

# Nutritional Composition and Value Addition to Selected NWFPs in Uganda

**Presentation at ICRAF-Uganda Workshop on Enhancing Opportunities For Sustainable Exploitation & Use NWFP on 19<sup>th</sup> Feb 2020 at Hotel Africana**

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# Background

- The west Nile sub region of Uganda is rich in NWFPs including
  - Honey
  - Indigenous fruits (e.g. *Vitellaria paradoxa* -shea butter and *Balanites aegyptiaca*)
  - Edible insects (e.g. *Ruspolia differens* -grass hoppers and white ants.
- These NWFPs have potential to contribute nutrition and food security,
- However, limited scientific information limited their wide utilization commercialization.
- Honey has significant nutritional and medicinal benefits, but different sources and origin lead to variation physicochemical and nutritional properties.
- Shea butter and balanite oil are multipurpose products that have been used as food, soap making, cosmetics and traditional medicine, but there is variability in physicochemical and nutritional composition as a result of processing techniques and geographic locations.
- Edible grasshopper insect (*Ruspolia differens*) has been a part of the food culture of west Nile with essential food nutrients, but nutritional properties vary by location and polymorphs vary.

# Objective

- To assess the chemical and nutritional composition of honey, Shea butter oil , Balanites oil and edible grass hoppers from selected districts of West Nile sub region of Uganda.

# Methodology

- Processed honey, shea butter and Balanites oil were collected from small scale processors in the districts of Arua, Yumbe and Moyo
- The products for shea butter and balanite oil ( approx 0.5-1.0L) were collected based on different processing techniques e.g. traditional or artisan methods and hydraulic cold pressing.
- The fruit seeds/kernels of shea butter and balanites (3-5kg) were also collected in the different districts from different trees.
- *Ruspolia differens* grass hoppers were sampled during the swarming season in Arua town. This was also compared with that collected at the same time in Kampala/Mukono

# Sampling plan for NWFP

NWFP	Sampling decision	Sample material
Honey	Local Processor	Different processors, or farmer organization
Shea butter	Processing method	processed by traditional artisan, cold pressing, and nuts/kernels for solvent extraction
Balanite oil	Processing method	Processed by traditional artisan, cold pressing, and kernels nuts for solvent extraction
Ruspolia differens (grass hopper)	District	Grass hoppers from Arua and Mukono districts

# Laboratory analysis of NWFPs

<b>NWFP</b>	<b>Parameter (chemical/nutritional)</b>
<b>Honey</b>	moisture content, pH, total acidity, insoluble matter, total soluble sugar, fructose, glucose, total carbohydrates, energy , mineral (Zn, Fe, and Mn) and vitamin C, pesticides, pyrrolizidine alkaloids
<b>Balanite and shea butter oil</b>	colour, refractive index, acid value, free fatty acid, peroxide value, saponification value and iodine value, beta carotene, vitamin E-tocopherol and fatty acid profile
<b>Ruspolia differens (grasshoppers)</b>	appearance colours and sizes (length and breadth), weight of the insect and edible portion. Proximate composition including moisture content, total fat, protein, fibre and minerals (Na, K, Mg, Ca, Fe, Zn, Se)

## Chemical/nutritional composition of Honey from different districts/processors in west Nile districts

Parameter	Arua	Yumbe	Moyo
Moisture content (%)	18.9	17.3	15.8
pH	3.81	3.89	4.15
Titration acidity (%)	0.0040	0.0046	0.0034
Total Sugar Content (Brix)	81	81	83
Fructose (g/100g)	39.73	38.10	42.26
Glucose (g/100g)	31.67	30.04	32.69
Energy (kcal/g)	3.12	2.96	3.19
Vitamin C (mg/100g)	15.59	10.41	10.89
Iron (mg/100g)	1.066	0.962	0.608
Selenium (mg/100g)	3.123	3.015	3.045
Zinc (mg/100g)	ND	0.017	0.057

# Bioactive components in honey samples in west Nile districts

Parameter	Arua	Yumbe	Moyo
Total Phenols (mg/100g QE)	14.70	13.11	13.42
Total Flavonoids ( $\mu\text{g}/100\text{mlRE}$ )	2432.9	2117.8	1446.6
Antioxidant activity (DPPH)			



## Pyrrazolidine alkaloids (PA) and Pesticides

- No pesticides was detected in any honey samples
- For PA, there 115, 9 and 12 detected in Arua, Moyo and Yumbe, respectively

