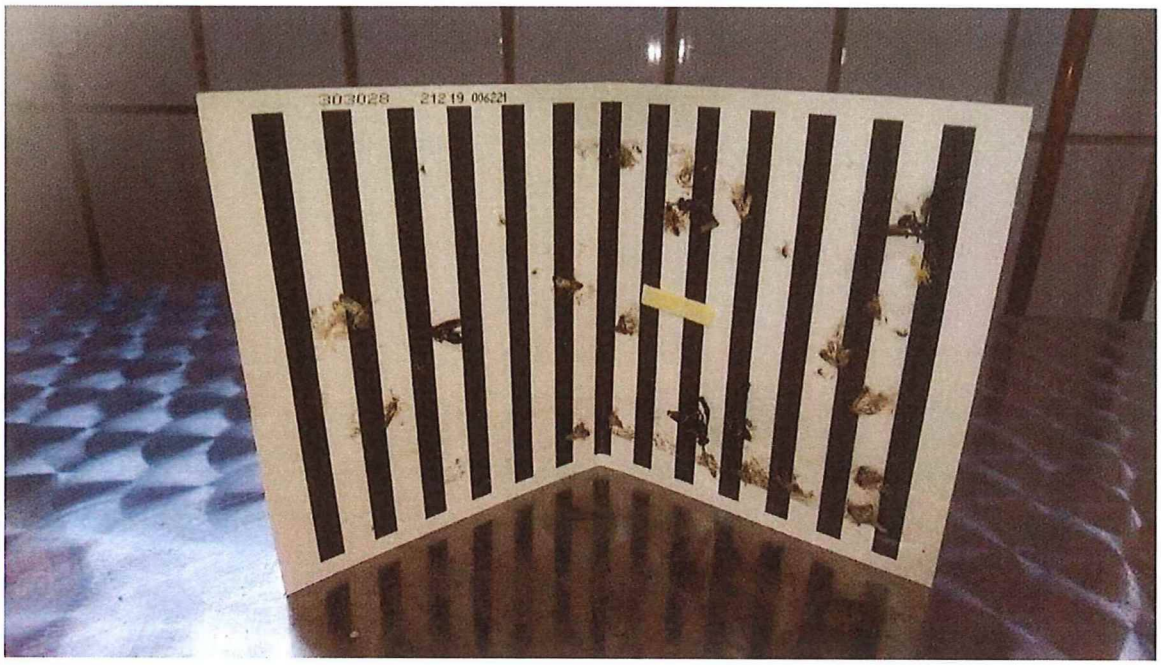

Abb. 2: Kommerzielle Insektenfalle für Lebensmittelmotten; Neben der Zielarten warden auch andere Arten (hier: Fruchtfliegen) gefangen, auch die hier gezüchteten Soldatenfliegen. Foto: N.T. Grabowski

Abb. 3: Kommerzielle Insektenfalle für Lebensmittelmotten; Neben der Zielarten warden auch andere Arten (hier: Fruchtfliegen) gefangen, auch die hier gezüchteten Soldatenfliegen. Foto: N.T. Grabowski

**Insektenvernichter** ziehen die Tiere mit ihrem Licht an und töten sie, wenn sie die Drähte berühren. Dies kann effektiv sein, um umfangreicheres/n oder konstantes/n Entweichen bzw. Eintrag zu kontrollieren (Abb. 4), aber das Thema Tierschutz wird in Zukunft auch hier bedacht werden müssen.

Abb. 4: Entwichene Soldatenfliegen in einem Insektenvernichter. Foto: N.T. Grabowski

Räuberische Gliederfüßer scheinen eine interessante Option zur Bekämpfung von Insekten zu sein. Örtliche Spinnenarten werden ohnehin ihren Weg in die Betrieb finden. Wenn es Arten gibt, die auch ein Gesundheitsrisiko für die Anwender darstellen (Spinnen, Skorpione, Tausendfüßler usw.), sollten diese Tiere beseitigt werden. Raubtiere wie Reptilien, Amphibien oder Vögel müssen so bekämpft werden, dass sie keinen freien Zugang zu den in ihren Behältern gehaltenen Nutzinsekten haben. Etwas "ausgefallen" ist die Haltung von räuberischen Arthropoden in den Räumen, in denen Insektenaufzuchtcontainer aufbewahrt werden, damit sie sich entwichener oder unerwünschter eingeschleppter Insekten annehmen können, z.B. Gottesanbeterinnen (Abb. 5). In Zukunft könnte diese Praxis im Hinblick auf das Wohlergehen der Tiere diskutiert werden[1]. In jedem Fall kann die Zucht von Raubinsekten auf verlegten Insekten und der anschließende Verkauf für den Insektenhalter ein weiteres Einkommen darstellen. Es muss jedoch äußerst vorsichtig vorgegangen werden, dass diese Tiere nicht in den Produktions- und Verarbeitungszyklus der Nutzinsekten gelangen.

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[1] Einerseits zeigen Insekten, die andere Insekten jagen, ein natürliches Verhalten, und Tierhalter, die diese fleischfressenden Arten züchten, füttern ihre Schützlinge ohnehin mit Nutzinsekten, von denen viele grundsätzlich auch für den Menschen essbar sind. Andererseits verbieten einige Tierschutzgesetze, ein Tier auf ein anderes zu hetzen. Dieser Passus hatte freilich Wirbeltiere im Auge und bezieht sich auf Hunde- oder Hahnenkämpfe, und es bleibt abzuwarten, inwiefern er auch bei Wirbellosen angewendet werden könnte.

