

Research Gaps on Scientific Investigation of Finger Millet (*Eleusine coracana*) Grain / Flour

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Presentation outlines

- Introduction
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Introduction

- Millets are small-seeded cereal grains belonging to the family *Poaceae* (Shobana *et al.*, 2013).
- They are staple food in Africa and Asia (Filli *et al.*, 2013).
- Millets are gluten-free cereal grains with low glycemic index (Taylor *et al.*, 2006; Apoorva *et al.*, 2010).
- They are nutritious and healthy food choice for people with celiac disease (Emmanuel *et al.*, 2013; Amadou *et al.*, 2014).

Objectives of the study

- To identify research gaps on scientific investigations of finger millet grain / flour.
- To evoke more research onto value-added finger millet products.



Foxtail millet



Pearl millet



Proso millet



Japanese millet



Teff millet



Finger millet

Figure 1. Different plant of millet species
(<http://portals.wi.wur.nl/foodnut/images/p255.gif>, 2014)

Table 1. Global production of millet in thousands per tons

Country	2010	2011	2012	2013
India	13293000	12660000	10750000	10910000
Nepal	2999523	302691	315067	305588
Nigeria	5170430	2711000	5000000	5000000
Sudan	471000	634000	378000	1090000
Uganda	267973	292000	244000	228000
South Africa	6900	7000	6500	6700
Ethiopia	634826	651851	742297	807056
Senegal	813295	480759	661673	572155
USA	261610	207500	70084	418145
Zimbabwe	50999	60000	44000	55000

Source. FAO (2013)

Finger millet grains...

- Originated in Ethiopia (Shiihii *et al.*, 2011; Wolie & Belete, 2013) and then reach India (Siwela *et al.*, 2010).
- Staple food to central African countries and India (Desai *et al.*, 2010; Karki & Kharel, 2013).
- It ranks fourth production in semi-arid regions, after sorghum, pearl millet and foxtail millet (Upadhyaya *et al.*, 2011; Mathur 2012).

Finger millet grains

- Fifty five to sixty percent of finger millet is cultivated in the Eastern, Central and Southern Africa (Apoorva *et al.*, 2010; Shukla & Srivastava, 2014).
- The world annual total production of finger millet is approximately 4.5 million tons while India produces 2.5 million and Africa about 2 million tons (Jayasinghe *et al.*, 2013).

Structure of finger millet grain

- The structures of finger millet are regarded as utricles, pericarp and seed coat as shown in Figure 2.

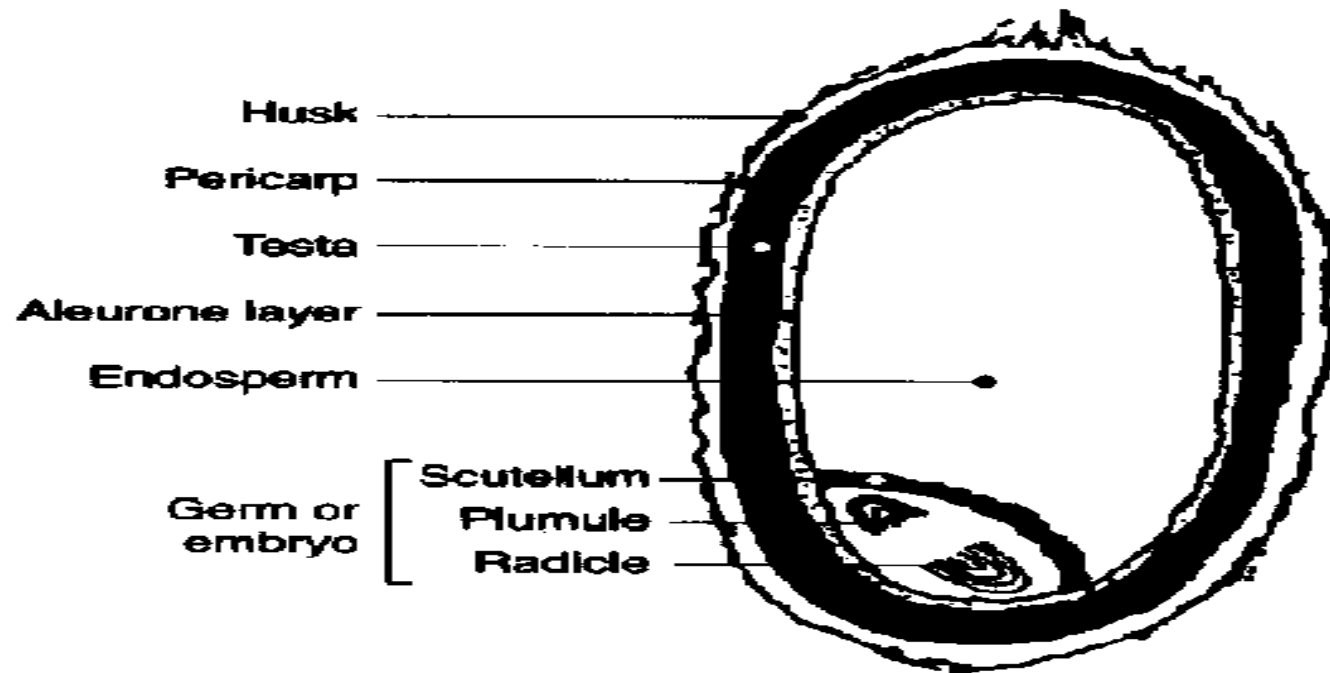


Figure 2. Structure of finger millet grain 9
(<http://portals.wi.wur.nl/foodnut/images/p255.gif>, 2014)

Finger millet grains

- The principal anatomical parts are pericarp, germ and endosperm (Wrigley & Batey, 2010).
- Colour: vary from white, brown or golden and black (Shimelis *et al.*, 2009; Mirza & Sharma, 2014).
- The predominant colour is brown and few varieties have white colour (Vadivoo *et al.*, 1998).