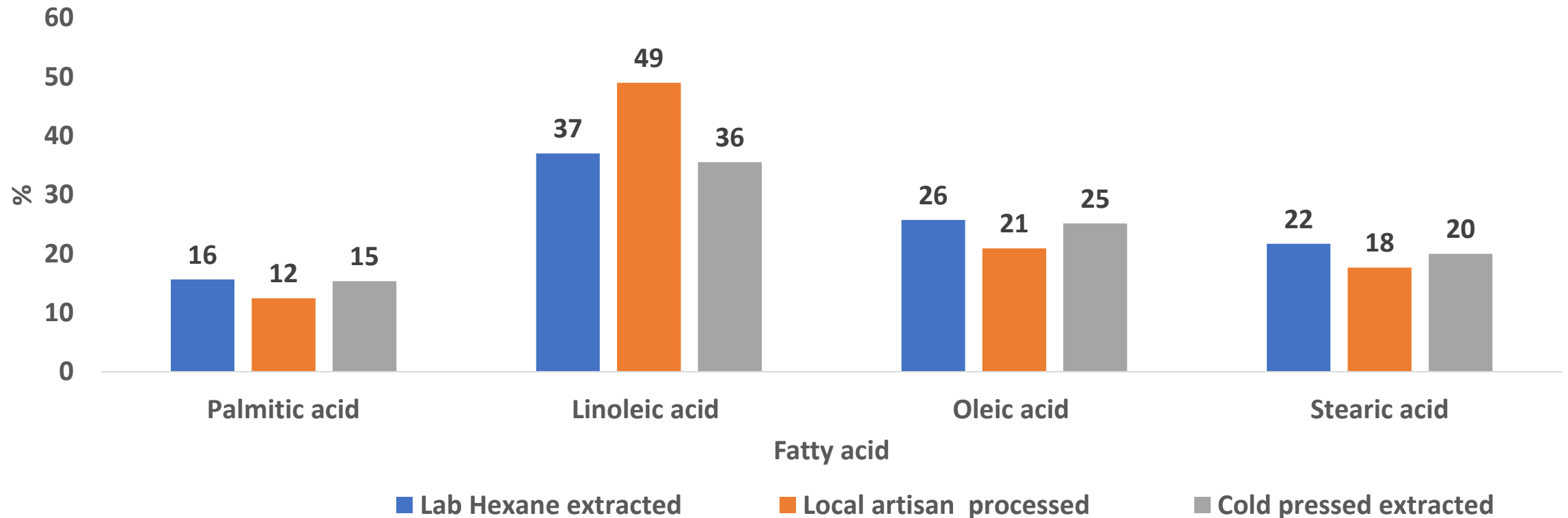
## Chemical X-tics of balanites oil processed by different techniques

Parameter	Lab Hexane extracted	Local artisan processed	Cold pressed extracted
Colour	Yellow Green	Yellow Orange	Yellow Green
Refractive index	1.457	1.471	1.471
Acid value (mg of KOH/g of oil))	1.275	8.366	2.504
Free fatty acids	0.637	4.183	1.252
Peroxide value (meq of O <sub>2</sub> /kg of oil)	6.585	7.691	10.159
Iodine value (g of I <sub>2</sub> /100 g of oil)	54.89	56.05	55.37
Saponification value (mg of KOH/g of oil)	148.50	163.86	171.23

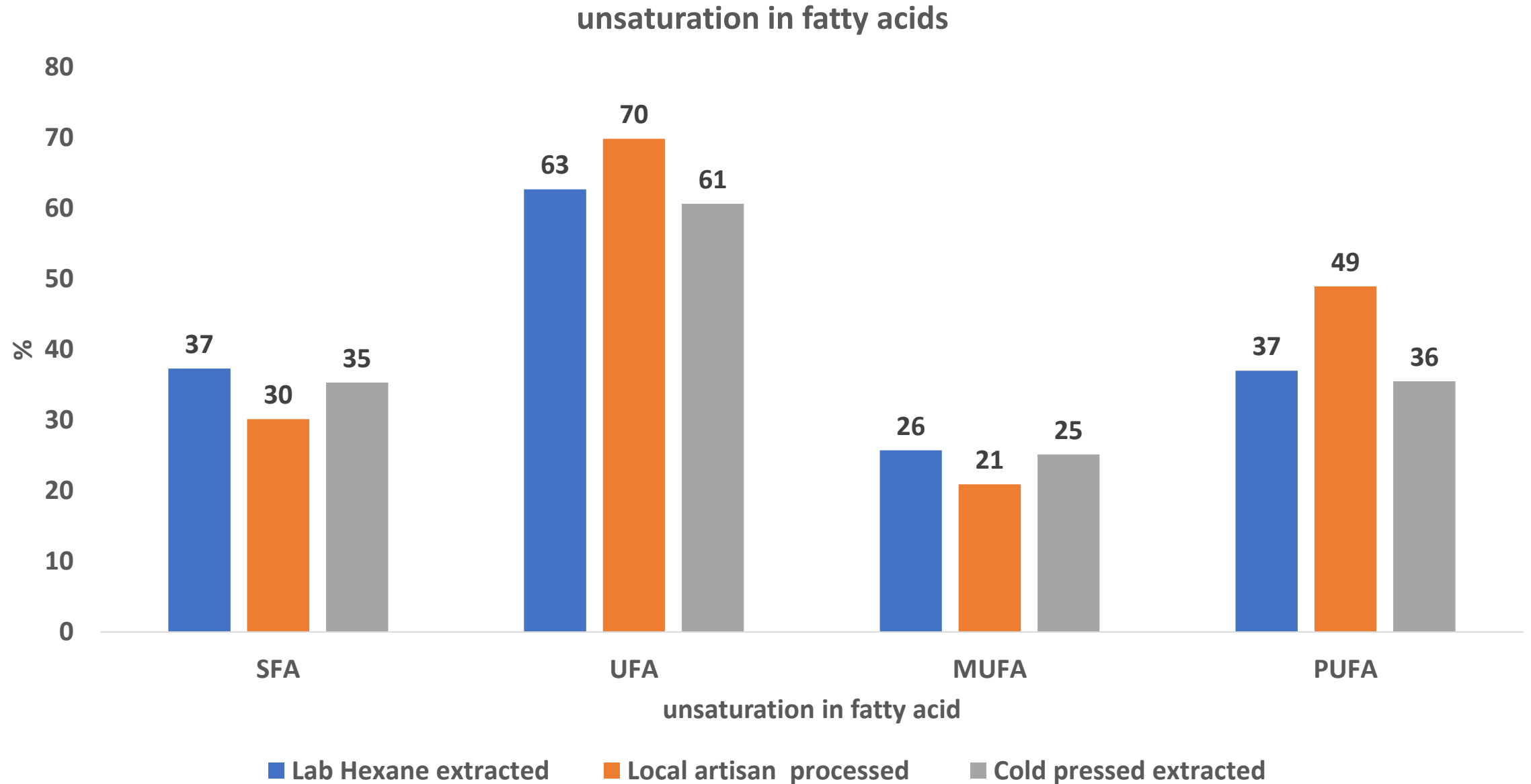
# Nutritional composition of balanite oil