Fig. 5: Indische Riesengottesanbeterin (*Hierodula membranacea*) im Zuchtraum zur Kontrolle deplatzierter Insekten. Foto: N.T. Grabowski

Neben dem aktiven Fangen der Insekten sind Maßnahmen erforderlich, die verhindern, dass sie ein Gebäude verlassen oder hineingelangen. **Insektenschutzgitter und -vorhänge** vor Fenstern und Türen halten viele Tiere dort, wo sie sein sollen, obwohl es keine vollständige Garantie gibt. **Netze**, die Behälter bedecken, sollten ebenfalls kritisch und regelmäßig überprüft werden. Auf der einen Seite können sich viele Larven, insbesondere solche mit weichem Körper wie Fliegenlarven oder Falterraupen, durch Maschen quetschen, die härtere und/oder größere Tiere zurückhalten würden. Bei unserem Versuch, Großen Wachsmotten (*Galleria mellonella*) zu etablieren, sahen uns jedoch mit einem hohen Ausmaß an Fluchtversuchen, selbst durch die kleinsten Löcher und die gewöhnlichen Insektennetze, konfrontiert. Nachdem wir ein Metallgitter verwendet und die Aufzuchtbox in einer anderen Box aufbewahrt hatten, die dicht verschlossen werden konnte, beschlossen wir, die Zucht dieser Art nicht weiter zu verfolgen.

Andererseits können einige Insekten einfach Löcher in das intakte Netz kauen und auf diese Weise entkommen. Wir haben das bei Grillen und Wachsmotten beobachtet.

Schließlich können entflohene Insekten ein Gebäude verlassen, indem sie sich einfach an die **Kleidung des Personals** klammern. Daher ist eine genaue Überprüfung vor dem Verlassen des Raumes eine gute Praxis. Spezielle Arbeitskleidung (Overalls, Laborkittel, Kappen usw.), die in der Einrichtung verbleibt, trägt ebenfalls zur Verringerung dieses Risikos bei.

Nicht erwähnt in Tab. 1, wird von der Verwendung von **Insektiziden** bei Routine-Praktiken entschieden abgeraten. Weder sind sie selektiv, noch kann ausgeschlossen werden, dass die Insektizide auf die geernteten Insekten übergehen und somit ein Risiko für die Produktqualität darstellen. Der einzige Zweck, den wir im Einsatz von Insektiziden sehen können, ist die Entseuchung von Räumen, die nicht der Zucht dienen.

## 4. Fazit

Wie bei anderen Lebensformen ist eine vollständige Kontrolle von Individuen nicht möglich und kann nicht garantiert werden. Es gibt jedoch Möglichkeiten, das Risiko zu verringern. Unserer Erfahrung nach ist der Umgang mit deplatzierten Insekten ein ständiger Lernprozess von Versuch und Fehlschlag, in dem die beste Kombination von Methoden individuell gefunden wird. Wie bei anderen biologischen Systemen wird sich die Situation in Bezug auf deplatzierte Insekten im Laufe der Zeit ändern, so dass die Maßnahmen ständig neu bewertet und angepasst werden müssen.

NOBILIS 41: DEZ 119

# Grillen zum Grillen

Wir essen gern Garnelen und Krabben. Für Feinschmecker sind Hummer, Muscheln, Austern und Schnecken verlockend. Aber warum ekeln sich viele Menschen vor **MEHLWÜRMERN** und **HEUSCHRECKEN** auf dem Teller?

**TEXT:** BEATE ROSSBACH

Wer in Asien oder China über die Märkte schlendert, kennt den Anblick: Essbare Insekten gehören hier ganz selbstverständlich auf den Speiseplan. So wie bei uns Scampi-Spieße werden dort niedliche kleine Skorpione auf Holzstäbchen angeboten. Statt einem leckeren Krabbenbrötchen isst man dort mit Genuss eine Reispfanne mit frittierten Würmern oder Wanzen. In Südamerika werden geröstete Spinnen als Delikatesse betrachtet.

„Die Menschen schrecken vor dem zurück, was ihnen ganz fremd oder ganz nah ist", sagt Dr. Nils Thomas Grabowski, Fachtierarzt für Milchhygiene und Spezialist für essbare Insekten an der Tierärztlichen Hochschule Hannover (TiHo). Grabowski selbst empfindet gegenüber Insekten keinen Ekel oder Vorurteile, denn er ist in Mexiko aufgewachsen und hat dort auch studiert. Geröstete Ameiseneier oder Grashüpfer – vielleicht mit Avocadomus auf Tortillas – sind dort traditionell eine Spezialität, zumal es rund 300 essbare Insektenarten gibt.

„Rein wissenschaftlich ist die Abneigung vor Insekten unbegründet, wenn sie, wie jedes andere Lebensmittel auch, hygienisch erzeugt, verarbeitet und zubereitet wurden. Was als Speiseinsekt auf den Markt kommt, ist grundsätzlich essbar", sagt Nils Grabowski. Es gibt allerdings Einschränkungen: Allergiker, die sensibel auf Shrimps, Schalentiere, Hausstaubmilben oder Schokolade reagieren, sollten auch auf Insekten lieber verzichten. Generell sollten Insekten nicht roh gegessen werden. „Immer schön

Fotos: Beate Rottbuch

Dr. Nils Grabowski erforscht, wie essbare Insekten auch zu Hause gezüchtet werden können.

vorher erhitzen", warnt Nils Grabowski, denn die Tiere können Bakterien oder Pilze enthalten.

