Organoleptic Attributes and Yield of Products From *Parinari Curatellifolia, Strychnos Cocculoides, Vitex Doniana Uapaca Kirkiana* and *Mangifera Indica* in Malawi.

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Paper presented at the International symposium
"Underutilized Plant Species for Food, nutrition, income and sustainable Development"
Ngurdoto Mountain Lodge, Arusha, Tanzania. 3-7 March 2008

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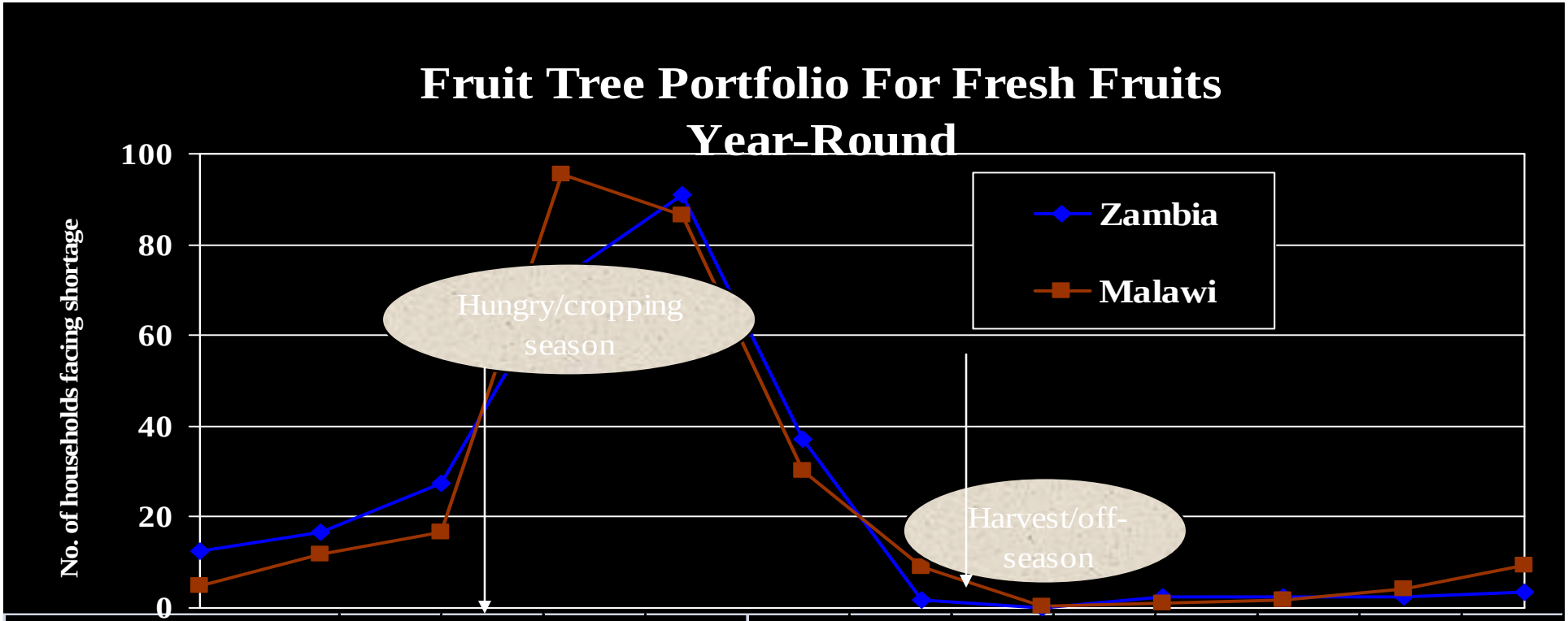
Introduction

- **Indigenous fruits species of the Miombo such as *Parinari curatellifolia, Strychnos cocculoides, Uapaca kirkiana* and *Vitex doniana* and exotic fruits like *Mangifera indica* are becoming increasingly important food sources for many rural communities in Malawi.**
- **In particular people living in rural areas in the miombo ecological zone have depended on forests for their livelihood through gathering, processing and utilization of tree products like**