Parameter	Lab Hexane extracted	Local artisan processed	Cold pressed extracted
Beta carotene (mg/100g)	0.264	0.714	0.208
Vitamin E- $\alpha$ -tocopherol (mg/100g)	0.193	0.052	0.050

fatty acids profile of balanite oil



# Unsaturation in the fatty acids in Balanite oil



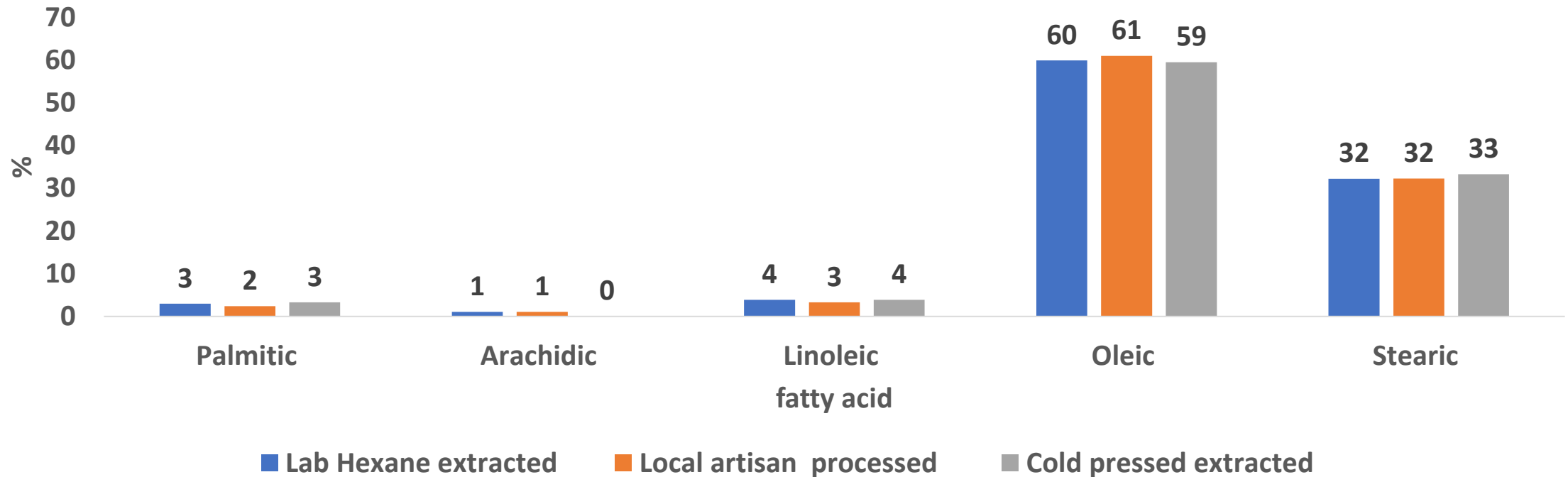
# Chemical X-tics of shea butter processed by different techniques

Parameter	Lab Hexane extracted	Local artisan processed	Cold pressed extracted
Colour	Yellow Orange	Yellow Orange	Yellow Orange
Refractive index	1.469	1.470	1.463
Acid value (mg of KOH/g of oil))	0.814	9.268	2.842
Free fatty acids	0.407	4.634	1.421
Peroxide value (meq of O <sub>2</sub> /kg of oil)	10.794	11.329	18.640
Iodine value (g of I <sub>2</sub> /100 g of oil)	45.32	46.02	51.54
Saponification value (mg of KOH/g of oil)	157.36	154.78	149.86