Heute beschäftigt sich der Wissenschaftler an seinem Arbeitsplatz in Hannover, dem Institut für Lebensmittelqualität und -sicherheit der TiHo, intensiv mit dem Thema Entomophagie, so der Fachausdruck für den Verzehr von Insekten. Weltweit gibt es über 2.000 essbare Insektenarten. Längst nicht alle davon werden kommerziell genutzt. Zu den auf dieser Liste hauptsächlich vertretenen Arten gehören diverse Käfer, Grashüpfer, Grillen und Kakerlaken sowie Schmetterlinge und Motten. Der Geschmack variiert, so die Gourmet-Experten aus diesem Bereich, von nussig (Termiten und Ameisen) über fruchtig (Stinkwanzen) bis zum fischigen Geschmack bei Wasserbewohnern und dem Geschmack nach Weizenbrot bei Mehlwürmern. Die Eier von Wasserwanzen sollen nach Kaviar schmecken – die perfekte Alternative für den akut bedrohten Stör?

In vielen Ländern wie Thailand oder Mexiko essen die Menschen Insekten aus Tradition oder weil sie schmecken. Sie sind eine alternative und ressourcenschonende Proteinquelle, denn ihre Zucht kann nachhaltiger und günstiger sein als die Zucht herkömmlicher Nutztierarten.

In Ländern, wo Insekten seit jeher auf dem Speiseplan stehen, werden sie in der Natur gefangen und gesammelt. Ein bekanntes Beispiel sind die bei den australischen Aborigines beliebten Witchetty-Maden, die dicken weißlichen Larven bestimmter Bockkäfer- und Schmetterlingsarten. In Indonesien werden gern Libellen gefangen, woanders sind schwarze, glänzende Wasserkäfer oder große Wanzen sehr gefragt.

Doch der weltweite Bedarf kann längst nicht mehr aus der freien Natur gedeckt werden. Durch eine sich ausbreitende Landwirtschaft, Umweltverschmutzung und den steigenden Bedarf geraten die wilden Insektenpopulationen immer mehr unter Druck. „Wenn der Insektenverzehr gesteigert werden soll, sind Wildfänge keine nachhaltige Lösung und auch zu teuer. In Kambodscha sind zum Beispiel essbare Vogelspinnen immer schwerer zu finden, wodurch die Preise gestiegen sind", berichtet Grabowski.

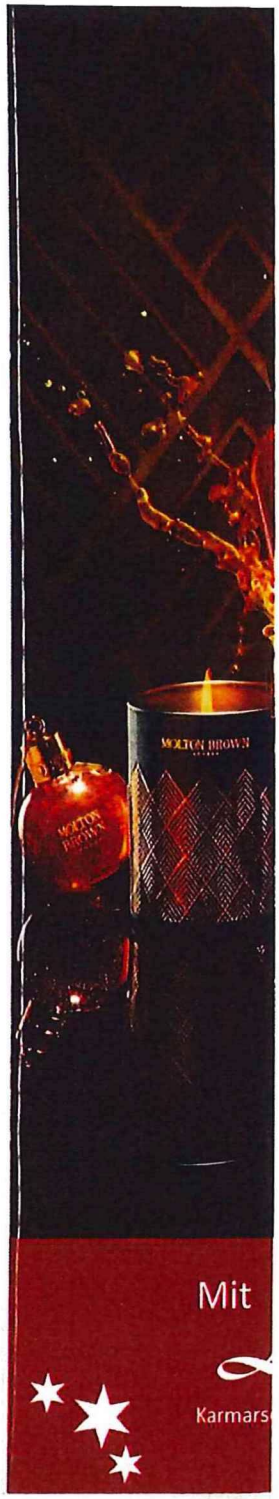
## Insektenfarmen in Planung

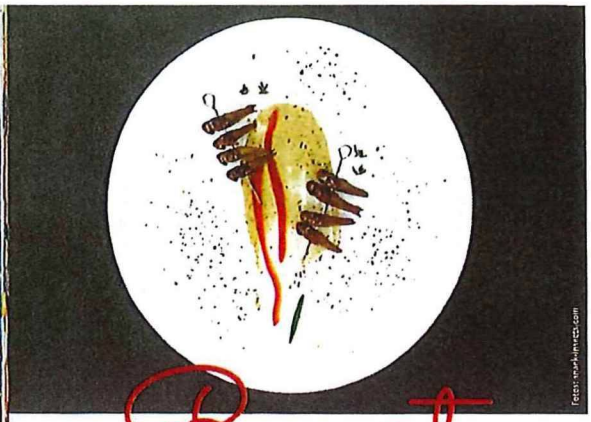
Insektenzucht wird also zu einem interessanten Wissenschaftsthema und eröffnet neue Perspektiven für die Landwirtschaft. In vielen Ländern wird aktuell dazu geforscht, so auch an der TiHo. Nils Grabowski ist der Koordinator eines in diesem Jahr gestarteten internationalen Projekts, das er gemeinsam mit Forschenden aus Thailand und Kambodscha durchführt und das von der Bundesanstalt für Landwirtschaft und Ernährung finanziell unterstützt wird. Es trägt den Titel „IFNext – bringing insect farming to the next level". Übersetzt bedeutet das, es soll erforscht werden, wie essbare Insekten niedrigschwellig und nachhaltig produziert werden können, zum Beispiel in den eigenen vier Wänden. „Wir möchten durch IFNext Familien mit einem Starter-Kit das Rüstzeug geben, für den Eigenbedarf zu Hause Insekten zu

