‘Alternative’ animal protein sources in RUTF products?

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Milk in RUTF products

• High quality protein
• No anti-nutrients
• Stimulates growth (through IGF1)
• Current RUTF requirement: >50% protein from milk
‘Alternative’ – or ‘local’ - animal-source foods?

**Fish**
- Nutritional ‘super food’
- Underutilized in nutrition interventions
- Available in many low-income countries

**Edible insects**
- Seasonal food in many cultures – more than 2000 species are edible
- Mass-production systems for selected species under development
- Legislation and regulation not (yet) in place
Small indigenous fish are the most accessible animal-source foods in many low-income countries.

The Role of Fish in Food-Based Strategies to Combat Vitamin A and Mineral Deficiencies in Developing Countries

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J Nutrition, 2007, 137(4)
Challenges in utilizing indigenous fish resources in processed products

Supply
Processing
Acceptability
**Small fish in nutrition products?**

- Can powdered small indigenous fish be incorporated in processed products for prevention and treatment of undernutrition?
- Since 2008: Collaborative research with partners in Cambodia

Fish in blended flour: **WinFood**

Fish in RUTF/RUSF: ‘**NumTrey’**
WinFood porridge: small fish can substitute milk

Effects of animal source food and micronutrient fortification in complementary food products on body composition, iron status, and linear growth: a randomized trial in Cambodia

Jutta KH Skau, Bunthang Touch, Chanman Chhoum, Mary Chea, Uma S Unni, Jan Makarat, Suzanne Fiteau, Frank T Wieringa, Marjoleine A Dijkhuizen, Christian Ritz, Jonathan C Wells, Jacques Berger, Henrik Friis, Kim F Michaelsen, and Nanna Roos

ABSTRACT
Background: Poor nutritional quality of complementary foods often limits growth. Animal source foods, such as milk or meat, are often unaffordable. Local affordable alternatives are needed.

Objectives: We evaluate the efficacy of 2 newly developed, rice-based complementary food products: WinFood (WF) with small fish and edible spiders and WinFood-Lite (WF-L) fortified with small fish, against 2 existing fortified corn-soy blend products, CSB+ (purely plant based) and CSB++ (8% dried skimmed milk).

Design: In total, 419 infants aged 6 mo were enrolled in this randomized, single-blinded study for 9 mo, designed primarily to assess increments in fat-free mass by a deuterium dilution technique and change in plasma ferritin and soluble transferrin receptor. Secondary endpoints were changes in anthropometric variables, including knee-heal length. Data were analyzed by the intention-to-treat approach.

Results: There was no difference in fat-free mass increment in WF or WF-L compared with CSB+ [WF: +0.04 kg (95% CI: −0.20, 0.28 kg); WF-L: +0.14 kg (95% CI: −0.10, 0.38 kg)] or CSB++ [WF: +0.03 kg (95% CI: −0.27, 0.21 kg); WF-L: +0.07 kg (95% CI: −0.18, 0.31 kg)] and no effect on iron status. The 1.7-mm (95% CI: −0.1, 3.5 mm) greater increase in knee-heal length in WF-L than in CSB+ was not significant.

Conclusions: No difference was found between the locally produced products (WF and WF-L) and the CSBs. Micronutrient fortification may be necessary, and small fish may be an affordable alternative to milk to improve complementary foods. The dietary role of edible spiders needs to be further explored. This trial was registered at controlled-trials.com as ISRCTN19918531.

