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Compositional analyses of traditionally fire-treated and dried Mopane worms harvested in Northern and Central regions of Zambia

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Presentation outline

- Introduction
  - Distribution of Mopane worms
- Objectives
- Materials and Methods
- Results / Discussion
- Conclusion
- Future research ideas
- References
- Ackowledgements

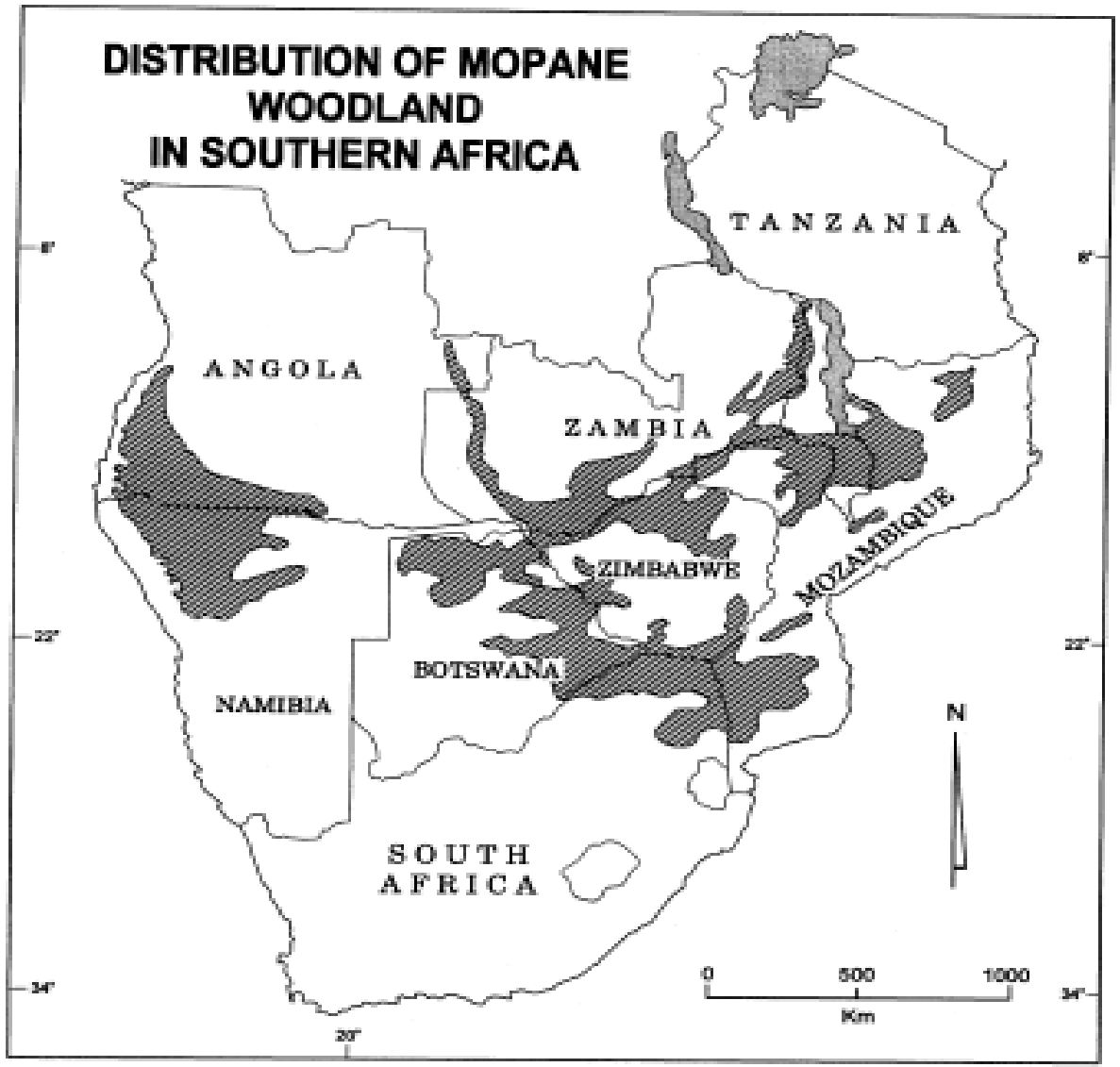
Introduction

- Mopane worms (*Gonimbrasia belina*)
  - Local names: *Mumpa*, *Vizimu*, *Ifishimu, etc*
- Commonly consumed in many parts of Zambia by most populations