### „Das Insekten-Kochbuch"

von Folke Dammann und Nadine Kuhlenkamp
Kosmos Verlag
128 Seiten mit 70 Farbfotos, 38 leckere Insekten-Rezepte mit tollen Fotos und vielen Informationen zum Thema Insektenverzehr, zum Beispiel frittierte Heuschrecken mit Chili, geröstete Mehlwürmer auf Kräuterbett, Grillen mit Honig und Sesam, feine Buffalowurm-Pralinen und mehr ...


Fotos: Nadine Kuhlenkamp/ KOSMOS Verlag





Fotos: snack-insects.com

# Rezepte

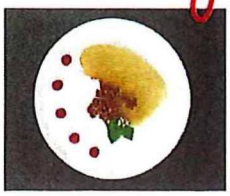
## Heuschrecken am Spieß

**Zutaten**

1 Portion Heuschrecken, Erdnussöl, Knoblauch, Rosmarin, Salz, Holz- oder Metallspieße

**Zubereitung**

Entferne Beine und Flügel der Heuschrecken. Stecke diese vorsichtig auf die Holz- bzw. Metallspieße. Erhitze das Öl in einer Pfanne und gib einige halbierte Knoblauchzehen und Rosmarin dazu. Nun die Heuschreckenspieße mit dem Würzöl bestreichen und diese im Backofen goldgelb backen. Je nach Geschmack mit süß-saurem oder auch scharfem Dip servieren.



Alle Rezepte von Feike Dammann, Snack-Insects Tafelinsekten, www.snack-insects.com

## Mehlwurm Knusper-Dessert

**Zutaten**

1 Portion Mehlwürmer, Zucker, flüssiger Honig, Naturjoghurt

**Zubereitung**

Zucker in einer Pfanne ohne Öl erhitzen. Sobald der Zucker karamellisiert Mehlwürmer dazugeben und alles gut miteinander vermengen. Das Mehlwurm-Karamell auf einem Backpapier aushärten lassen. Naturjoghurt mit etwas flüssigem Honig auf einem Teller anrichten. Mehlwurm-Karamell grob zerteilen und über den Joghurt geben. Mit frischen Beeren servieren.

## Heuschrecke in Backteig

**Zutaten**

1 Portion Heuschrecken, 100 ml Öl, 100 g Mehl, 2 Eier, Salz, Bier, Küchenpapier

**Zubereitung**

Verrühre Mehl, Eier und Bier zu einem gleichmäßigen Teig und schmecke diesen mit Salz ab. Entferne an den Heuschrecken die Beine und Flügel, röste die Körper in einer Pfanne an und stelle sie in einer Schüssel bereit. Erhitze das Öl in der heißen Pfanne, tauche die Heuschrecken in den Backteig und tauche sie dann einzeln in das heiße Öl. Backe die Heuschrecken so lange, bis der Teigmantel eine goldbraune Farbe hat.
Lasse die Heuschrecken auf einem Küchenpapier kurz abtropfen, dann servieren. Dazu passt prima ein scharfer Paprika- oder Chili-Dip.

Foto (links): Sanja – stock.adobe.com

züchten und Produkte aus Insekten auf dem Markt zu verkaufen."

Dazu müssen gezielt zweckdienliche Verfahren und Techniken entwickelt werden. Im Insektarium des Instituts leben Grabowskis Versuchsinsekten in geeigneten Behausungen, zum Beispiel die Hausgrille, auch Heimchen genannt, der Mehlkäfer, dessen Larven die Mehlwürmer sind, und die Soldatenfliege, deren Larven essbar sind. Der Tiermediziner erforscht nun, in welchem Ambiente sie sich besonders wohl fühlen, was sie gern fressen und wie sie sich kräftig fortpflanzen. Im Moment macht er bezüglich der Fütterung gute Erfahrungen mit Obst- und Gemüseresten, die bei der Speisenzubereitung anfallen. „Ich habe da einen Deal mit den Kollegen aus der TiHo-Mensa", verrät er und zeigt, wie schnell ein Eimer Salatabfälle im Fliegenkäfig verdrückt wird.

### Insekten erobern Supermarktregale

Ängste und Vorurteile, essbare Insekten seien ungesund und gefährlich, können durch gezielte Zucht und korrekte Zubereitungsmethoden entkräftet werden und sollten solch exzellenten Nahrungsmitteln nicht im Wege stehen, sagen die Experten im In- und Ausland. Und wer sich etwas umschaut, macht mittlerweile in Ländern des westlichen Kulturkreises und auch in Deutschland erstaunliche Entdeckungen. Nach und nach erobern Insekten unsere Supermarktregale. Im Buchhandel gibt es bereits verlockende Kochbücher – mit Rezepten von der Vorspeise bis zum Dessert und dem kleinen Würmer-Snack zwischendurch. Wie wäre es mit Süßem aus den USA: Cricket Lick-it, ein echtes Insekt in einem zuckerfreien Lutscher mit Minzcreme-Geschmack? Oder der Zitronen-Lolli mit Mehlwürmern, den Folke Dammann, ein norddeutscher Insekten-Feinkosthändler, in seinem Kochbuch empfiehlt, das durchaus Appetit auf mehr macht. ■

Fotos: Christian Schmies/Alexander Fischer



**BLITZQUIZ**
Die Gottesanbeterin ist berühmt-berüchtigt, weil sie nach dem Geschlechtsakt das Männchen tötet. Wann war die Gottesanbeterin „Insekt des Jahres"?

