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Development of alternative formulations

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Issues surrounding the local production of ready-to-use therapeutic foods (RUTF) using peanuts/ milk powder

- Peanuts - problems related to mycotoxins - QC
- Peanuts (protein) - potential to cause allergic reaction (a major issue in developed countries)
- Fatty acid profile - peanut oil/peanuts have the largest variation in 18:2 linoleic acid: range from 13-43%
- Most other oils range much narrower, e.g. sunflower oil 42-48%; cottonseed oil 47-58%
- Milk powder still remains a relatively expensive commodity

Ready-to-use therapeutic foods (RUTF)

Question:

- Can we completely replace peanuts and milk powder from the formulation and produce a product of high nutritional quality, taste and shelf-life?

An ideal RUTF formulation must have the following attributes:

- Good nutritional quality (i.e. protein, energy and micronutrient content)
- Long shelf-life
- Highly palatable
- A consistency suitable for feeding infants/children
- Requires no additional processing prior to feeding

The Food Square concept to develop RUTF

A **The Staple** cereals (tubers and roots)	B **Protein source** includes all legumes and animal foods
C **Vitamin and mineral mixture** vegetables and fruits	D **Energy source** fats, oils, sugars

Example of a food mixture

A **Rice** 25%	B **Soybean** 30%
C **Nutriset vitamin/mineral mix** 1-2%	D **Sunflower oil** 20% **Sugar** 20%

Plumpy'nut® physicochemical structure
(from publicity literature)

- **Form**: paste
- **Taste & smell**: typical of peanut
- **Humidity**: < 5%
- **Total fat**: 57% in energy input
- **Protein**: 11% in energy input
- **Total energy**: 530 kcal per 100 g
- **Aflatoxins**: < 5 μg/kg or 5 ppb/kg (European standards) but may reach 20 ppb (American standards). Check the standards applicable in the country concerned

A total of over 15 trial formulations were developed

Examples of trial formulations:

	Energy (kcal/100 g)	per 100 g Protein	Fat	CHO
Brown chick peas (*Cicer arietinum*) and wheat (*Triticum spp.*)	507	9.2	30.1	49.8
Lentils (*Lens culinaris*) and barley (*Hordeum vulgare*)	520	9.7	30.6	51.4
Split peas (*Pisum sativum*) and wheat (*Triticum spp.*)	523	8.9	30.9	52.3
Soybean (*Glycine max*), and maize (*Zea mays*)	522	12.2	33.6	42.8

All cereals and legumes were roasted. Appropriate proportion of sugar, oil and vitamins and minerals were added

Various RUTF formulations showing textural and colour differences

Example of RUTF gross composition compared to Plumpy'nut®

	RUTF (100 g)	% energy	Plumpy'nut® (100 g)	% energy
Energy (kcal)	512		530*	
Energy (kJ)	2142		2218	
Protein (g)	13.4	10.5	14.5	11.0*
Carbohydrate (g)	50.2	39.2	43.0	32.0
Fat (g)	28.6	50.3	33.5	57.0*
Ash (g)	4.9		4.0	
Moisture (g)	2.9		< 5.0	

*Values from Nutriset

Protein digestibility-corrected amino acid score

- Protein digestibility-corrected amino acid score of a food is calculated as follows:

