

Sorghum *Ugali*

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Summary

Ugali (Kiswahili language) is a thick porridge popular in Eastern and Southern Africa and is prepared using flour from whole or dehulled grains. Traditional methods of ugali preparation and consumption are described. Ugali quality characteristics of 61 sorghum cultivars, including those of the International Sorghum Food Quality Trials, were evaluated by taste panels. It was observed that a light colored ugali with least tackiness was the most desirable. In general, cultivars with corneous grains and high breaking strength produced ugali with the most desirable texture and keeping quality.

Sorghum and millets are the traditional staple cereals in most countries of Eastern and Southern Africa and used to be the only cereals grown until the introduction of maize about 50 years ago. Maize is now extensively grown in the whole region especially in fertile and high rainfall areas. Sorghum and millets are, however, still the favored traditional cereals and are especially important in areas with relatively poor soils, and low and unreliable rainfall. All these cereals are similarly consumed in a variety of ways but the most important and widespread method of consumption as food is in the form of flour that is mixed with hot water and cooked into a stiff paste or thick porridge. An equally large percentage of sorghum and millets are used in the preparation of a wide range of traditional alcoholic and nonalcoholic beverages.

The cooked stiff porridge that is prepared from all the cereals is commonly known as *ugali* (Kiswahili language) in Kenya, Uganda, and Tanzania; *sof* or *mafo* in Somalia; *nsima* in Malawi and Zambia and *sadza* in Zimbabwe. It is also called by several other different names in tribal dialects throughout the entire region. For convenience and ease of presentation, we will refer to all the cooked stiff porridges (neutral pH) prepared from sorghum as *ugali*.

Today most *ugali* is made from maize, but sorghum *ugali* still enjoys considerable importance and popularity among the rural poor for whom it is an important dish. In this paper, we will attempt to describe some of the traditional methods of grain processing and *ugali* preparation noting significant variations if any in some countries of eastern and southern Africa. We will also present the results of taste panel evaluations carried out at ICRISAT Center on *ugali* prepared from several different sorghum cultivars and discuss their quality variations.

Grain Types Used

A wide range of sorghum grain types are used in the preparation of *ugali*. However, the white-seeded and highly corneous grains where available are preferred by most people in several countries. In Uganda, Rwanda, and parts of Western Tanzania, the brown-seeded high tannin sorghum grain types are most common and are used for *ugali* preparation as well as for brewing traditional beers. In Zimbabwe, all the brown-seeded grains with testa are used for brewing while the white or red-seeded types without testa are preferred for *ugali*.

Grain Processing

Traditional methods of sorghum grain processing are similar and are largely dependent on the grain

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types used for *ugali*. Sorghum grain processing is generally carried out by women. The white or red-seeded and highly corneous grains without testa are usually dehulled to remove the pericarp before they are ground into flour. Traditional sorghum grain dehulling generally involves pounding the soaked or damp grain in a wooden mortar with a pestle and winnowing to separate the dehulled grain from bran. The highly corneous grains are preferred because they are much easier to dehull and give higher recovery rates of dehulled grain. In Malawi, the grain is soaked in water for 1-2 hr before pounding it lightly to remove the pericarp. In Tanzania, a little water is added to the grain in the mortar and then pounded vigorously, followed by winnowing. This process is repeated until the pericarp is completely removed. The white-seeded grains with a floury endosperm as well as the brown-seeded high tannin types, which also have a soft endosperm, are not dehulled. However they are usually lightly pounded dry and winnowed before grinding into flour.

The traditional dehulling is hard work and consumes much time for the housewives thus restricting the amount of grain that can be processed and utilized. As far as we know, no suitable mechanical dehullers are available in these countries that could be used to process sorghum to produce dehulled grains of similar quality as the traditionally dehulled grain.

The dehulled or whole grain is then finely ground into flour on traditional grinding stones. The grinding stones consist of a small flat stone on a larger rectangular stone. The grain must be clean and sufficiently dry to produce flour of high quality. Grinding is always carried out by experienced women who try to produce finely milled flour. Small-scale mechanical grinders have been introduced in some areas, usually for maize, and these are becoming popular for sorghum as well. For many people in rural areas where mechanical grinders are not available or who cannot afford the prices charged for grinding, traditional grinding on stones is still the practice.

In Zimbabwe, the dehulled damp grain is sometimes roasted in a clay pot to dry before grinding it into flour. This is believed to improve the flavor of the *ugali* produced. In Tanzania, the dehulled grain is sometimes soaked in water for 1-2 days after which it is dried and ground into flour. This improves the whiteness of the flour. In the northern and eastern parts of Uganda, western Tanzania, and Kenya, the brown-seeded grains are

mixed with a little dry cassava, finger millet or maize and the mixture is ground into flour.