**A.** 2017
**B.** 1997
**C.** 1981

*Lösung unten auf der Seite*



Leckere Mehlwürmer, köstliche Grillen: An der **Tierärztlichen Hochschule forscht Nils Grabowski** mit seinem Team am Thema **„Insekten als Lebensmittel"**. Die NP sprach mit dem Experten über **Barrieren im Kopf, Proteine und Mineralstoffe** in 2000 essbaren Arten – und seinen **Gemüse-„Deal"** mit der TiHo-Kantine.

# Kriecht hier die Zukunft der Ernährung?

**DAS TIHO-TEAM: Stefan Trögel, Birte Ahlfeld und Nils Grabowski forschen gemeinsam. In der Box sind ausgewachsene Mehlkäfer.**

**WIE SCHMECKT DAS? Nils Grabowski lässt die Larve eines Riesenmehlkäfers über seine Hand krabbeln.**
*Fotos: Behrens*

VON ANDREA TRATNER

**Verzehr von Insekten nennt man Entomophagie – wie kamen Sie zum Thema?**
Ich habe lange in Mexiko gelebt, das Land hat eine reiche indigene Kultur, dort werden 300 Sprachen und Dialekte gesprochen. Entomophagie hat dort lange Tradition – vor der Entdeckung Amerikas durch die Europäer gab es auf dem Kontinent keine Kühe, Schafe, Pferde oder Ziegen, nur zwei Haustierrassen wurden gezielt gezüchtet und konsumiert. Die Menschen waren Sammler und Jäger, auf dem Speiseplan standen Fische, Hirsche, große Nager, Frösche, Axolotl, aber auch etwa essbare Insekten.

**Spielen die heute noch eine Rolle bei der Ernährung?**
Nicht nur Indigene schätzen frittierte Heuschrecken, Grashüpfer oder Grillen, die auf Märkten verkauft werden. Ameisenpuppen gelten als Delikatessen, 30 Gramm werden für etwa 50 US-Dollar verkauft – das entspricht dem Wert von Kaviar. Denn die Nester muss man ausgraben und vorsichtig ausschütteln, dafür braucht man Schutzkleidung.

**Haben Sie damals in Mexiko auch Insekten probiert?**
Während des Studiums in den 80ern haben Kollegen und ich öfter Grashüpfer gesammelt und in Salzwasser gekocht, dann geröstet und mit einem Schuss Limettensaft oder Chili gewürzt. Eine tolle Knabberei!

**Und eine Lösung für den Hunger auf der Welt?**
Es kann eine Lösung von vielen sein. So wie es nicht *die* Säugetiere gibt, gibt es auch nicht *die* Insekten. Jede Art ist anders. Aber das Potenzial der etwa 2000 essbaren Arten wird erkannt und Forscher weltweit arbeiten daran, es zu nutzen. Denn viele Insekten brauchen wenig Wasser, Platz und Futter, produzieren wenig $CO_2$, außerdem haben sie relativ kurze Lebenszyklen. In ihnen stecken viel Protein, Mineralstoffe, wertvolle Fettsäuren und Vitamine. Die Schwarze Soldatenfliege zum Beispiel liefert hochwertiges Eiweiß, aus ihrem Fett kann sogar Biodiesel gewonnen werden.

**Aber die Tiere sind winzig ...**
Deshalb braucht man große Mengen, das stimmt. Auch, wenn sich – nach unserer subjektiven Beobachtung – beim Insektenkonsum schneller ein Völlegefühl eingestellt. Da Umweltverschmutzung und Landwirtschaft aber immer mehr Lebensraum vernichten, muss Zucht betrieben werden. Wichtig ist aber, keine invasiven Arten zu ziehen, die ein Ökosystem aus dem Gleichgewicht bringen können. Wir fokussieren uns außerdem auf Arten, die auch in der Futtermittelproduktion verwendet werden können. In der Natur fressen viele Tiere ja auch Insekten.

**Aber bei Menschen ist die Hemmschwelle meist gewaltig, oder?**
Millionen Menschen essen regelmäßig Insekten – bei uns in Europa hingegen gilt es immer noch als „primitiv", erinnert an Notzeiten wie nach den Weltkriegen, als auch mal Maikäfersuppe auf den Tisch kam. Menschen schrecken eben vor dem zurück, was ihnen fremd ist. Wir haben festgestellt, dass Information und die gleichzeitige Möglichkeit zur Verkostung die eine oder andere Barriere im Kopf durchbricht. Die Menschen sind überrascht, dass etwas, das sie optisch als eklig empfinden, so gut schmecken kann.

