SUMMARY OF NUTRITION & CONSUMER STUDIES on Millets

Over the last 4 years, a team of multi-disciplinary specialists from different organizations and countries have designed and undertaken studies to identify scientific evidence on the nutritional value of millets and consumer acceptance.

Content

1) Impacts on anaemia

The study

This was a systematic review and meta-analysis published in *Frontiers in Nutrition*. It included 30 studies on 6 types of millet, with 22 studies on humans (including about 1,000 children, adolescents and adults, for short (<4 months) and long (>4 months) periods of time) and 8 *in vitro* (laboratory) studies.

Results included that consuming millets:

- **reduced anaemia.** This is based on studies showing increased haemogloban and serum ferritin levels, and studies on adolescents who went from moderately anaemic to normal levels.
- **increased haemoglobin levels by 13.2%** compared to regular diet (increased by 2.7%)
- **increased serum ferritin levels by an average 54.7%.**

Bioavailability of the iron in millets:

- **Bioavailability percentage of iron in millets is at the upper level for plant-based sources** (7.22% ± 1.78)
- **Anti-nutrients of millet are similar or lower than common staples**
- **Processing can significantly increase the amount of iron bioavailable**
  - Expansion (extrusion) increased bioavailable iron 5.4 times
  - Fermentation, popping and malting more than tripled bioavailable iron (3.4, 3.4, 3.5 times)
  - Germination (sprouting) and decortication (dehulling) more than doubled bioavailable iron (2.2, 2.6 times)
  - Dephytinization increased bioavailable iron 1.4 times
  - Adding an absorption enhancing agent such as vitamin C rich food improved iron bioavailability percentage up to 6.8 times
- **Millets can provide all or most of the daily physiological requirement of the average person** dependent on the millet variety and form of processing.

2) Impacts on type 2 diabetes

The study

This was based on a systematic review and meta-analysis, published in *Frontiers in Nutrition*. Surprisingly a very large number of studies were found undertaken including 80 studies on humans and 65 of these were eligible for deeper statistical analysis of their data.

Results were better than we ever expected and clearly showed that:

- consumption of millet **reduced the risk of diabetes**.
- For diabetic individuals: **blood glucose levels were lowered** by 12% and 15% for fasting and post-meal respectively. **Individuals' blood glucose levels went from diabetic to pre-diabetic level**
- For diabetic individuals: **HbA1c** (blood glucose bound to hemoglobin) was lowered by an overall average of 15%
- For pre-diabetic individuals: **HbA1c was lowered** up to 17% and individuals' **HbA1c level went from pre-diabetic to normal status.**

3) Impacts on cardiovascular disease

The study

This was based on a systematic review and meta-analysis published in *Frontiers in Nutrition*. It included 19 efficacy studies on humans, with almost 900 people involved. Five millets were studied, finger millet, foxtail millet, barnyard millet, sorghum and little millet combined with other millets in a meal. All results are based on consumption of 50 to 200 g of millets per day for a duration ranging from 21 days to four months. Results from the consumption of millets included:

- **reduced risk of cardiovascular disease**
- **reduced total cholesterol** by 8%, lowering cholesterol in the people studied, from high to normal levels.
- nearly 10% **decrease in low and very low-density cholesterol** (commonly viewed as 'bad cholesterol') and triacylglycerol levels in blood. Through these reductions, triacylglycerol levels reduced from a hypertriglyceridaemic condition to normal.
- a slight **increase in what is 'commonly' called the good cholesterols** (high-density lipoprotein cholesterol).
- **lower blood pressure** with the diastolic blood pressure decreasing by 5%.
- **reduced BMI** by 7% in people who were overweight and obese, showing the possibility of returning to a normal BMI.

4) Impacts on growth

The study

This is based on two systematic reviews and meta analyses - one analyses on the impact of consuming finger millet on bone health and one analyses (submitted and under review) on the impact on growth. The papers are expected to be published and results available soon.