# Nutritional composition of shea butter

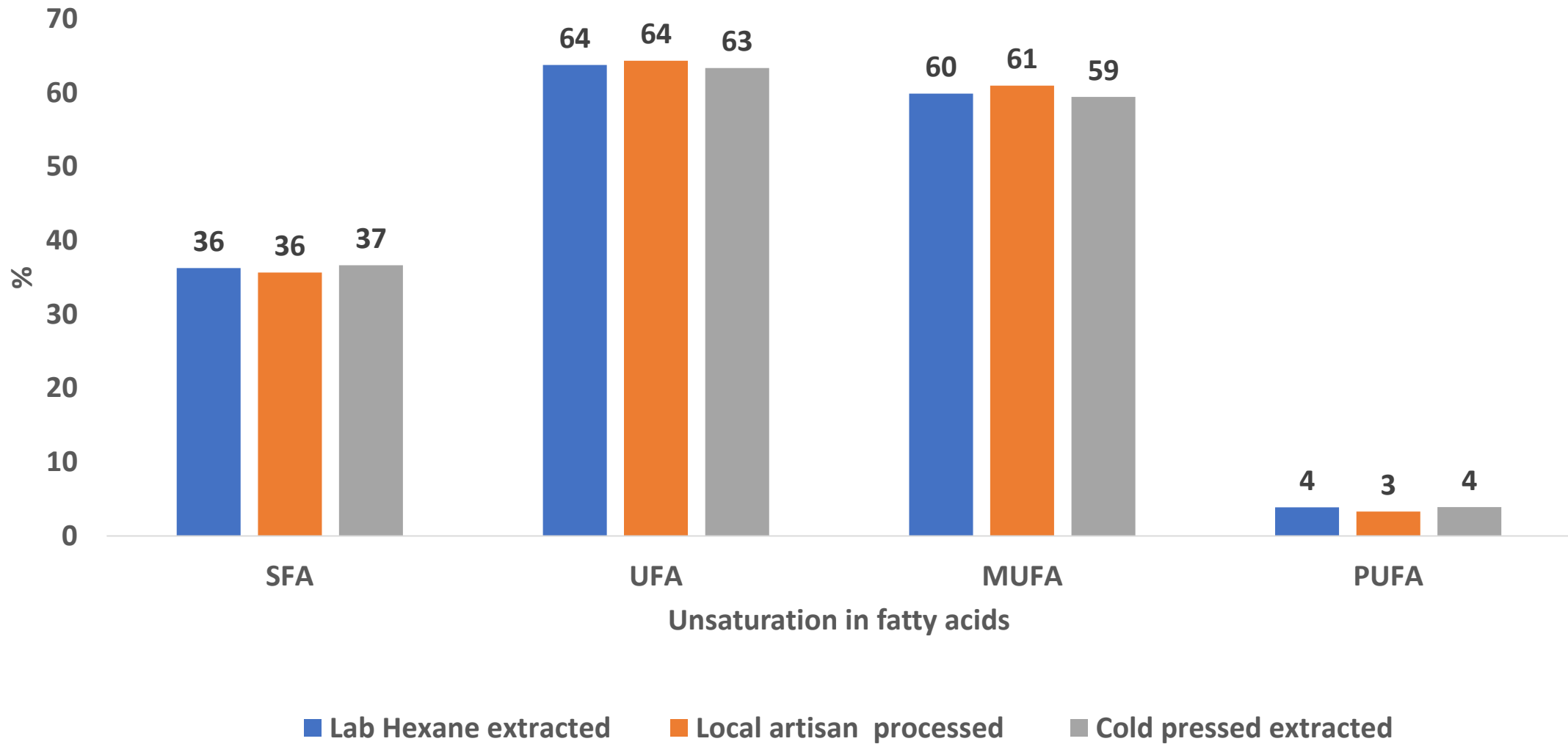
Parameter	Lab Hexane extracted	Local artisan processed	Cold pressed extracted
Beta carotene (mg/100g)	0.483	0.231	0.343
Vitamin E- $\alpha$ -tocopherol (mg/100g)	0.024	0.108	0.355