**Garnelen oder Krabben hingegen sind Alltag auf dem Teller. Macht das Hoffnung?**
Hoffnung macht, dass wir sehen, dass sich das Bewusstsein ändert. Tierwohl spielt eine immer größere Rolle, nachhaltige Ernährung ist hipper geworden. Der Markt ist in Bewegung: Es gibt Müsli mit Insekten, Burger-Patties, Lutscher, Mehl, auch Proteinpulver für Sportler. Heute sind die Menschen offener als noch vor zehn Jahren.

**Stichwort Tierwohl: Auch Insekten müssen sterben für unsere Ernährung ...**
Es hieß lange in der Forschung, dass Insekten keinen Schmerz empfinden, weil ihnen entsprechende Rezeptoren fehlen. Man kann heute nur mit Sicherheit sagen, dass einige Insektenarten einige Reize als stressig oder schmerzhaft empfinden dürften. Nach heutigem Stand ist Einfrieren die wohl schonendste Methode. Und auch wenn es grausam klingt: Beim „Musen" schütten Insekten ebenfalls nicht viele Stresshormone aus. Wir sind da in einem Lernprozess. Aber Tierärzte müssen sich des Themas annehmen, wir wollen das im Sinne des Tiers richtig machen.

**FORSCHUNG: Im Insektarium der TiHo züchtet Grabowskis Team Mittelmeer-Grillen und Mehlwürmer.**

**NP** VISITENKARTE

*Dr. Nils Grabowski*

*3. Juli 1969 in Norden (Ostfriesland). Grabowskis Vater arbeitet für Olympia Schreibmaschinen, baut in Mexiko-Stadt ein neues Werk auf. 1983 siedelt die Familie um, Grabowski macht am Humboldt-„Colegio" sein Abitur, **studiert danach Tiermedizin in Mexiko.** Zurück in Hannover spezialisiert er sich auf Wiederkäuer, wird **Leiter des Fachbereichs Milchhygiene** an der TiHo. **Grabowski spricht zehn Sprachen:** Neben Deutsch, Englisch, Spanisch, Italienisch und Französisch auch etwas Arabisch, Niederländisch, Mandarin, Thai, Khmer und Aztekisch – „und natürlich Plattdeutsch". Grabowski ist zum Thema „Insekten als Lebensmittel" **beratender Experte bei der Europäischen Behörde** für Lebensmittelsicherheit" (EFSA).*

## Heute ist ein schöner Tag, weil ...

... der Hannoveraner Karsten Bettin (Foto) das **spektakuläre Faltrad „Kwiggle"** erfunden hat, das in Serie geht. Wie das Mini-Rad funktioniert, erklärt er ab 20 Uhr in der nächsten Runde des **Kiez-Talks** im Café Lohengrin (Sedanstraße 35). Die Gastgeber Ossy Pfeiffer und Wolfgang Grieger empfangen außerdem Spax, Hip-Hopper der ersten Stunde, und Thomas Schäffer von der Nordmedia Film- und Mediengesellschaft. Der Eintritt kostet sechs Euro.

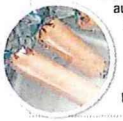
... vor 83 Jahren diese Ente groß herauskam: Donald Duck wurde am 9. Januar 1937 Hauptdarsteller in einem Zeichentrickfilm von Walt Disney. Titel des Premieren-Streifens: **„Don Donald"**. Ein Jahr später wurden seine cleveren Neffen Tick, Trick und Track eingeführt.

... wir unseren **Lieblings-Wollpulli** mit diesem Trick durch den Winter retten: Wollfasern sind von einer schmutzabweisenden Fettschicht ummantelt, die sich beim Waschen langsam zersetzt. Also: Lieber öfter auslüften statt waschen!

**BLITZQUIZ-AUFLÖSUNG**
*Die richtige Lösung lautet: A*

**DIE PRÄMIERTE MEHLKÄFER-WURST**

Das ist ein Erfolgserlebnis: Sechs Monate experimentierte Stefan Trögel, wissenschaftlicher Mitarbeiter am Institut für Lebensmittelqualität und Sicherheit an der TiHo, an einer Wurst, in der Mehlkäferlarven verarbeitet werden. „Sie sieht aus wie Leberwurst – und schmeckt auch so." Dafür hat er einen Beweis: Bei einer sensorischen Prüfung der Deutschen Gesellschaft für Ernährung wurde Trögels Produkt mit einer Silbermedaille ausgezeichnet – es konkurrierte mit vegetarischen und veganen Lebensmitteln. „Ich arbeite daran, sie auf den Markt zu bringen." Die Basis der Wurst sei ein Pulver aus den Maikäferlarven, mit dem man auch Nudeln, Burger oder Schokoriegel herstellen könne.



# Grabowski: Insekten sind „kein Ersatz für Fleisch"

**Insekten als Lebensmittel – das klingt noch immer etwas befremdlich. Wie weit ist die Forschung?**
2014 gab es einen Kongress zum Thema Insekten als Futter- und Nahrungsmittel, das war der Urknall. 500 Wissenschaftler trafen sich im Auftrag der „Food and Agriculture Organization" der UN. Und endlich fühlte man sich nicht mehr als Nerd (*lacht*). Seitdem hat sich viel getan.

**Der Weg zum Insekt als Lebensmittel ist schwierig?**
Stimmt. In der EU gibt es strenge Kontrollen. Es gibt die „Novel Food Verordnung" für jedes neue Lebensmittel. Im Januar 2018 wurde zum Beispiel der „Buffalowurm" als Speiseinsekt eingereicht, der Antrag ist bis heute noch nicht durch. Aber Lebensmittelhygiene und Sicherheit sind enorm wichtig, bei diesen Themen sind wir Europäer vorne. In anderen Bereichen hinken wir hinterher – deshalb ist internationaler Austausch auch so wichtig.