AJCN 2015, 101 p 742-51
**NumTrey**: A fish-based RUTF product

Stepwise product development since 2013 involving:

**Research:**
- University of Copenhagen, Denmark
- Institut de Recherche pour le Développement, IRD, France
- Department of Fisheries Post-Harvest Technologies and Quality Control (DFPTQ), Cambodia

**Implementation:**
- UNICEF Cambodia, Department of Child Survival and Development*
- Ministry of Health, Cambodia

**Production:**
- Vissot Co., Ltd. Food Company and Social Enterprise, Cambodia
- Danish Care Foods Co., Ltd. Cambodia
Fish-paste accepted by wrapping in wafer

Acceptability among children and their caregivers: products ‘liked the most’

Data from Sigh et al. (FNB accepted)
# NumTrey RUTF prototype composition

<table>
<thead>
<tr>
<th></th>
<th>NumTrey</th>
<th>ONLY fish paste</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Energy (Kcal/100 g)</strong></td>
<td>506</td>
<td>531</td>
<td>520 – 550</td>
</tr>
<tr>
<td><strong>Protein/Total (E%)</strong></td>
<td>9.7</td>
<td>11.3</td>
<td>10 – 12</td>
</tr>
<tr>
<td><strong>Protein from milk products (%)</strong></td>
<td>0.0</td>
<td>0.0</td>
<td>≥ 50</td>
</tr>
<tr>
<td><strong>Dried small fish, g/100g</strong></td>
<td>5.6</td>
<td>8.0</td>
<td>–</td>
</tr>
<tr>
<td><strong>Fish protein (%)</strong></td>
<td>31.3</td>
<td>36.6</td>
<td>–</td>
</tr>
<tr>
<td><strong>Fat/Total (E%)</strong></td>
<td>49.6</td>
<td>56.2</td>
<td>45 – 60</td>
</tr>
<tr>
<td><strong>Omega-6/Energy ratio (%)</strong></td>
<td>–</td>
<td>15</td>
<td>3 – 10</td>
</tr>
<tr>
<td><strong>Omega-3/Energy ratio (%)</strong></td>
<td>–</td>
<td>3.6</td>
<td>0.3 – 2.5</td>
</tr>
</tbody>
</table>
NumTrey tested in outpatient SAM treatment

- 120 outpatient children age 6-59 mo (mean 21 mo) randomized to NumTrey wafer or BP100 for 8 weeks treatment
- No difference in weight-gain between products
- However, overall weight-gain for both products was 1 g/kg BW/d, well below the expected 4 g/kg BW/d

Sigh et al. (submitted)
Product development

- RUTF in development for optimizing product quality, nutrition composition and flavour variation (‘NutriX’)

- RUSF versions in development for MAM treatment and prevention (‘Num Nutrii’)

Key challenge

- Secure and safe supply chain of high-quality wild caught fish across seasonal and annual fluctuations
‘Alternative’ – or ‘local’ - animal-source foods?

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Edible insect in transition from ‘wild foods’ to farmed food

Crickets (food)  Black Soldier Fly (feed)  Mealworm (food and feed)
Insect species emerging for mass-production

- **Species farmed for food and feed:**
  - Crickets (4-6 species)
  - Mealworm (3 species)
  - Locust/grasshoppers (various species)
  - Few other species

- **Species farmed for animal feed:**
  - Black soldier fly (BSF) (*Hermentia illucens*)
  - Housefly (*Musca domestica*)
  - Few other fly larvae

- **By-products from two existing insects systems:**
  - Silk larvae/pupae
  - Honey bee brood (larvae/pupae)

- **About 10-12 species are farmed at present**
- **More will come – but not many**
Insects are animals-source foods: a source of protein, fat and micronutrients.

