

Full Length Research Paper

Economic assessment of malt and traditional beer (*dolo*) production in Burkina Faso

S. PALE^{1*}, D. P. KABORE¹, S. J. B. TAONDA¹, B. BOUGOUMA² and S. C. MASON³

¹Intitut de l'Environnement et de Recherches Agricoles, 04 BP 8645 Ouagadougou 04, Burkina Faso.

²Institut de Recherches en Sciences Appliquées et Technologies, 03 BP 7047 Ouagadougou 03, Burkina Faso.

³University of Nebraska-Lincoln, Department of Agronomy and Horticulture, 279 Plant Science, P. O. Box 830915, Lincoln, NE 68583-0915, USA.

Accepted 14 November, 2011

Costs and profits in malt processing, *dolo* brewing and retail sales and ways to improve the *dolo* supply chain were surveyed in six cities in Burkina Faso, through questionnaires administered to malt processors, *dolo* processors, retailers and consumers. The highest costs were reported for *dolo* processing and the lowest profits for *dolo* retail sales. Large malt and *dolo* processors and *dolo* retailers had higher costs which were compensated for by greater profits than for medium and small processors/retailers. Comparisons of profits per unit cost indicated that malt processing in medium category, *dolo* processing in small category and *dolo* retail sales in large category often generate more profit per unit cost. The profit made by each member of the supply chain was higher than the Inter-professional minimum guaranteed salary (IMGS) in Burkina Faso. It appeared in this study that the improvement of the *dolo* supply chain would require that (1) credit be available and accessible for farmers to produce quality sorghum grain and women processors to purchase equipment needed for malt and *dolo* processing, conservation and distribution, and (2) malt and *dolo* production and marketing systems to the benefit of all members of the supply chain be organized through improvement of the partnership between members, increase profit of all supply chain members and training to improve all supply chain members production skills.

Key words: Costs, *dolo*, malt, processors, retailers, profits.

INTRODUCTION

Grain sorghum [*Sorghum bicolor* (L.) Moench] originated in Africa and India, and has historically been one of the five major world cereal crops [along with rice (*Oryza sativa* L.), maize (*Zea mays* L.), wheat (*Triticum aestivum* L.) and pearl millet (*Pennisetum glaucum* (L.) R. Br.)] used as human food. Grain sorghum constitutes, along with pearl millet, the staple cereal of millions of people living in the very hot, drought-prone tropical regions of West Africa and India (Maunder, 2002). In addition to the use as food, grain sorghum is used as livestock (swine, poultry and cattle) feed in the western hemisphere (Bramel-Cox et al., 1995). Grain sorghum is the major cereal crop used to produce the traditional beer,

commonly called *dolo* in Burkina Faso and in many countries in West Africa.

Dolo is obtained by brewing starch from grain sorghum, millet and maize, and is commonly filtered but still cloudy. It has a combination of sweet and sour taste, fruity aroma, and contains 1 to 5% v/v alcohol (Demuyakor and Ohta, 1993; Murty and Kumar, 1995). In Burkina Faso, the traditional preparation of *dolo* involves malting of red sorghum grain followed by crushing, mashing-in, cooking, lactic fermentation, filtration, boiling and alcoholic fermentation of the wort. *Dolo* should be consumed within one day following the alcoholic fermentation to avoid losses. Malting in *dolo* production involves steeping of grain, germination of the grain for several days in high humidity air (90 to 95% relative humidity) under controlled conditions and drying of the malt produced to obtain the required diastatic power for brewing (Beta et al., 1995;

*Corresponding author. E-mail: siebout.pale@yahoo.fr.

Taylor and Dewar, 2000).