**Das machen Sie mit Ihrem Projekt „IFNext"?**
Ja, das steht für „Bringing Insect Farming to the next Level". Essbare Insekten sollen nachhaltig und einfach produziert werden können. In Thailand und Kambodscha gibt es viele unterernährte Mütter und Kinder – an sie richten wir uns. In jedem Land wurden 20 Familien ausgewählt und mit Starter-Kits versorgt. Wissenschaftler vor Ort betreuen sie.

**Sie sind Koordinator und Chef des Projektes. Welchen Beitrag leistet die TiHo?**
Wir sind mit unserem neuen Insektarium beteiligt. In allen drei Ländern wird parallel an der Zucht der Mittelmeer-Grille gearbeitet, denn sie ist von Spanien bis Indien weit verbreitet. In Thailand kommt der Seidenspinner dazu, in Kambodscha eine weitere Grillenart. Wir in Hannover konzentrieren uns neben den Mittelmeer-Grillen auf Mehlwürmer – sie sind bei uns bereits als Lebensmittel bekannt, wir setzen auf den „Aha"-Effekt.

**Wie läuft die Zucht ab?**
Riesenmehlwürmer gehören zur Familie der Schwarzkäfer. Die legen Eier, daraus entstehen Larven, die verpuppen sich und werden zum Käfer. Der Zyklus dauert 173 bis 186 Tage. Essbar sind die Tiere im Larvenstadium. Für die Zucht haben wir einen Deal mit der TiHo-Kantine (*lacht*). Die Küche versorgt uns mit Salatblättern und Obst- und Gemüseresten, die nicht verarbeitet wurden.

**Wie werden die Insekten verarbeitet?**
Wichtig ist, dass man sie einen Tag fasten lässt, bevor man sie in den Schockfroster gibt – so ist der Magen-Darm-Trakt entleert. Nach dem Einfrieren werden sie sorgfältig gespült, anschließend zehn Minuten in Salzwasser gekocht, damit alle Keime abgetötet werden. Danach sind der Fantasie keine Grenzen gesetzt.

**Was sind die besten Rezepte?**
Man kann die Insekten über Nacht in Marinaden einlegen, denn in den meisten Fällen ist der Eigengeschmack nicht besonders dominant. Anschließend kann man sie frittieren. Man kann Beine, Flügel oder Antennen entfernen. Ich persönlich fasse Heuschrecken an den Flügeln an und ziehe sie mit den Zähnen davon ab – insofern sind die Flügel bei Heuschrecken eher ein Griff wie der Stängel an der Kirsche


**NEULAND: Auf asiatischen Märkten (unten) sind Insektengerichte normal – in Europa sind sie noch rar.**

**Wie schmecken Insekten?**
Wir haben einem Team von Sensorikern gekochte Insekten vorgesetzt, um den Arten Profile zuweisen zu können. Insekten gelten allgemein als nussig, es wurden bei einzelnen Arten auch Gemüsenoten, Milch-, Kaffee- oder Raucharomen festgestellt. Insekten sollte man nicht als Ersatz für Fleisch sehen – als Nahrungsmittel sind sie etwas ganz Eigenes, jede Art schmeckt anders – so wie Fleisch oder Fisch.

**Kann jeder Insekten essen?**
Allergiker müssen vorsichtig sein. Wer sensibel auf Shrimps, Schalentiere oder Hausstaub reagiert, sollte verzichten. Bei Insekten sitzen diese Allergene in den Muskeln.

Annex 4.3

# Skript für den RTL-Nord-Beitrag, 8. bzw. 10.1.2020 (für den internen Gebrauch)

(Hinweis: „J" steht für den Redakteur, Jan Bockemüller, „G" für Grabowski)

*„Ob Grillen, Würmer oder Käfer - im Insektarium an der Tierärztliche Hochschule Hannover herrscht das große Krabbeln.*
*Und neben Forschung und Zucht, landen einige Insekten auch zu Versuchszwecken auf dem Teller der hauseigenen Laborküche.*

***Freistand:***
***J: "Also kann ich jetzt so ne Grille nehmen und einfach essen? Jo! Ungewohnt, aber crunchy, seltsamer weise ist das würzig, aber ich könnte jetzt auch nicht sagen wonach es schmeckt, so nuss vielleicht eine würzige Nuss"***

*Doch bevor es richtig an die Rezepte geht, zeigt mir Nils Grabowski seinen tierischen Arbeitsplatz. Der 50 Jährige und sein Team sind hier im wahrsten Sinne die Herren der Fliegen und forschen seit 2006 an so manchen Krabbeltieren und die können viel mehr als man so denkt.*

***Freistand***
***Grabowski: "Was Sie hier sehen, sind die erwachsenen Tiere der schwarzen Soldatenfliege, Hermetia illucens, da ist es so, dass die Larven und Puppen essbar sind und der Vorteil dieser Spezies ist, dass sie als Lebensmittel, als Futtermittel aber auch für die Industrienutzung verwendet werden können. Also lässt sich aus dem Fett dieser Tiere Biodiesel oder Biokerosin herstellen."***
***J: "Man kann daraus also Treibstoff herstellen?!"***
***G: Ja sicherlich nicht mehr aus den Tieren, die man essen möchte, ist auch klar, aber sehr viele Insektenarten haben ein Potenzial zur Mehrfachnutzung".***
***J: "Haben Sie da Beispiele für?"***
***G: "Zum Beispiel die Fliegen oder auch Mehlwürmer können in der Lage sein, Plastik zu fressen und zu verdauen."***