- **Although the Miombo are a wealth to the people residing near them, they continue to disappear as they give way to the pressures of a growing human population.**
- Better management of these tree species could be achieved in part by increasing knowledge about products that could be made from them.
- **Most of these fruits are also normally available at critical times of the year when there is food shortage and have been used traditionally as a coping strategy against the trauma of hunger.**

Fruit Tree Portfolio For Fresh Fruits Year-Round



Tree Species	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Avocado	■	■	■	■	■	■	■	■	■	■	■	■
Citrus	■						■	■	■	■	■	■
Parinari curatellifolia	■	■							■	■	■	■
Mangoes	■	■	■									■
Uapaca kirkiana	■	■	■	■								
Strychnos cocculoides		■	■									
Syzygium cordatum		■	■	■	■	■						
Annona seneghalesis			■	■	■	■						
Azanza garckeana			■	■	■	■						
Flacourtia indica				■	■	■	■					
Vangueria infausta					■	■	■					
Vitex doniana					■	■	■	■	■			
Adansonia digitata							■	■	■	■	■	■
Ziziphus mauritiana									■	■	■	■

- Previous work on indigenous fruit processing in Malawi has concentrated on evaluating the organoleptic properties of products made using some conventional formulas based on other fruits like the exotic ones.
- Recently, there has been a proliferation of small scale fruit processors producing apparently different constitutions of different products.
- This has created problems in certification and standardization by the bureau of standards and in some instances, dissatisfaction to the consumers.

- Consumer acceptability of the product is influenced by many factors including the type of formulation/constitution.

No systematic work has been done to evaluate the effect of the type of formulation on acceptability of the product.

On the other hand, information is limited on the output (volume of juice and or jam recovered/fruit weight used) of the different species upon pulp extraction.

•These, among other things is what necessitated this study

Objectives:

To

-evaluate consumer preferences for different formulations of juice made from each one of *P. curatellifolia, S. Cocculoides* and *V. doniana*

- *evaluate* consumer preferences for different formulations of jam made from *P. curatellifolia* and *V. doniana*.

- determine yield of juice per unit weight of fruit of *P. curatellifolia, Uapaca kirkiana* and *Mangifera indica (control)*

Materials and Methods

- Ripe fruits of *P. curatellifolia*, *S. Cocculoides* and *V. doniana* were collected and prepared for processing.
- Four juice formulations were constituted for each one of the species with formulation 1 having the highest pulp and formulation 4 having the lowest pulp
- All other constituents were kept proportionally constant.
- Similarly five jam formulations were made from *P. curatellifolia* and *V. doniana* with formulation 1 having the highest sugar content and formulation 5 the lowest sugar content, all other constituents being proportionately equal.

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Materials and Methods contd.

- An untrained, randomly selected panel of 30 people was used to taste each of the juice and jam formulations made (total 150 people) from each of the species.
- Some panelists sampled more than one product.
- The panelists included Staff members and students representing the University community.
- The products were assessed before and after tasting.
- A preference score for each product was assigned on a scale of one to four (1=very good, 2=good, 3=poor and 4= very bad).

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Tasters were then asked to rank the formulations in terms of relative preference (1= most favourite, 2=favourite, 3=less favourite and 4= least favourite).

Materials and Methods

- During the tasting panelists were asked to score each of the samples in terms of taste, smell and aftertaste on a scale of 1-4 (1=very good, 2=good, 3=poor and 4= very bad)
- And then rank them in terms of overall preference (1= most favourite, 2=favourite, 3=less favourite and 4= least favourite). The same procedure was followed for the jam test but bread was used for spreading the jam on.
- Each of the juice and jam formulations were replicated 4 times.

Materials and Methods contd.

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Tasters were then asked to rank the formulations in terms of relative preference (1= most favourite, 2=favourite, 3=less favourite and 4= least favourite).

Materials and Methods contd.

- Data were analysed using the Statistical Package for the Social Sciences (SPSS) version 11.5 following a Post-hoc analysis for the organoleptic scores for the juices and jams. Multiple comparison tests were done on all attributes that showed significant differences between mean scores of the different formulations using least significant differences (lsd) at 5%.
- Unbalanced linear regression model was used to analyse the data for the yield of juice using the Genstat Discovery edition 2.