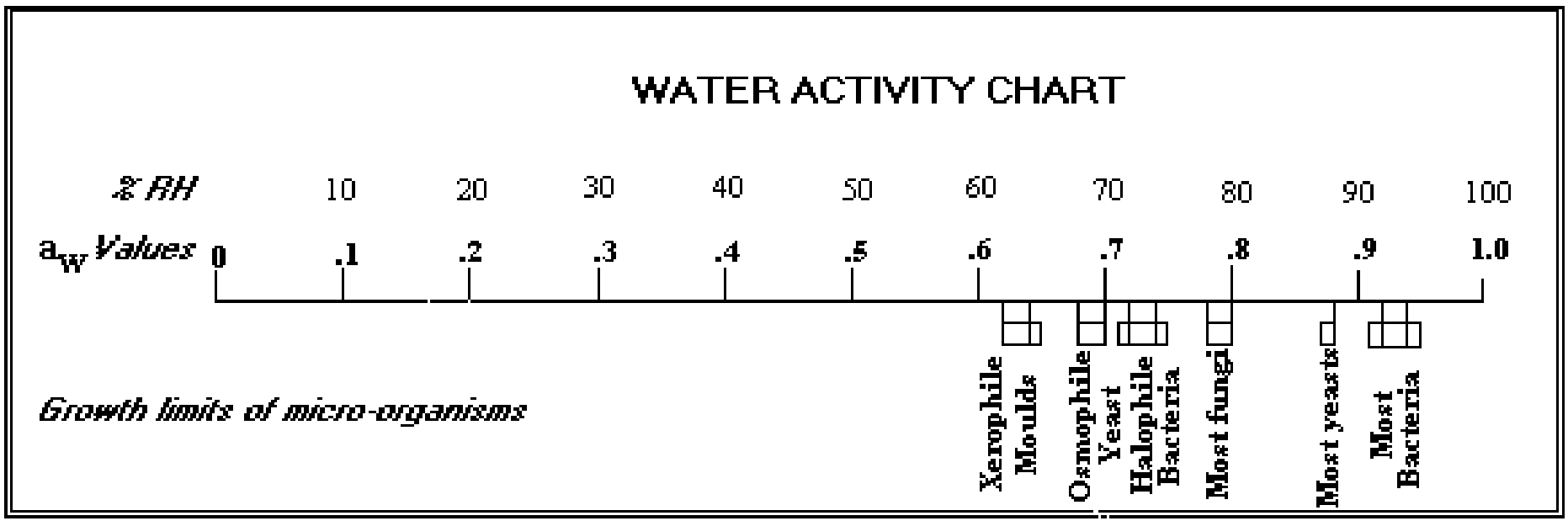
Lowest amino acid ratio x true protein digestibility

Protein digestibility-corrected amino acid score

RUTF sample	PDCAAS (%)
RUTF-1	80
RUTF-2	92
Plumpy'nut®	83

Water activity (a_w)

- The term water activity (a_w) refers to unbound water in food
- The water activity (a_w) represents the ratio of the water vapour pressure of the food to the water vapour pressure of pure water under the same conditions and is expressed as a fraction
- Water activity (a_w) has its most useful application in predicting the growth of bacteria, yeasts and moulds



(http://www.dfst.csiro.au/water_fs.htm)

Water activity (a_w) in RUTF samples and Plumpy'nut®

RUTF sample	Water activity (a_w)
RUTF-1	0.29
RUTF-2	0.26
Plumpy'nut®	0.24

Interaction between a_w and microbial proliferation in some foods

Water activity	Foods	Microorganisms
0.98	Fresh meats, fish, vegetables, milk	Most food spoilage and food-borne pathogenic organisms grow
0.85-0.60	Flour, cereals, nuts	No pathogenic bacteria grow
0.60	Confectionery, noodles, dried milk	Microorganisms do not multiply, but can remain viable for long period
0.30-0.20	Biscuits, instant coffee	No viable microbial growth

(Fellows, 2000)

Conclusions (1)

- It is feasible to produce low cost, ready-to-use therapeutic foods without the use of peanuts and milk powder
- No animal-based ingredients were used in the formulations
- The RUTF formulations were developed from the complementary effect of combining two or more ingredients, mainly oilseeds, grains and legumes with appropriate vitamins and minerals
- All RUTF's reported do not contain any trace of peanuts, mainly to minimise mycotoxin contamination
- With increasing concerns about the use of peanuts in infant food (due to allergenicity and mycotoxin contamination), the developed RUTF's have considerable global promise

Conclusions (2)

- The gross composition and texture of the RUTF's developed were comparable to Plumpy'nut®
- All RUTF's had an acceptable level of protein quality and energy density and were suitable for feeding young children and vulnerable groups
- The products had good shelf stability
- The alternative RUTF formulation may be a useful addendum to Plumpy'nut® in the developing world