### Fatty acid profile of shea butter

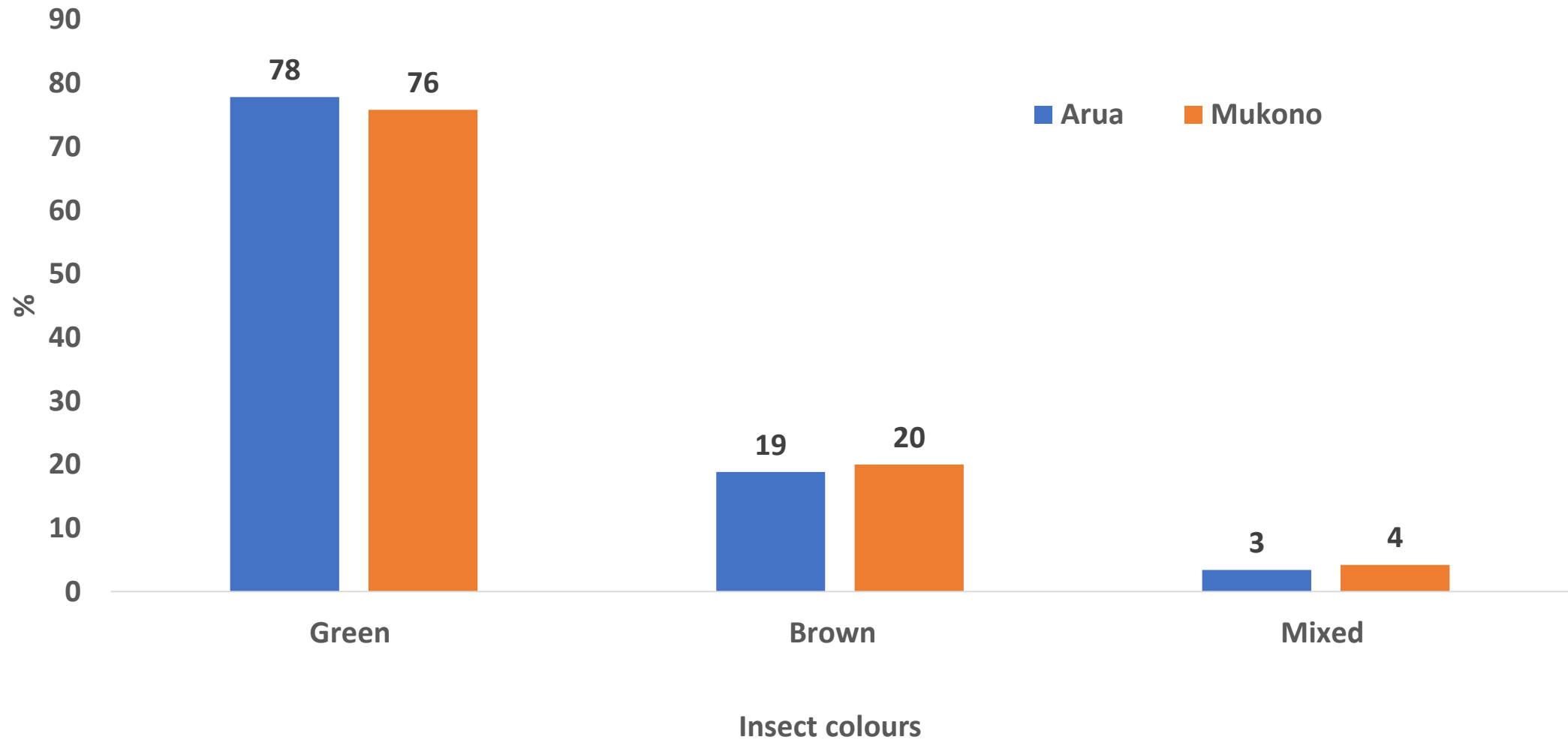


# Level of unsaturation in fatty acids in shea butter

## Unsaturation in shea butter fatty acids

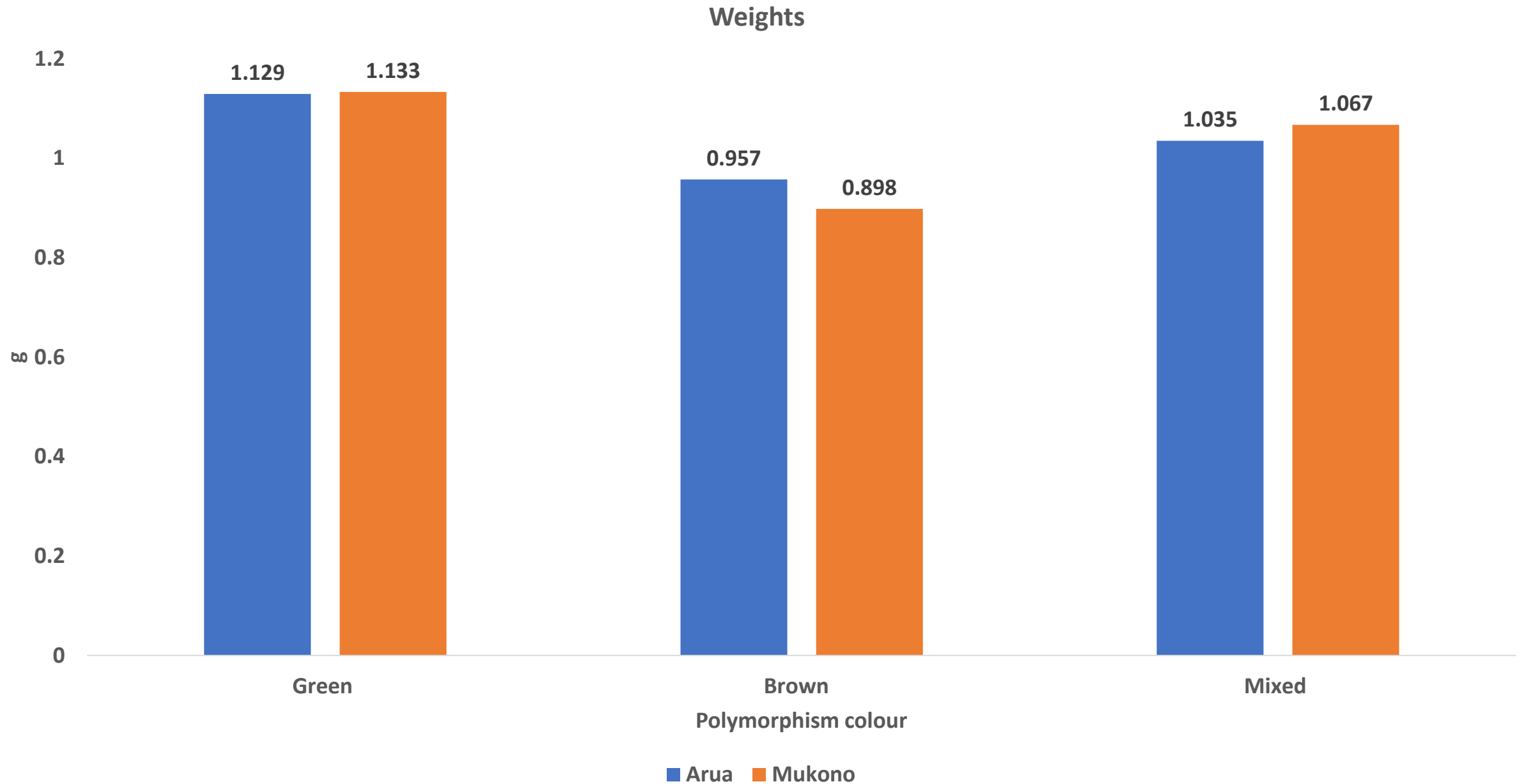