Previous studies indicated that the majority of red sorghum grain is sold in the capital (Ouagadougou) or exported to neighboring countries in the form of malt. An important part of the grain is transformed into traditional beer (*dolo*) for local consumption. Malt and *dolo* production is primarily a female enterprise and their economic well being and reputation is greatly influenced by the quality of the beer they produce (Murty and Kumar, 1995; Saul, 1981). This generates significant profits, particularly for large-scale processors, thus, benefiting females, an under-represented segment of the society in Burkina Faso. Unfortunately, an economic assessment of the traditional beer production that would result in a better understanding of key problems that need to be solved in order to improve the *dolo* supply chain and thus increase the economic potential of grain sorghum in Burkina Faso and neighboring countries remains an issue. Murty and Kumar (1995) indicated that a commercialized traditional product has a greater chance of being popular and culturally acceptable than an exotic or novel product.

The successful growth of *dolo* brewing depends on the presence of adequate infrastructure, skilled personnel, consistent quality of raw materials (clean, mature sorghum grain with low moisture content free of breakage and stress cracks, and insect damage), development of efficient brewing processes (Novellie and Taylor, 1993) and economic profitability. Most breeding programs conducted in Africa tend to focus on grain yield, not on grain quality for specific end uses and economic profitability. Many studies have been carried out to improve sorghum grain-based food performance based on agronomic characteristics, mainly high yield and tolerance to drought and pests (Badu-Apraku et al., 1995). The utilization of sorghum in beer brewing (EtokAkpan and Palmer, 1990; Ogbonna et al., 2003), malting and malt quality (Subramanian et al., 1992; Beta et al., 1995; Hagir et al., 1999; Taylor and Dewar, 2000) as well as mashing features (Taylor and Boxd, 1986; Aisien and Muts, 1987; Palmer, 1989), and criteria for assessing *dolo* quality and parameters affecting quality (Kayode et al., 2005; Palé et al., 2010) have been studied. To date, research to assess the economic profitability of *dolo* production and to determine ways to improve the *dolo* supply chain has not been documented in Burkina Faso. The objective of this study was to assess the cost and benefit of malt and *dolo* production, and *dolo* retail sales. Results will help design programs to improve the *dolo* supply chain.

MATERIALS AND METHODS

The survey questionnaires used in the study were prepared by the senior author with assistance of survey professionals at the Institute of Environment and Agricultural Research (INERA) and the Department of Food Technology at the Institute of Applied Sciences

and Technology Research (DTA/IRSAT). Questionnaires were approved by the two institutions and the participating authors. The survey was conducted using these questionnaires, from December, 2006 through January, 2007, in six cities in the Central Plateau of Burkina Faso: Ouagadougou (capital of Burkina Faso), Manga, Pouytenga, Mogtêdo, Pabré and Kamboinsé (Figure 1).

These cities were chosen for the survey since they are located in major red sorghum production zones where malt and *dolo* production and consumption is widespread. Two hundred and thirty four (234) randomly chosen individuals including 40 malt processors, 64 *dolo* processors, 30 retailers and 100 consumers participated in the survey. Unfortunately, some of the economic data were unusable, thus reducing the number of malt processors to 37 and *dolo* processors to 32. The survey indicated that all the malt processors, *dolo* processors and retailers were female, while the consumers were either male or female; supporting the widely recognized fact that *dolo* commercial activity is primarily practiced by women in Burkina Faso (Murty and Kumar, 1995). The questionnaires included questions addressing the following issues:

1. Production and distribution costs, sales and profit in malt and *dolo* production, and retail sales;
2. Ways to improve the *dolo* chain as perceived by all individuals who participated in the survey.

Mean sales, mean costs, mean profits, profit per unit cost and variation coefficients for profits were calculated from the survey data using the following equations:

$$\text{Mean Sales (MS)} = \frac{\sum_{i=1}^N S_i}{N} \quad (1)$$

$$\text{Mean Cost (MC)} = \frac{\sum_{i=1}^N C_i}{N} \quad (2)$$

$$\text{Mean Profit (MP)} = \frac{\sum_{i=1}^N P_i}{N} = \text{MS} - \text{MC} \quad (3)$$

$$\text{Profit per Unit Cost (PUC)} = \frac{\text{MP}}{\text{MC}} \quad (4)$$

$$\text{Variation coefficient (VC)} = \frac{\text{Standard deviation}}{\text{Mean}} \times 100 \quad (5)$$

where S_i , the monthly sales for each individual; C_i , the monthly cost (variable costs + fixed costs) for each individual; P_i , the monthly profit for each individual; N , the number of observations (individuals).