Dry mopane worms

Mopane worms in Zambia and neighbouring regions

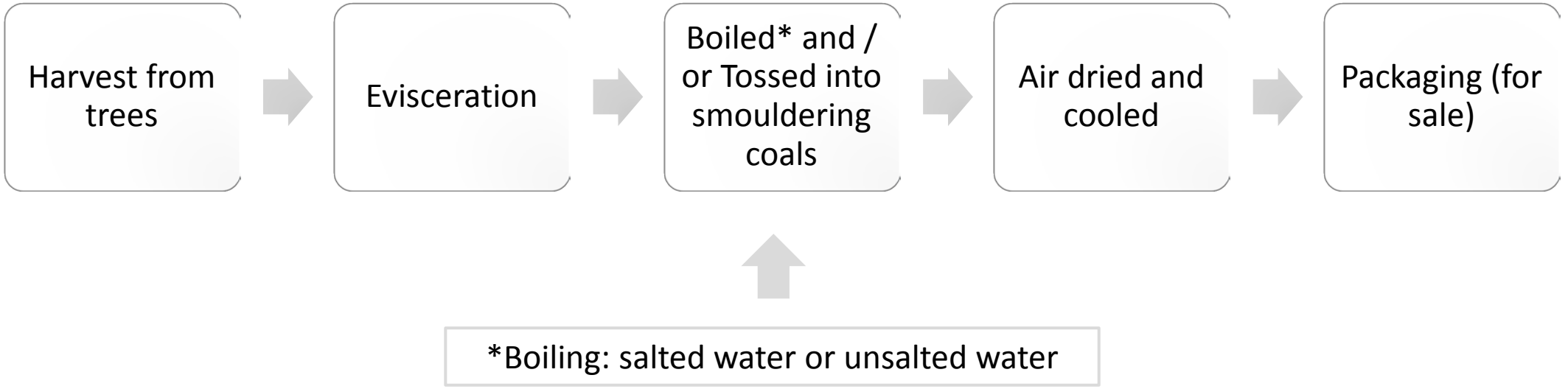
- Largely found where its principal host, the mopane tree (*Colophospermum mopane*) grows → Mopane woodlands



Introduction

- Mopane worms
  - Commonly consumed in most parts of Zambia – Cheap source of proteins and other nutrients
  - Affordable by poor households
- Children in poor households are likely to be undernourished
  - Nutrient intake can alleviate malnutrition
- Mopane worms contain important nutrients beneficial to growth of children and mothers (pregnant and lactating)
  - Macronutrients: Proteins and amino acids; lipids
  - Essential fatty acids
  - Minerals – Calcium, zinc, iron, and others

Processing of Mopane Worms



Objective of study

To determine the nutritional* content of mopane worms (processed by a traditional fire treatment and air-drying method) harvested in Northern and Central parts of Zambia

*(Emphasis on nutrients that are important in the growth and development of children and mothers (pregnant and lactating))

Materials and Methods

- Mopane worms – Three batches (3 - 5 kg each of Mopane worms)
  - Purchased / collected from Serenje and Mpika districts, Central and Muchinga Provinces (November and December, 2016)
- Proximate Analyses
- Carbohydrate and energy content by difference
- Select minerals – Ca, Zn, Fe, K, Na, Mg
- Fatty acid profile / Essential Fatty acids
- Cholesterol
- Amino acid profile
  - Amino acid scores
  - *In vitro* protein digestibility

Milled Mopane worms

Results: Proximate Results

Table 1: Proximate composition[a] of mopane worms harvested in Serenje and Mpika, Zambia

Analyses		Range of proximate and chemical contents
Moisture content (%)		9.23±0.30 - 11.2±0.19
Protein content (%)		50.5±3.36 - 69.8±1.24
Lipid content (%)		10.4±0.53 - 11.6±0.41
Cholesterol content (mg / 100 g)		7.86±0.27 - 9.74±1.82
Total mineral content (%)		6.09±0.14 - 7.20±0.20
Select individual minerals (mg / 100 g)	Potassium	1123.2±73.5 - 1261.7±19.6
	Sodium	64.9±12.3 -169.4±12.6
	Iron	9.98±1.04 - 24.6±0.64
	Calcium	331.1±4.56 - 395.5±6.48
	Magnesium	357.7±18.3 - 424.4±7.95
	Zinc	12.9±1.20 - 14.8±2.21
Carbohydrate (%)		11.2±1.48 - 24.6±4.92
Energy (Kilocalories /100 g)		375±2.58 - 391±1.34