*Klingt nach einer möglichen Lösung für das weltweite Müllproblem - doch die Forschung befindet sich noch am Anfang.*
*Weiter fortgeschritten ist Grabowskis Arbeit bei IFNext. Ein von der Bundesanstalt für Landwirtschaft und Ernährung gefördertes internationales Projekt, das erforschen soll, wie essbare Insekten einfach und nachhaltig produziert werden können. Doch...*

***Freistand***
***J: "Was machen Mehlwürmer denn zu einem guten Lebensmittel?"***
***G: "Zum einen sicherlich der Nährstoffgehalt, sehr viele Eiweiße drin sehr viele Fette, sehr viele Vitamine und Mineralstoffe aber auch die Leichtigkeit der Züchtung die Lebenszyklen sind relativ kurz und die Handhabung ist relativ einfach."***

*Durch eine Kooperation mit der Uni Mensa bekommen Grabowskis Tierchen Nahrung gespendet und die sind ganz schön gefräßig. Wie diese Zeitraffer-Aufnahme zeigt, ist eine ganze Kartoffelscheibe innerhalb kurzer Zeit komplett bedeckt und auch Salat steht bei den Mehlwürmern hoch im Kurs.*

***Freistand***
***J: Können Sie denn den allgemeinen Ekel nachvollziehen? (Schnitt)***
***G: Es ist so unser Ekel ist relativ. Ekel ist kulturell bedingt. Mögen Sie Mettbrötchen zum Beispiel?***

*J: Ja*
***G: Ich ebenfalls, ich habe lange in Mexiko gewohnt, da ist sowas vollkommen eklig.***
***J: wegen dem rohen Schwein.***
***G: Genau, rohes Fleisch im allgemeinen, das geht überhaupt nicht, also ekel ist relativ und wir haben gesehen, wenn Leute das erste Mal todesmutig in die Heuschrecke beißen."***

*Heuschrecken gibt es heute zwar nicht, dafür stehen vor allem Mehlwürmer auf dem Speiseplan. Einmal frisch aus der eigenen Zucht und einmal weiterverarbeitet als Mehl. Daraus zaubern wir zum einen Mais- Mehlwürmer-Kroketten und zum anderen gibt es die ganzen Tiere gebraten mit Chili, Limetten und Salz.*
*Circa 3000 Insektenarten auf der Welt sind essbar, doch trotzdem sind die Insekten mit Vorsicht zu genießen.*

***Freistand***
***J: Kann eigentlich jeder Mensch Insekten essen, oder muss man da auch ein bisschen auf Allergien achten?***
***G: Man hat die Gefahr der Kreuzreaktion bei Allergien, also Leute, die empfindlich sind gegenüber Hausstaub, Hausmilben, aber auch Krustentieren.***

*Wichtig ist, dass die Tiere nicht lebendig[1] gegessen werden dürfen und bei der Weiterverarbeitung getrocknet und danach gut gewürzt und erhitzt werden. Für unser Essen brauchen wir auch nicht mehr als das: Insekten und Maismehl, Gewürze, etwas Wasser und Frittierfet.*

***Freistand***
***J: Ja das sieht ja ganz lecker aus, gut, Kroketten sind es jetzt nicht klassisch, sie haben eine Kroketten-Anmutung, dann probieren wir das ganze doch mal***
***G: vom feinsten, gut geworden.***
***J: sehr sehr lecker und ich werde ja mit unseren fast Kroketten noch etwas verköstigen und ich bin gespannt was die Hannoveraner so sagen.***

***Vöxe***
***"also eigentlich bin ich mutig, aber nein das geht nicht, ich bin zu verwöhnt was essen angeht."***
***J: "und zwar habe ich Mehlwürmer gemacht."***
***P: "Lieben Dank aber ich bin Veganerin."***
***J: "Kann ich Ihnen einen kleinen Snack anbieten?"***
***P: "Ne, wir haben gerade Mittag gegessen."***
***J: "Es ist wirklich nur ein kleiner Snack, es geht ganz schnell, bitte testen Sie doch was. Niemand testet was, niemand hat Lust.***

*und dann finden sich doch noch ein paar Passanten.*

***Vöxe***
***"Hab schonmal was schlechteres gegessen."***
***"salzig, aber kann man essen"***
***Schmeckt gut, aber es schmeckt mehr nach Würze als nach Tier"***

*Gut, das liegt wahrscheinlich auch etwas an meinen Kochkünsten.*

***Absager:***

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[1] Bei der Abnahme des Textes wurde darauf hingewiesen, dass das sachlich falsch ist und „roh", aber nicht „lebendig" heißen muss. Dem wurde entsprochen.

***Die Meinungen gehen auseinander. Ich finde nach wie vor, dass es eigentlich ein ganz guter Snack ist, hat sich auf jeden Fall gelohnt und ich würde sowas auch häufiger essen.***

*Denn wenn man genau überlegt, können Insekten tatsächlich eine gute und nachhaltige Alternative sein."*