Malt and *dolo* processors, and retail sellers were classified as large, medium or small based on monthly sales (Table 1). Data were analyzed using Microsoft Excel and Genstat version 14. An analysis of variance (ANOVA) was performed to compare sales, costs and profits for (1) chain members: groups of malt processors, *dolo* processors, and *dolo* retailers and (2) categories within

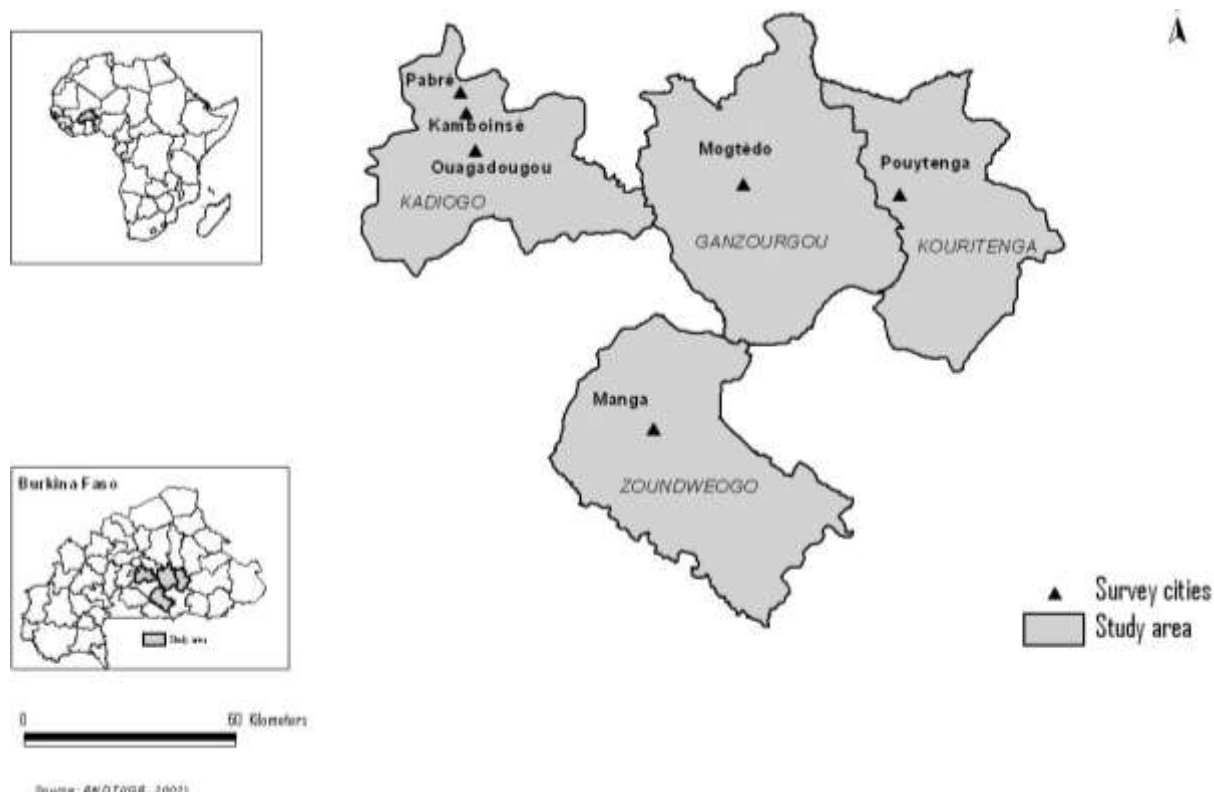


Figure 1. Map of Burkina Faso showing the provinces (Kadiogo, Ganzourgou, Kouritenga and Zoundwéogo) and the study sites. Source: Remote Sensing and Geographical Information Unit (CTIG) / (CTIG) / Institute of Environment and Agricultural Research (INERA). 2009. Ouagadougou, Burkina Faso : CTIG/INERA.