[a]All analyses carried out in triplicate (n=3) unless stated; Results expressed as mean±SD; [c]Carbohydrate by difference 100 – (moisture + protein + lipid + ash contents); [d]Estimation of gross energy 100 – ((4xProtein) + (9 x Lipid) + 4 x (Carbohydrates))

Results: Non essential and essential amino acids

Table 2: Essential and Non-Essential Amino Acid profiles of mopane worms from Serenje and Mpika, Zambia

Essential Amino acids		Non-essential Amino acids	
Amino acids (% of total amino acids)		**Amino acids (% of total amino acids)**	
Histidine	2.90±0.50 - 3.06±0.04	**Serine**	5.22±0.45 - 5.50±0.09
Threonine	4.58±0.59 - 5.37±0.44	**Arginine**	5.73±0.18 - 5.94±0.09
Cysteine	0.48±0.07 - 0.58±0.05	**Glycine**	5.97±0.45 - 6.49±0.43
Lysine	5.10±0.47 - 7.22±0.62	**Aspartate**	9.82±1.17 - 10.1±0.22
Tyrosine	6.85±0.90 - 7.92±0.31	**Glutamic acid**	13.1±1.29 - 13.7±1.85
Methionine	1.26±0.08 - 1.41±0.08	**Alanine**	5.88±0.43 - 6.33±0.13
Valine	5.66±0.31 - 5.93±0.44	**Proline**	6.58±0.78 - 6.85±0.27
Isoleucine	3.98±0.79 - 4.46±0.10	**Asparagine**	0.00±0.00 - 0.01±0.01
Leucine	5.79±0.31 - 6.51±0.03	**Glutamine**	0.00±0.00 - 0.07±0.10
Phenylalanine	4.73±0.18 - 5.43±0.31		
Tryptophan	0.00±0.00		

[a]All analyses carried out in triplicate (n=3) unless stated; Results expressed as mean±SD of % of total amino acids and as a range of three batches of mopane worms;

Results: Additional protein parameters

Table 3: Essential amino acids (as a fraction of total amino acids and in vitro protein digestibility of proteins in Mopane worms from Serenje and Mpika, Zambia

Additional protein parameters	Range of parameter (%)
Percent (%) of essential amino acids as total amino acids	45.3±0.57 - 47.7±4.27
In vitro protein digestibility (%)	62.1±0.15 to 63.3±0.21