# Polymorphism of *Ruspolia differens* of Arua and Mukono districts

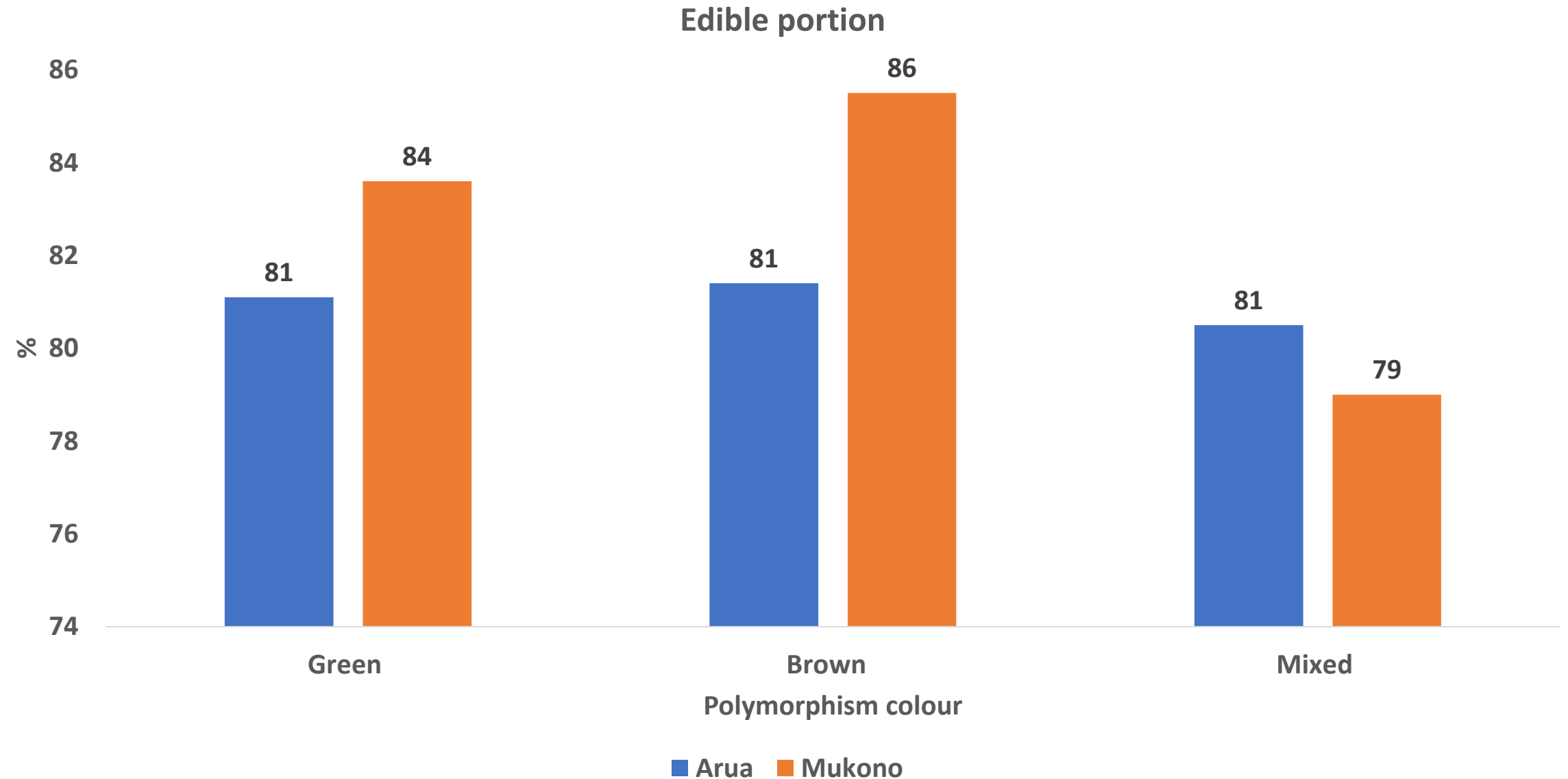




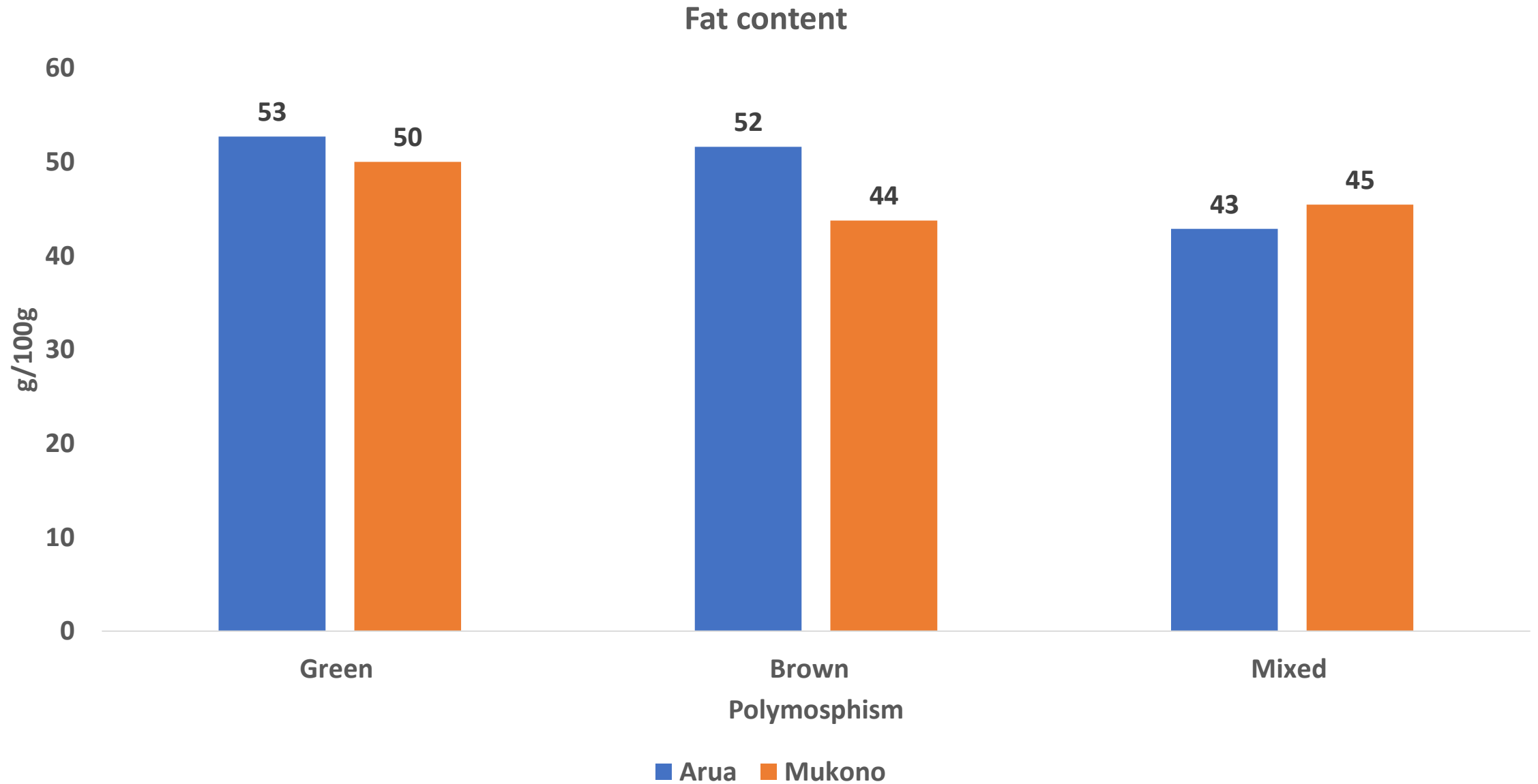