Table 1. Categories of malt and *dolo* processors and retailers, defined based on monthly sales, Burkina Faso, from November, 2006 through December, 2007.

Category	Malt processors	N	<i>Dolo</i> processors	N	<i>Dolo</i> retailers	N
Small	≤ 200 000	23	≤ 250 000	18	≤ 150 000	10
Medium	(200 000 to 400 000)	7	(250 000 to 500 000)	7	(150 000 to 300 000)	18
Large	≥ 400 000	7	≥ 500 000	5	≥ 300 000	2

N, Number of people interviewed. Values for category classification are in FCFA.

these groups. Sales, costs and profits were considered significantly different when $P \leq 0.10$. Ways to improve the *dolo* chain mentioned by at least 50% of the survey respondents were judged to be of great importance. Variation coefficients, used to assess levels of risk incurred by each category of malt processors, *dolo* processors and *dolo* retailers, were calculated to compare the categories within each group (Table 1).

RESULTS AND DISCUSSION

Products sold and major costs

The main products sold are malt for malt processors; *dolo*, sediment (animal feed), yeast and charcoal for *dolo* processors; and *dolo* and yeast for *dolo* retailers. The survey indicated that the major costs were:

1) Costs for malt processors include (a) acquisition of raw material (grain, water), (b) building, production and distribution equipment (areas for malting and drying, warehouses, pots, bowls, buckets, drums, cans, jars, calabashes, baskets), (c) labor, (d) transport, and (e) taxes and fees.

2) Costs for *dolo* processors include (a) acquisition of raw material (grain or malt, water, yeast, mucilage, etc.), (b) houses and production and distribution equipment ["improved stoves" for *dolo* preparation, warehouses, pots, bowls, buckets, drums, cans, jars, calabashes, baskets, filters, cabinets, benches, tables, soap, energy (wood particularly), etc.], (c) labor, (d) transport, and (e) taxes and fees.

3) Costs for *dolo* retailers include (a) purchase of *dolo* from processors, (b) acquisition of water and soap, (c)

Table 2. Monthly sales, costs, profits, profits per unit cost and variation coefficients for all chain members, Burkina Faso, from November, 2006 through December, 2007.

Group	N	Sales	Cost	Profit	PUC	VC
		FCFA				
<i>Dolo</i> processors	37	297 726	195 758	101 968	0.52	64
Malt processors	30	214 219	129 788	84 431	0.65	99
<i>Dolo</i> retailers	30	189 295	130 851	58 444	0.45	80
p-value		0.02	0.03	0.05	-	
I.s.d.		66 527	45 844	27 883	-	

N, Number of people interviewed; PUC, profit per unit cost; VC, variation coefficient; I.s.d., least significant difference of means; 1 Euro, 656 FCFA.

Table 3. Monthly costs, profits, profits per unit cost and variation coefficients for malt processors, *dolo* processors and *dolo* retailers, Burkina Faso, from November, 2006 through December, 2007.

Category	Malt processors				<i>Dolo</i> processors				<i>Dolo</i> retailers			
	Cost	Profit	PUC	VC	Cost	Profit	PUC	VC	Cost	Profit	PUC	VC
	FCFA											
Large	331 238	227 781	0.69	30	440 535	160 745	0.36	53	331 320	175 368	0.53	22
Medium	152 620	114 618	0.75	17	237 007	137 014	0.58	49	126 885	62 480	0.49	61
Small	61 528	31 616	0.51	59	111 722	72 012	0.64	52	97 896	27 795	0.28	39
p-value	< 0.01	< 0.01	-		< 0.01	< 0.01	-		< 0.01	< 0.01	-	
I.s.d.	50 711	24 578	-		41 063	46 806	-		46 018	40 115	-	

PUC: Profit per unit cost; VC: variation coefficient; I.s.d., least significant difference of means; 1 Euro, 656 FCFA.

places for selling *dolo*, bowls, buckets, drums, cans, jars, calabashes, baskets, cabinets, benches, tables, soap, etc.), and (d) taxes and fees.