***Ugali* Preparation**

The traditional preparation methods for *ugali* in most countries are basically similar. A clay pot is used to boil an estimated amount of water, depending on the size of the family and the amount of flour available. When the water starts boiling, a little flour is sprinkled on the surface of the water and heating is continued. As soon as the water begins boiling again, most of the flour is poured into the pot and allowed to cook for about 2 min. After this one-fourth to one-half of the hot slurry is removed and kept in a separate container. The remaining boiling water and flour in the pot are vigorously mixed with a wooden stick, which has a cylindrical handle and a flat end. Additional slurry or flour is added as required until *ugali* with the right consistency is obtained. Then the *ugali* in the pot is allowed to continue cooking on a reduced fire for an additional 4-5 min. The *ugali* is removed from the pot into baskets made for this purpose, as *ugali* kept on plates becomes watery after some time. The whole process of *ugali* preparation might take up to 20 min.

In northern Uganda, tamarind water or mango or lemon juice is added to boiling water to improve the taste and flavor of *ugali*. In Kenya, lemon juice or milk may be added to boiling water. *Ugali* is usually served with beans or peas, vegetable soup, meat or fish stew, etc.

To prepare a high quality *ugali*, the flour used should be ground from clean grain free of mold and weevil damage.

A good *ugali* should not contain any lumps. When eating *ugali* one should be able to take pieces of it with the fingers without the *ugali* sticking to the fingers or teeth while eating. After *ugali* has cooled, a thin crust forms on the surface, but the *ugali* inside should be soft but not sticky and should be able to keep in a similar condition for up to 24 hr.

***Ugali* Quality Differences**

At ICRIASAT, sorghum *ugali* preparation methods were standardized with the help of trainees from Kenya familiar with sorghum *ugali* (Murty and House 1980). Whole grain samples of sorghum were ground to a moderately coarse flour using a

carborundum stone grinder (Milcent-Size D2) powered by 0.5 hp motor. Flour samples were sieved with a U.S. standard 35 mesh sieve and the throughs were used for *ugali* preparation.

Four hundred and fifty ml of tap water were heated on an electric hot plate. As soon as the water started boiling, flour was added in increments coupled with vigorous stirring with a wooden laddle. Further quantities of flour were added as required until a thick well cooked paste was formed devoid of any lumps. The *ugali* was then removed from the heater and allowed to cool. The whole process took 10-12 min. The amount of flour required to produce *ugali* with the desired consistency and texture was recorded.

Twenty-nine standard sorghum cultivars were evaluated for their *ugali* quality in 1978 and 1979. *Ugali* for each variety was prepared following the standard preparation methods described above. The *ugali* was scored by trainees from Kenya for the most important quality characteristics, i.e., color, taste, texture, and keeping quality on a scale of 1 to 5 where 1 represented good and 5 poor quality. Five trainees in 1978 and six different trainees in 1979 were used to score all the *ugali* prepared from the same seed lots of the 29 cultivars. The sorghum grain of 25 cultivars was white, pale yellow, or cream color while the grains of the remaining four cultivars had a red pericarp without a testa.

The amount of flour added to 450 ml of water to make *ugali* varied from 200 to 300 g among the sorghum cultivars. The endosperm texture score and breaking strength (kg) of grain samples from the 29 cultivars together with their *ugali* quality characteristics are presented in Table 1. The *ugali* quality scores of the sorghum cultivars varied considerably from variety to variety even though 80% of them were white. The average scores obtained in 1978 generally agreed with those obtained in 1979. The results indicated that light colored *ugali* without tackiness was the most desirable. Light yellow colored and slightly sweet *ugali* was often compared to maize *ugali*. The cultivars E35-1, M35-1, IS-5341, IS-6928, and CSH-5 obtained the best scores. It is interesting to note that IS-1475 obtained desirable scores despite having a red pericarp. In general, cultivars with corneous grains and high breaking strength produced *ugali* with the most desirable texture and keeping quality.

Grain samples of an additional 11 cultivars of the International Sorghum Food Quality Trials

(ISFQT) 1979, and 21 cultivars obtained from Mr. Pinto, sorghum breeder, Kenya were evaluated for their *ugali* qualities in 1979 and 1980 (Tables 2 and 3). Cultivars E35-1, Swarna, and M35-1 from the ISFQT and four cultivars from Kenya; 2219A x Lulu-D, 2KX17 B 1, Serena-1-2W, and 2KX17 6 produced the best *ugali* products. Cultivars with a red pericarp and testa obtained poor scores for *ugali* color. Cultivars 2KX17 B 1 and Lulu-D needed the least amount of flour (163 and 169 g, respectively) for the standard preparation.