<table>
<thead>
<tr>
<th>INSECT ORDER</th>
<th>COMMON NAME (IN DANISH)</th>
<th>LIFE-STAGES USED</th>
<th>PROTEIN (% dry matter)</th>
<th>FAT (% dry matter)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orthoptera</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crickets</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acheta domesticus</td>
<td>House cricket (Husfårekylling)</td>
<td>Adult</td>
<td>60-75</td>
<td>7-20</td>
</tr>
<tr>
<td>Gryllodes sigillatus</td>
<td>Banded cricket (Steppe færekylling)</td>
<td>Adult</td>
<td>60-75</td>
<td>7-20</td>
</tr>
<tr>
<td>Grasshoppers/locusts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Locusta migratoria</td>
<td>Migratory locust (Alm. vandregræshoppe)</td>
<td>Adult</td>
<td>40-60</td>
<td>10-25</td>
</tr>
<tr>
<td>Schistocerca americana</td>
<td>American grasshopper (Amerikansk græshoppe)</td>
<td>Adult</td>
<td>40-60</td>
<td>10-25</td>
</tr>
<tr>
<td>Diptera (flies)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Musca domestica</td>
<td>Common housefly (Stueflue)</td>
<td>Larvae</td>
<td>55-70</td>
<td>10-25</td>
</tr>
<tr>
<td>Hermetia illucens</td>
<td>Black soldier fly (Sort soldaterflue)</td>
<td>Larvae/prepupae</td>
<td>40-60</td>
<td>20-40</td>
</tr>
<tr>
<td>Coleoptera (beetles)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tenebrio molitor</td>
<td>Mealworm (Melskrubbe, melorm)</td>
<td>Larvae</td>
<td>45-55</td>
<td>25-35</td>
</tr>
<tr>
<td>Zophobas atratus</td>
<td>Giant mealworm (Kæmpemelorm)</td>
<td>Larvae</td>
<td>40-50</td>
<td>40-45</td>
</tr>
<tr>
<td>Alphitobus diaperinus</td>
<td>Lesser mealworm (Hønseribille, lille melorm)</td>
<td>Larvae</td>
<td>45-60</td>
<td>25-30</td>
</tr>
<tr>
<td>Lepidoptera (moths)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Galleria mellonella</td>
<td>Greater wax moth (Stor voksål)</td>
<td>Larvae</td>
<td>35-45</td>
<td>40-60</td>
</tr>
<tr>
<td>Achroia grisella</td>
<td>Lesser wax moth (Lille voksål)</td>
<td>Larvae</td>
<td>35-45</td>
<td>40-60</td>
</tr>
<tr>
<td>Bombyx mori</td>
<td>Silkworm (Silkesommerfugl)</td>
<td>Larvea/pupae</td>
<td>50-70</td>
<td>8-10</td>
</tr>
</tbody>
</table>

Protein quality: PDCAAS assessed to 79-84% in cricket and mealworm. DIAAS study ongoing for 5 species.
Pilot testing cricket-based products in Kenya

Testing cricket-biscuits vs milk over 4 weeks in school children:
- High acceptability
- No difference in gut microbiota and growth

Testing cricket-porridge vs milk and control over 6 m (Feb-Jul 2017) in pre-school children

Anja Homann, Univ Copenhagen
Carolyn Kipkoech, JKUAT
Are insects safe?

- Covers potential **biological** (incl. prions), **chemical and environmental** hazards, as well as **allergenicity**

- **Farmed** insects used as food and feed
Summary of hazards in farmed insects for food and feed

- Biological and chemical hazards would depend on **production methods**, in particular what the insects are fed on (**substrate**)

- When **currently allowed feed materials** are used to feed insects, the possible occurrence of microbiological hazards are equal (or lower) to other sources of protein of animal origin and **should not pose any additional risk**

- The use of **other (currently not allowed) substrates** to feed insects such as organic wastes (food waste and manures) must be specifically evaluated
Are insects legal food sources?

EU

❖ Since January 2018: The new Regulation (EU) 2015/2283 on novel foods is applicable (replaces Regulation (EC) No 258/97 in which status of insects was unclear)

❖ The new regulation specifically mention insects as novel foods for which product dossiers can be submitted for approval.

❖ Each product applied for is evaluated for safety by EFSA

❖ It is known that several dossiers for insect based products are in process for approval following the January 2018 regulation
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Research project 2014-2017:
GREEiNSECT  *Insects for green economy*
www.greeinsect.ku.dk

Research project 2017-2019:
InValuable  *Insect Value Chain in a Circular Bioeconomy*
www.invaluable.dk

Journal of Insects as Food and Feed
Co-editor on nutrition
http://www.wageningenacademic.com/loi/jiff

Halloran, Flores, Vantomme, **Roos** (eds), 2018.
Edible insects in Sustainable Food Systems.
Springer