Materials and Methods contd.

- In another experiment, data were collected from a small scale processor over a period of 4-12 months on quantities of fruit used to produce a given quantity of juice for each one of Mango (n= 4), *P. Curatellifolia (n=23) and Uapaca kirkiana (n= 6).*
- One standard formula was used to produce the juices. Each entry was a replicate for a given species.

Mat. & methods contd.

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Results and discussion

- Juice Products
- 1. *Parinari curatellifolia juice.*
- From table 1, significant differences were found between formulations for preference for colour, viscosity and overall preferences both before and after tasting with formulation 2 giving significantly lower mean scores (1.9) for colour preference (most prefered)(P=0.01) than all the other three formulations.
- No significant differences between formulations in product smell before and aftertaste.

Parinari curatellifolia juice.

- formulated has an effect on consumer preference. Once determined, products can be standardized, and their recipes published for wide scale production.

Table 1. Mean organoleptic scores for *Parinari curatellifolia* juice formulations

	Before tasting				**During/After tasting**			
Formulation	**Colour**	**Smell**	**Viscosity**	**Overall preference**	**Smell**	**Taste**	**Aftertaste**	**Overall preference**
1	2.2a	2.4	2.0a	2.2a	2.1	2.1a	2.1	2.0a
2	1.9a	2.4	2.3b	2.0a	2.1	2.0a	2.5	2.1a
3	2.4b	2.4	2.4b	2.7b	2.5	2.8b	2.5	2.6b
4	2.8b	2.5	2.8b	3.0b	2.6	2.9b	2.4	3.2c
P (0.05)	**0.01**	**0.96**	**0.01**	**0.01**	**0.08**	**0.01**	**0.34**	**0.01**

Parinari curatellifolia juice.

- In general the aftertaste assessment results for all formulations of *P. Curatellifolia* juice were described as good. The results in table 1 imply that the concentration of the fruit pulp does not have a significant effect on the smell and aftertaste of the juice from this indigenous fruit species.
- *Parinari curatellifolia* smell retained in the juice made from the fruit will probably be dictated even at low concentrations of the pulp in the product.

2. *Vitex doniana juice* (table 2)

- There were no significant differences between formulations for smell and the overall visual preference before tasting while significant differences were observed in all the attributes during and after tasting.
- Formulation 2 had the lowest mean score (1.6) for colour while the other three formulations had their mean scores ranging from good to poor colour.
- The results also show that in the visual and olfactory assessment of *Vitex doniana juice, formulation 1 gave significantly lower mean scores in the smell attribute and overall preference compared to the formulations 3 and 4*

Vitex doniana juice

- Formulation 4 was significantly poor in the overall assessment as being the least favourite of the four juice formulations and would therefore not be ideal for producing juice from this species

Table 2. Mean organoleptic scores for *Vitex doniana* juice formulations

	Before tasting				During/After tasting			
Formulation	**Colour**	**Smell**	**Viscosity**	**Overall preference**	**Smell**	**Taste**	**Aftertaste**	**Overall preference**
1	2.5b	2.4	2.0a	2.3	2.4b	1.8a	2.0a	1.9a
2	1.6a	2.5	2.0a	2.3	2.1a	2.1a	2;.2a	2.0a
3	2.4b	26	2.4b	2.3	2.4b	2.8b	2.5b	2.7b
4	3.2c	2.7	3.0c	2.9	2.9c	3.0c	3.1c	3.1c
P (0.05)	**0.01**	**0.77**	**0.01**	**0.07**	**0.02**	**0.01**	**0.01**	**0.01**

Strychnos cocculoides juice

- There were no significant differences in scores between the formulations of *Strychnos cocculoides* juice for smell before tasting and aftertaste that could have influenced preference of the products (table 3).
- However significant differences were found between formulations in almost all attributes of smell (during and after tasting), viscosity, overall visual preference, taste and overall taste preference of the juice formulations.
- *Strychnos cocculoides* juice is one of the new products from such an underutilised fruit species with a high potential for commercialisation and large scale production.
- Based on the mean scores attached to the juice formulations, panellists tended to prefer moderately diluted *Strychnos cocculoides* juice (formulation 2) to the most concentrated and more dilute types (formulations 1, 3 and 4) respectively.