References

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Table 1. Variation for *ugali* quality as assessed by two different groups of taste panels in the years 1978 and 1979.^a

Genotype	Grain ^c		Color appeal ^b			Taste ^b			Texture ^b			Keeping quality ^b		
	Endo-sperm texture	Breaking strength (kg)	1978	1979	Mean	1978	1979	Mean	1978	1979	Mean	1978	1979	Mean
CSH-5	2	9.5	1.6	2.1	1.8	1.6	1.7	1.6	1.5	1.9	1.7	1.4	2.2	1.8
E35-1	1	13.2	1.2	1.7	1.5	1.3	2.2	1.8	1.1	1.8	1.5	1.4	2.5	1.9
Swarna	3	10.6	3.6	2.9	3.2	3.2	3.0	3.1	2.5	2.2	2.4	2.6	2.4	2.5
IS-2550	2	8.8	1.7	2.2	2.0	2.1	2.3	2.2	2.7	1.9	2.3	4.4	2.9	3.4
IS-1475	3	7.5	2.0	3.2	2.6	2.5	2.6	2.5	1.2	1.9	1.6	1.5	2.4	2.0
IS-5341	1	10.2	1.2	1.7	1.5	1.5	2.0	1.8	1.3	2.0	1.6	2.0	2.7	2.4
IS-1457	3	7.4	3.3	2.9	3.1	2.2	2.5	2.3	1.6	2.1	1.8	2.0	2.5	2.2
IS-1070	3	7.0	3.1	2.7	2.9	2.7	1.5	2.1	2.2	1.7	1.9	2.4	2.6	2.5
IS-11025	2	8.4	1.2	2.3	1.7	1.7	2.6	2.2	1.7	2.3	2.0	2.2	2.0	2.1
M35-1	3	8.6	1.1	1.5	1.3	1.2	2.0	1.6	1.2	2.0	1.6	1.3	2.0	1.6
SC-423	2	8.0	2.2	2.3	2.3	2.2	2.8	2.5	2.0	2.8	2.4	1.0	3.0	2.2
2219B	2	8.7	1.4	2.1	1.7	1.7	1.8	1.8	1.6	1.8	1.7	2.0	2.2	2.1
8272-1	3	8.9	1.8	1.9	1.9	2.0	2.2	2.1	2.0	2.2	2.1	1.9	2.5	2.2
SC-108-3	2	10.0	2.8	2.6	2.7	2.1	2.3	2.2	2.0	2.3	2.2	3.1	2.8	2.4
UChV ₂	2	10.0	2.1	2.6	2.4	2.5	2.5	2.4	1.8	2.5	2.2	1.5	2.2	1.8
Vidisha-60-1	3	7.3	2.8	3.3	3.0	2.8	2.5	2.7	2.3	2.1	2.2	2.4	1.8	2.1
Improved Saoner	3	8.1	2.7	2.7	2.7	2.2	2.7	2.4	1.8	2.5	2.2	2.4	1.8	2.1
IS-1122	3	6.7	4.7	3.7	4.2	2.9	2.2	2.5	2.9	2.0	2.4	3.5	2.5	3.0
IS-9530	3	10.0	3.9	3.2	3.5	2.3	2.7	2.5	2.7	2.2	2.4	2.6	2.6	2.6
IS-6928	2	11.0	1.2	1.7	1.5	1.2	2.8	2.0	1.2	1.9	1.6	1.0	2.8	1.9
E187	3	9.6	1.9	2.9	2.4	3.0	2.3	2.6	2.6	2.3	2.5	2.4	2.3	2.4
BG-137	3	10.2	3.7	3.5	3.6	2.5	2.6	2.5	2.7	2.6	3.0	3.0	3.0	3.0
SC-110-14	3	9.4	2.1	2.9	2.5	2.0	3.3	2.6	2.0	2.8	2.4	2.7	3.2	2.9
IS-4582	3	8.5	2.7	2.5	2.6	2.7	2.7	2.7	2.1	2.2	2.2	2.0	2.5	2.2
IS-4242	3	9.6	2.8	2.7	2.8	1.7	2.4	2.0	1.8	2.3	2.1	1.0	2.2	1.6
E6954	2	11.0	1.8	2.1	2.0	1.8	2.4	2.1	1.7	2.1	1.9	1.5	2.2	1.9
SPV-101	3	10.5	2.3	2.7	2.4	2.3	2.4	2.4	1.9	2.4	2.1	2.0	2.3	2.1
TAM-428	3	8.2	2.4	2.3	2.4	2.1	2.6	2.3	1.8	2.0	1.9	1.6	2.4	2.0
BP-53	3	8.1	3.0	3.0	3.0	3.1	2.3	2.7	2.2	2.1	2.1	2.0	2.4	2.2

a. The panelists were Kenyans and each panel consisted of 5 to 6 members. Values represent averages of the independent scores of the panelists.