# Weights by Polymorphism of *Ruspolia differens* of Arua and Mukono districts



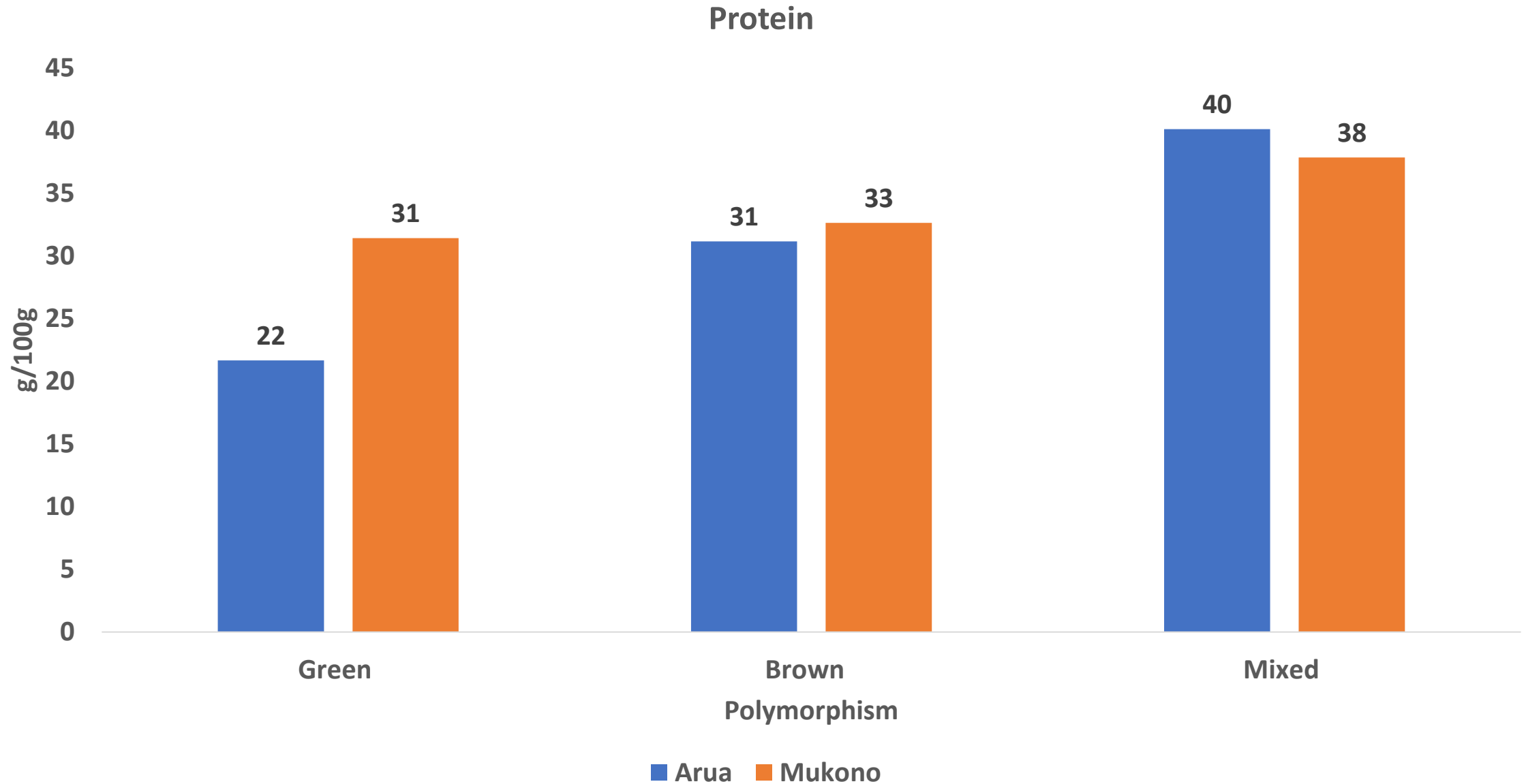
# Edible portion by Polymorphism of *Ruspolia differens* of Arua and Mukono districts