Table 2. Proximate compositions of millet species at 12% moisture

Cereal grains	protein	Carbohydrates	Fat	Minerals	Crude fiber
Finger millet	7.3	75	1.5	2.7	3.6
Foxtail millet	12.3	72	2.5	3.3	10
Proso millet	12.5	70	4	1.9	3.2
Kodo millet	8.3	74	1.4	2.6	10.4
Barnyard millet	6.2	49	4.5	4.4	14.7

Sources. Jideani, 2012; Talukder & Sharma, 2015; Verma & Patel, 2013

Table 3. Mineral contents of millet species (mg/100 g)

Cereal grain	Calcium	Phosphorus	Magnesium	Manganese	Zinc
Finger millet	350	250	140	1.9	1,5
Foxtail millet	31	290	81	0.60	2.4
Pearl millet	42	296	137	1.15	3.1
Kodo millet	37	188	228	1.10 - 3.3	0.7
Barnyard millet	22	280	82	0.96	3.0

Sources. Siwela, 2009; Saleh *et al.*, 2013; Shahidi *et al.*, 2013; Shobana *et al.*, 2013

Phytochemical properties of finger millet

- Polyphenols consist of phytic acid, tannins and flavonoids.
- They reduce bioavailability of minerals, resulting in reducing the nutritional quality of finger millet (Shankar *et al.*, 2013).
- They are associated with lower risk of diabetes and cardiovascular diseases (Okoyomoh *et al.*, 2013).
- Finger millet contain high amount of tannins ranging from 0.04 to 74%.
- Dark brown finger millet grain have higher phenols and tannins levels than white varieties (Dykes & Rooney, 2006).

Table 4. Global uses of finger millet

Uses	Countries	References
<i>Isidudu</i> (unfermented thin porridge that gels when it cool), <i>Imbila</i> (fermented thin porridge), instant food, formulated dog food and <i>mahewu</i>	South Africa	Dendy,1995; Wrigley & Batey, 2010; Adhikari, 2012; Nyanzi & Jooste, 2012
Breakfast cereals, gluten-free baked products lager beer and stout	USA	Wrigley & Batey, 2010
Extruded products, fermented food, weaning food, bakery products and <i>ragi</i> soup	India	Verna & Patel, 2013
Porridge, production of alcoholic and non-alcoholic drinks	Nigeria	Saleh <i>et al.</i> , 2013
Fermented porridge and instant foods	Kenya	Karki & Kharel, 2013
Small quantity of finger millet also used for commercial brewing and opaque beer	Zimbabwe	Léder, 2004
Light and thick porridge, beer called <i>pito</i>	Ghana	Nyanzi & Jooste, 2012



Finger millet flour



Ragi cookies



Finger millet *roti*



Ragi-puttu

Figure 3. Finger millet (<http://portals.wi.wur.nl/foodnut/images/p255.gif>, 2014)

Potential health benefits of finger millet

- High content of polyphenols and dietary fibre exhibits anti-diabetic, antioxidant against tumor.
- Consumption of finger millet reduce the risk of diabetes and gastrointestinal tract.
- Finger millet contains essential amino acids methionine and threonine which helps to lowering high cholesterol levels (Mathanghi & Sudha, 2012; Thapliyal & Singh, 2015).

Previous studies

- Most of the research have been conducted traditionally on finger millet grain / flour in developing countries.
- Grain has been processed by soaking, milling, cooking, germination, fermentation and popping in the rural areas (Ranase *et al.*, 2015).

Research gaps

- New processing and preparation methods are needed to enhance the bioavailability of micronutrients and improve the quality of the millet diets in human.
- Commercialisation of finger millet food products that may be consumed by people suffering with celiac disease and diabetes is important.
- This study is conducted in order to commercialise, encourage and increase the consumption of fortified finger millet in urban areas .

Future studies

- Future research on finger millet need to be conducted by food scientists, government agencies, non-governmental organization, research institutions, private sectors and universities.
- This will help to generate more available information around the globe.
- The availability of commercialised fortified finger millet products in the developed countries will also help people who are suffering from celiac disease and obesity.

Conclusion and recommendation

- Finger millet is neglected and underutilized crops even though it is a gluten-free grains with nutritional and nutraceutical advantages.
- It is a food grain that is contributing to food security for people especially in developing economy.
- Little information is available in terms of research and innovation as compared to economic development of major cereals: maize, wheat and rice.
- Therefore, there is need for commercialization the development of more value-added and fortified gluten-free products.

Selected references

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Thank you

Ndi a livhuwa

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Kea leboha

Ngia thokhoza