Results: Amino acid scores of essential amino acids in Mopane worms

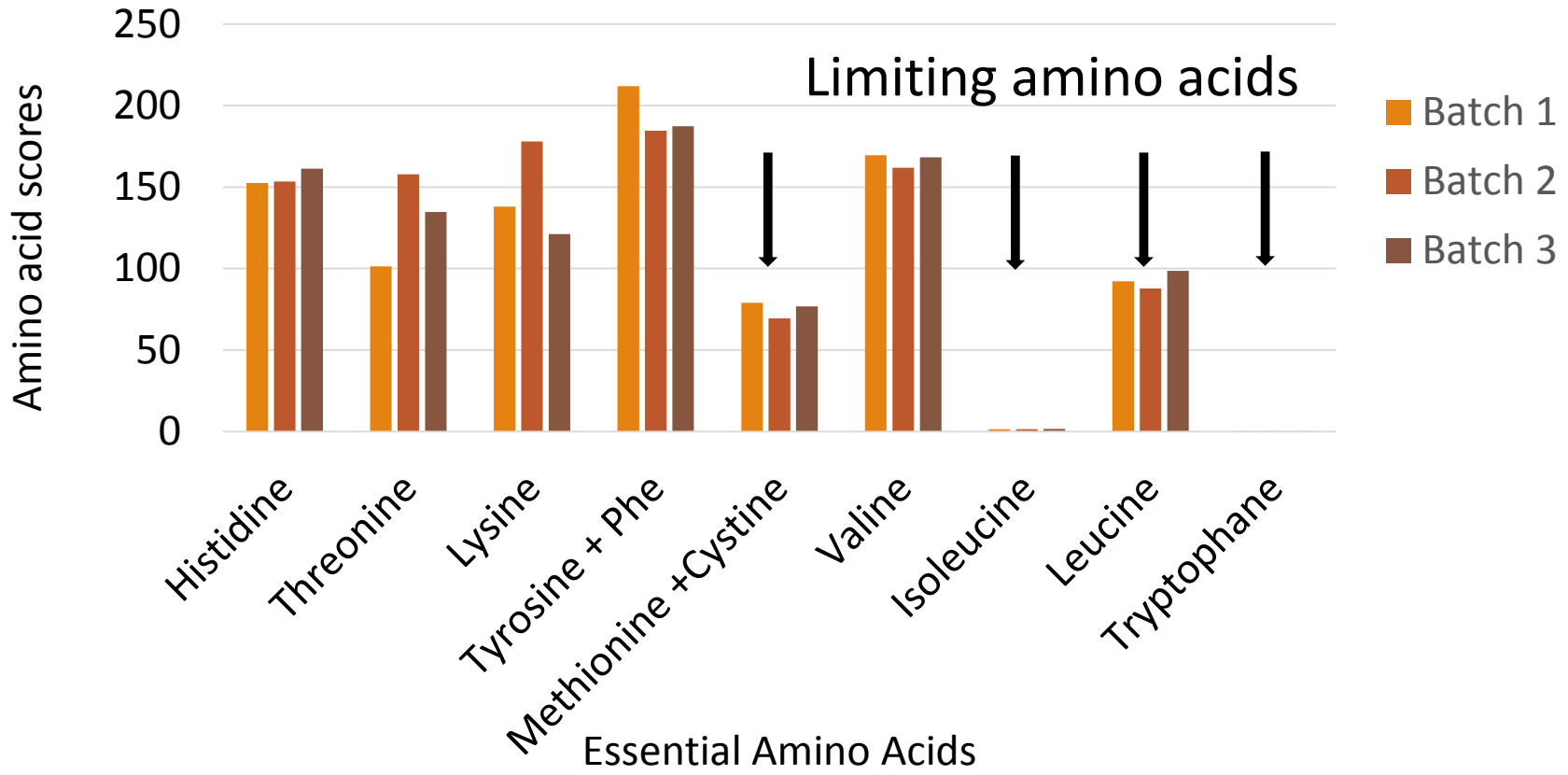


Figure 2: Amino acid scores of essential amino acids in Mopane worms from Serenje and Mpika, Zambia

Results: Fatty acids of mopane worms

Table 5: Essential and Non-Essential Amino Acid profiles of mopane worms from Serenje and Mpika, Zambia

Fatty acids	Fatty acids (full name)	Fatty acids (% of total fatty acids)
C11	Undecanoate acid	0.09 – 0.15
C14	Myristic acid	0.21 – 0.22
C15	Pentadecanoic acid	0.14 – 0.16
C16	Palmitic acid	15.5 - 17.7
C18	Stearic acid	12.5 – 12.8
ΣSFA		**28.8 - 30.7**
C16:1	Palmitoleic acid	0.25 – 0.40
C18:1n9t	Elaidic acid	7.92 - 9.09
C18:1n9c	Oleic acid	0.23 - 0.29
ΣMUFA		**8.40 - 9.71**
C18:2n6c	Linoleic acid (ω6)	11.0 – 13.7
C18:3n3	α-linolenic acid (ω3)	0.51 – 0.75
C18:3n6	γ-linolenic acid (ω6)	48.1 – 49.0
ΣPUFA		**59.7 – 62.6**

Potential contribution of minerals from Mopane worms to women and children

Table 6: Potential contribution of select minerals in mopane worms in a standard[a] portion to average RNI[b] (%) to PLW[c] and children (7 – 23 months)

	Iron (mg / 100 g)		Calcium (mg / 100 g)		Zinc (mg / 100 g)	
	PLW	Infants	PLW	Infants	PLW	Infants
Average daily recommended nutrient intake (RNI)* - %	15	7	1040	467	7.9	4.1
Batch 1	68	73	17	18	82	79
Batch 2	33	36	16	18	94	91
Batch 3	82	88	19	21	91	88

[a]Standard portion is assumed to be 50 g / day for PLW and 25 g / day for children; [b] Recommended nutrient intake (%) unless stated; [c]Pregnant, Lactating women

Conclusion

- Consumption of mopane worms could address issues of malnutrition in children and women
  - Adequate proteins, lipids, and energy
  - Iron and zinc contribute >25 % to diet of PLW and children
  - Calcium contributes <25% to the diet of PLW and children
- *In vitro* protein digestibility (62 to 63 %)
  - Raw versus cooked
- Consumption of other foods to address:
  - Limiting amino acids present in Mopane worms
  - Essential fatty acids especially omega 3 fatty acids
  - Low digestibility of proteins

Future research ideas

- Effects of different processing technologies on the nutritional composition of mopane worms
  - Fire treated vs non - fire treated vs fresh vs fire treated and boiled
- Nutritional composition, and sensory evaluation of differently processed Mopane worms
- Product / value addition of mopane worms and associated sensory evaluation
  - Powdered mopane worms
  - Pre-cooked mopane worms
  - Canned mopane worms

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