Table 3. Mean organoleptic scores for *Strychnos cocculoides* juice formulations

		Before tasting			During/After tasting			
Formulation	**Colour**	**Smell**	**Viscosity**	**Overall preference**	**Smell**	**Taste**	**Aftertaste**	**Overall preference**
	2.6	2.7b	2.0a	2.5b	2.4a	2.1a	2.6	2.4b
	2.3	1.9a	2.2a	2.0a	2.2a	2.1a	2.2	1.9a
	2.2	2.4b	2.6b	2.4b	2.4a	2.6b	2.3	2.4b
	2.7	3.0c	3.1c	2.8c	3.1b	3.3c	2.5	3.1c
P(0.05)	**0.18**	**0.01**	**0.01**	**0.04**	**0.01**	**0.01**	**0.38**	**0.01**

Table 3. Mean organoleptic scores for *Strychnos cocculoides* juice formulations

		Before tasting			During/After tasting			
Formulation	**Colour**	**Smell**	**Viscosity**	**Overall preference**	**Smell**	**Taste**	**Aftertaste**	**Overall preference**
	2.6	2.7b	2.0a	2.5b	2.4a	2.1a	2.6	2.4b
	2.3	1.9a	2.2a	2.0a	2.2a	2.1a	2.2	1.9a
	2.2	2.4b	2.6b	2.4b	2.4a	2.6b	2.3	2.4b
	2.7	3.0c	3.1c	2.8c	3.1b	3.3c	2.5	3.1c
P(0.05)	**0.18**	**0.01**	**0.01**	**0.04**	**0.01**	**0.01**	**0.38**	**0.01**

Jam products

- ***Parinari curatellifolia* jam**
- From table 4 no significant differences were found between mean scores for all attributes of the 5 jam formulations made from this species.
- all the jam formulations did not influence the scores of the attributes assessed in the study. Most importantly, all the jam formulations were acceptable to the consumer. Other factors beyond the objective of this study should be looked into in evaluating the attributes of jam from this species.
- Issues such as longevity and benefit cost may be more critical for evaluating the potential of jam products from *P. Curatellifolia* than consumer preference as it were. Traditionally *P. Curatellifolia* fruit is used to make many types traditional foods
- Jam making is a potentially viable new product .
- The absence of significant differences in sensory attributes between formulations means the species is easily amenable for jam production.

Table 4. Mean organoleptic scores for *Parinari curatellifolia* jam formulations

		Before tasting			During/After tasting			
Formulation	**Colour**	**Smell**	**Viscosity**	**Overall preference**	**Smell**	**Taste**	**Aftertaste**	**Overall preference**
1	2.4	2.6	2.2	2.2	2.5	2.1	2.5	2.5
2	2.3	2.5	2.3	2.6	2.4	2.6	2.6	2.4
3	2.4	2.7	2.7	2.8	2.7	2.7	2.6	2.5
4	2.8	2.4	2.6	2.7	2.4	2.8	2.8	2.8
5	2.7	2.0	2.7	2.6	2.5	2.7	2.9	2.9
P(0.05)	**0.24**	**0.20**	**0.28**	**0.36**	**0.83**	**0.13**	**0.62**	**0.36**

Table 5. Mean organoleptic scores for *Vitex doniana* jam formulations

		Before tasting			During/After tasting			
Formulation	**Colour**	**Smell**	**Viscosity**	**Overall preference**	**Smell**	**Taste**	**Aftertaste**	**Overall preference**
1	2.2	2.2	2.0a	1.6a	2.1a	1.8a	2.1a	2.0a
2	2.4	2.4	2.3b	2.5b	2.5b	2.3b	2.1a	2.2a
3	2.8	2.5	2.9c	2.9c	2.7c	2.8c	2.4b	2.5b
4	2.8	2.8	2.8c	3.2c	2.9c	2.8c	2.9c	2.9c
5	2.5	2.7	2.7c	2.8c	2.8c	3.0c	2.8c	3.0c
P (0.05)	**0.08**	**0.27**	**0.01**	**0.01**	**0.05**	**0.01**	**0.01**	**0.01**