# Fat content by Polymorphism of Ruspolia differens of Arua and Mukono districts



# Protein content by Polymorphism of *Ruspolia differens* of Arua and Mukono districts



# Mineral contents by Polymorphism of *Ruspolia differens* of Arua and Mukono districts

Mineral	Arua			Mukono		
	Green colour	Brown colour	Mixed colour	Green colour	Brown colour	Mixed colour
<b>Mg</b>	<b>41.38</b>	<b>45.42</b>	<b>54.33</b>	<b>69.98</b>	<b>42.21</b>	<b>65.50</b>
<b>K</b>	<b>480.88</b>	<b>506.24</b>	<b>626.11</b>	<b>600.29</b>	<b>492.49</b>	<b>700.97</b>
<b>Ca</b>	<b>48.60</b>	<b>49.95</b>	<b>74.64</b>	<b>57.42</b>	<b>41.16</b>	<b>67.33</b>
<b>Se</b>	<b>2.49</b>	<b>3.63</b>	<b>3.58</b>	<b>4.24</b>	<b>3.37</b>	<b>4.56</b>
<b>Na</b>	<b>25.59</b>	<b>27.70</b>	<b>28.85</b>	<b>29.74</b>	<b>24.76</b>	<b>42.72</b>
<b>Fe</b>	<b>4.77</b>	<b>5.39</b>	<b>5.76</b>	<b>32.51</b>	<b>40.83</b>	<b>29.24</b>
<b>Zn</b>	<b>4.47</b>	<b>4.73</b>	<b>4.98</b>	<b>6.26</b>	<b>7.12</b>	<b>7.70</b>

# Fatty acid profile by Polymorphism of *Ruspolia differens* of Arua and Mukono districts

Fatty acid	Arua			Mukono		
	Green colour	Brown colour	Mixed colour	Green colour	Brown colour	Mixed colour
Palmitic Acid (C16:0)	0.25	0.47	0.36	0.00	0.00	0.00
Palmitoleic Acid (C16:1)	1.88	2.04	1.98	1.70	1.42	1.54
Stearic Acid (C18:0)	28.67	31.73	31.52	27.87	27.43	27.69
Linoleic Acid C18:2)	4.27	0.00	5.02	5.41	0.00	0.00
Oleic Acid (C18:1)	62.46	63.09	61.12	65.01	67.36	67.41
Arachidic Acid (C20:0)	2.48	2.67	0.00	0.00	3.79	3.36
SFA	31.39	34.87	31.88	27.87	31.23	31.05
UFA	68.61	65.13	68.12	72.13	68.77	68.95
MUFA	64.33	65.13	63.10	66.71	68.77	68.95
PUFA	4.27	0.00	5.02	5.41	0.00	0.00
Ratio P/S	0.13	0.00	0.15	0.19	0.00	0.00

# Conclusion

- Physico-chemical characteristic of honey, for balanite oil and shea butter in west Nile sub region meet national and international standard.
- Nutritionally, honey is rich in fructose and glucose, and natural antioxidant compounds with enormous health benefits.
- Balanite oil and shea butter contain vitamin A and vitamin E, and fatty acids that are essential in house hold diet.
- Similarly, *Ruspolia differens* contain essential food nutrients like fats, proteins, mineral (Fe, Zn and Se) and unsaturated fatty acid (oleic acid) that are essential in the human diet

## Recommendation

- There is need to promotion consumption of honey, shea butter, balanite oil and *R. differens* to improve the nutritional status of the population and household income.
- Shea butter and balanite oil can be promoted not only as edible oil, but as ingredients in many industrial applications like soap making, cosmetics and pharmaceutical products.