b. Color appeal, taste, texture and keeping quality of the *ugali* product were scored by each panelist independently on a scale of 1 to 5 where 1 = the best and 5 = very poor.

c. Endosperm texture was scored by examining 10 grains and noting the approximate amount of corneous endosperm. 1 = 80-100% corneousness, 2 = 60-80% corneousness, and 3 = 40-60% corneousness. Breaking strength of 10 grains was independently noted on a Kiya Grain Hardness Tester.

Table 2. *Ugali* quality characters of sorghum cultivars from the ISFQT.^a

Genotype	Color of grain	Color ^b appeal	Taste ^b	Texture ^b	Keeping quality ^b
CSH-5	White	2.0	2.4	2.1	2.5
M50009	White	2.3	2.9	2.5	2.4
M50013	White	2.2	2.9	2.2	2.8
M50297	White	2.2	2.3	2.0	2.8
CO4	Red	3.2	2.4	2.6	2.5
E35-1	White	2.0	1.9	2.0	2.8
WS-1297	Red with testa	4.0	3.1	3.5	3.8
Swarna	White	2.2	2.1	2.1	1.9
IS-7035	Red with testa	4.0	3.0	2.9	2.4
CS-3541	White	2.3	2.7	2.3	2.3
Segaolane	White	2.4	2.5	1.8	2.6

a. The panelists were Kenyans and each panel consisted of 5 to 6 members. Values represent averages of the independent scores of the panelists.

b. Color appeal, taste, texture, keeping quality of the *ugali* product were scored by each panelist independently on a scale of 1 to 5, where 1 = the best.

Table 3. Grain and Ugali quality properties of sorghum varieties from Kenya.

Genotype	Grain					Ugali				
	Color	Endosperm ^a texture	100 grain wt (gm)	Breaking ^a strength (kg)	Flour quantity (g)	Color appeal ^a	Cooking quality ^b	Taste ^a	Texture ^a	Keeping quality ^a
CK 60AxSB65	Strong brown	4	2.44	5.1	205	4.4	1	3.4	3.1	3.0
8M51AxLulu-1	White	3	2.42	5.2	202	1.8	1	2.6	2.4	2.6
ISI0406xLulu-D	White	3	2.55	6.1	212	1.2	1	1.1	2.0	3.4
2219AxLulu-D	Pale yellow	3	2.47	6.0	208	1.3	1	1.6	1.6	2.5
5D × 135/13/1/3/1	Reddish yellow	4	2.37	6.2	175	3.2	2	3.6	3.5	2.6
Katimum AxSB65	Reddish brown	3	2.32	4.8	204	3.3	2	2.9	3.0	3.4
KAFAxSB65										
KX17/3/1	Pale yellow	2	2.39	8.0	163	2.4	1	2.0	2.3	2.6
2KX71/3	Pale yellow	3	2.84	7.9	176	2.6	1	2.5	3.0	3.0
2KX76/752	Very pale brown	2	2.17	7.2	184	3.3	1	2.7	2.9	2.7
2KX76/325	White	2	2.51	6.5	177	3.2	1	3.1	2.8	3.3
Tx430	Brown yellow	3	2.74	6.1	192	4.6	2	4.0	3.4	3.4
10x5.41/1	White	3	2.33	5.9	179	1.5	1	4.4	1.8	2.8
SERENA-12-W	White	2	2.53	7.3	194	1.7	1	1.7	2.3	2.4
Makueni Local	Pink	5	2.06	5.1	191	3.2	2	3.2	2.8	2.6
2KX17/5	White	2	2.60	8.3	170	2.6	1	2.3	2.2	2.6
2KX17	White	2	2.83	9.1	196	1.9	1	2.3	2.4	2.4
2KX17/6	Pale yellow	3	2.55	9.1	196	1.9	1	2.4	2.6	1.8
Mukenba Local	Light brownish	3	3.09	10.2	176	4.2	2	2.9	3.0	2.5
Lulu-D	White	3	2.30	6.2	169	1.6	1	2.3	2.3	2.4
SERENA	Reddish yellow	2	1.92	6.8	201	4.1	2	3.3	2.9	2.6
E525HR	Reddish yellow	5	2.14	5.6	183	4.5	2	3.4	2.9	3.3

a. See footnote in Table 1 for methods.

b. Cooking quality was subjectively evaluated by skilled women on a scale of 1 to 3, where 1 = good.