Results

- The consumption of millets **increased growth in young children and adolescents**
- **Finger millets has extremely high calcium, good bioavailability percentage and high calcium retention*:*** finger millet has 3 times the calcium as milk and bioavailability is almost the same as milk (28% for finger millet, 32.1% for milk). Alternative sources of

calcium are especially important given that 65% of people globally are lactose intolerant, which can be up to 90% across many areas in Asia, Africa and South America.

5) School feeding studies in India and Tanzania

- ⇨ **First school feeding study on millets** conducted in **India** and published in *Nutrients* journal. Our pilot with 1,500 school children (and 1,500 control group) showed millet-based meals compared to iron fortified rice-based meals led to 50% relative more growth of the children in 3 months, (compared to the control group) and all millet-based meals were rated 4.5 or higher out of 5 for taste. The meal was designed as a balanced meal of millets, legumes and vegetables.

- ⇨ In **Tanzania**, over 2,800 students in 4 schools had finger millet and pigeonpea introduced to their meals. 15 months later (Jan 2020) we returned and surveyed 681 students (26%). Published in Ecology of Food and Nutrition Journal, this showed:
  - 80% and 70% of the students changed their negative perception of finger millet and pigeonpea respectively.
  - >95% of the students wanted to eat the finger millet and pigeonpea dishes at school.
  - 84% of the students wanted to include pigeonpea 2-7 times a week and 80% of the students wanted to include finger millet on all 7 days in school meal.

6) Protein in millets

A **protein study** published in *Cereal Chemistry* highlighted that even though legumes are an important protein source (affordable proteins in developing countries and with rising plant-based diets globally), few people look deeper than the total protein level. Legumes have good protein levels yet are not a complete protein as they are low in one essential amino acid – methionine. Millets studied had 50% higher methionine and the combination of the millets and legumes made a complete, quality and highly digestible protein, while also having a basket of micronutrients.

See articles in: Food Tank, and in Africa.

7) Study on the acceptance to diversify diets in Kenya

In **Kenya**, parents of over 60,000 children below 5 years old were reached with Smart Food Ambassadors to spread nutrition messages and have fun activities and cook offs. At the end of the first year there was:

- almost 100% increase in diet diversity for the children; and
- 20% increase in diet diversity of the women.

(Stories of Impact publication, pages 38-50; Article - Ecology of Food and Nutrition.)

8) Acceptance and impact on wasting in Myanmar

In **Myanmar** we undertook a very small study and showed the millets and pigeonpea meals:

- had a positive impact on the extent of wasting and underweight children between 2-14 months; and
- sensory evaluations in the community showed on average 4 out of 5 for all recipes and products.

Article in *Journal of the science of food and agriculture* (Note: not open access).

9) Consumer study in India

The largest ever consumer survey on millets was undertaken with 15,500 face-to-face interviews in cities across 7 states in India provides baseline and insights about consumers' awareness, attitudes and consumption of millets. Published in *Frontiers in sustainable food systems*.

Some key results:

Health and wellness were the most common factors influencing consumption of millets in urban areas, with 58% of the interviewees attributing this to consumption.

Largest reasons for consuming millets

1. 'I have a health problem' (nearly 30% or people stating this)
2. 'I want to lose weight' (15.1%)
3. 'I like the taste' (about 14.6%)

Identified knowledge gap by a target audience

- 91 % of respondents were very or reasonably health conscious
- However, only 40% were sure millets were healthy

Market segments

- The data indicates that the early adopters of millets are consumers with a health problem and searching for solutions.
- Second are the people who are health conscious and interested in healthy lifestyles, where the identified knowledge gap about millets being healthy indicates market potential.
- However, to make a big impact it will be important to reach the mass markets.

The major reason the respondents did not eat (more) millets

1. 'It is not eaten at home', expressed by nearly 40% of the respondents
   This indicates the potential to have a multiplier effect of reaching many people if promotions can reach and influence the decision maker in the household.
2. 'Don't like the taste' expressed by nearly 22%
   Interestingly taste was observed to be a major reason why the respondents both did and did not eat millets, indicating that health awareness alone would not significantly boost millet consumption. Together, these insights showed the need for tasty products and simple recipes made from millets as well as changing the image of millets.
3. 'Price is high' (13%)
4. 'It takes a long time to cook' (8%)