Vitex doniana jam

- As shown in table 5, no significant differences were found between formulations for colour and smell before tasting but significant differences were found between formulations for texture (P 0.01) and smell during tasting (P 0.05).
- Formulations differed significantly in scores for texture, overall visual preference, taste, aftertaste and overall taste preference P (0.01).
- The texture of *Vitex doniana* jam made from the five formulations produced mixed results. No significant differences were noted for colour and the smell before tasting of *Vitex doniana* jam, but the rest of the attributes assessed showed significant differences. *Vitex doniana* is a versatile tree; its leaves, pods and seeds are edible to animals and can be used as good fodder.
- In some instances, *Vitex doniana* has many reported pharmaceutical uses. In general formulations 1 and 2 scored higher than the other formulations in all attributes and higher concentrations of sugar seem to be ideal for jam making for this species.

Yield of products

- There were significant differences in the juice output from the three species under test. Mango produced significantly higher out put (litres of juice/kg fruit) than *Uapaca kirkiana*,
- but was comparable to *P. Curatellifolia. Uapaca kirkiana* produced significantly lower out put than the two species. All things being equal, it may be more worthwhile to produce juice from Mango and *Parinari curatellifolia* than *Uapaca kirkiana*.
- Mango juice was rated as the number one priority by many consumers in Malawi during a product priority setting by Akinnifesi, et al (2008).
- These results translate to different monetary values of the product per unit fruit weight used (table 6). However, an economic analysis is required to validate the profitability of each of the products before concrete conclusions could be made.
- One major problem with *Uapaca kirkiana* is that it is difficult to extract pulp from the fruit.

Table 6. Yield of Juice from three indigenous fruit tree species (Litres of juice/kg of fruit)

Species	Yield (litres/kg of Fruit	Equivalent value (Malawi Kwacha
Mango	1.949a	311.8 (2.2)
Parinari curatellifolia	1.467a	234.7 (1.6)
Uapaca kirkiana	0.545b	87.3 (0.6)
P (0.05)	**0.003**	**Mean 211.26 (1.5)**

Note: 1Us $ =141MK

Figures in parentheses are US $ equivalents.

Conclusion

- It is evident from the results that indigenous fruit trees especially *Strychnos cocculoides*, *Parinari curatellifolia* and *Vitex doniana* are important both for commerce and food security.
- Juice and/or jam from *Strychnos cocculoides*, *Parinari curatellifolia* and *Vitex doniana* in the study are palatable and acceptable to consumers. Generally *the* three are amenable for juice production but that attention should be paid to the way the product is formulated as it does influence the acceptability of the product by the consumer.

Conclusions

- Significant differences in organoleptic preferences do exist according to the way the products are prepared.
- Blending of fruits might offer a chance to reduce excessive smell from fruits like *Parinari curatellifolia* and *Vitex doniana.*
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Conclusion

- Formulations (1 and 2) with more fruit pulp are generally more preferable for juice extraction than the more dilute ones, (formulation 3 and 4) for all species.
- Based on overall assessment, all formulations of *Parinari curatellifolia* jam were within acceptable organoleptic limits of this study while formulations 1 to 3 of *Vitex doniana* jam products were within the acceptable limit.
- Formulation number 2 of *Strychnos cocculoides* juice was the most preferred.
- The amount of out put realised in processing depends on the species with Mango and *Parinari curatellifolia* producing comparable output while there is significantly lesser amount of recovery from *Uapaca kirkiana*.

Conclusion

- *All Vitex doniana* products (juice and jam) kept the original smell and colour of the fruit while the smell of *P. curatellifolia* was hidden in the jam made but was retained in the juice regardless of the formulation used.

Conclusion

- An economic analysis of the different products that could be made from different fruit species is being proposed. This would assist in developing value-added options for the commercialization of the underutilized indigenous fruit tree species like the ones in this study.

ACKNOWLEDGEMENTS

I would like to thank Dr. Hanna Jaenicke for organizing this workshop and assisting me to get funding to attend. Thank you very much.

I am grateful to The World Agroforestry Centre for sponsoring me to attend the symposium.

I thank Mzuzu University for funding the study.

Thank you very much.