The survey also indicated that malt and *dolo* prices vary depending on daily supply and demand (Saul, 1981), which is influenced by the fact that, it is not easy to store sorghum beer (Palé et al., 2010; Saul, 1981).

Sales, cost and profit

Given that the categories of malt processors, *dolo* processors and retailers were defined, based on their monthly sales, only costs, profits and profits per unit cost are presented and discussed. The ANOVA showed results that are largely influenced by natural variation and the number of respondents in each category.

Chain members

Costs in malt processing and *dolo* retail were similar while *dolo* processors who usually used more labor than the other groups had approximately 33% higher costs (Table 2). Economic profits for *dolo* and malt processing were similar, while retail sales had lower profit potential

as they had to purchase *dolo* to sell. The production of *dolo* is mainly hampered by lack of capital particularly for young or small-scale brewers and for retailers who buy *dolo* from brewers and retail it with reduced profit (Saul, 1981). In addition, consumers ask to taste the product before they buy thereby reducing the quantity of *dolo* being sold and profit made. Comparison of the profits per unit cost showed that, although *dolo* processors had higher economic profits, malt processing generated greater profit per unit cost, but risk in this latter activity is greater than in others (Table 2). In Burkina Faso, a salary of 30 684 FCFA is considered as the Inter-professional minimum guaranteed salary (IMGS) (Ministry of budget and finances, 2006). Results from this survey indicated that the profit made by each member of the supply chain was higher than the IMGS in Burkina Faso (Table 2).

Malt processors

Large malt producers had higher costs and higher profits due to higher labor requirement which was compensated for by greater sales than for medium and small processors who produced less malt (Table 3). Costs for medium and small malt processors were 54 and 81%

Table 4. Ways to the *dolo* chain improvement according to participants in the survey (in % of N respondents), Burkina Faso, from November, 2006 through December, 2007.

Proposition	<i>Dolo</i> producers	Malt producers	<i>Dolo</i> consumers	<i>Dolo</i> retailers
N	64	40	100	30
Information, consciousness-raising and training on processing, conservation and distribution skills and on good hygienic practices	18	16	44	7
Access to credit	63	51	71	77
Organization of the production and marketing systems	48	56	38	57
Fight against the use of prohibited products such as toxic chemicals and drugs to consumers	2	4	25	0
Reduction of the quantities of industrially produced beer or increase of their prices	5	7	3	0
Reduction of taxes and fees	8	0	0	0

N, Number of people interviewed.

less than for large malt processors, but large malt processors had 99 and 620% greater profit. Comparison of the profits per unit cost showed that, although large malt processors had higher economic profits, malt processing in medium category generated greater profit per unit cost with lower risk (Table 3). All three malt processor classes made greater profits than the IMGS in Burkina Faso which is particularly important since all were females.

***Dolo* processors**

Large *dolo* producers had higher costs compared to medium and low processors due to the volume of *dolo* produced being greater (Table 3). Medium *dolo* processors had higher costs than small processors. Large and medium *dolo* processors had similar profit, while small processors had -55% profits. Costs for medium and small *dolo* processors were 46 and 75% less than those for large malt processors. Comparison of the profits per unit cost showed that, although large and medium *dolo* processors had higher economic profits, *dolo* brewing in small category generated

greater profit per unit cost, while brewing in medium category had greater risk (Table 3).

Two of the *dolo* processors were found to be outliers with profits ranging from 1 000 000 to nearly 1 500 000 FCFA, and profits per unit cost of 2.56 and 2.84. These two outliers with modern equipment for processing and distribution were found in the capital (Ouagadougou) and were the biggest suppliers of *dolo* for retail sellers in this city. All three *dolo* processor classes made profits higher than the IMGS in Burkina Faso (Table 3). The study also showed that household-scale brewing that is an economic activity of women is one of the few income-generating activities available to females in sub-Saharan Africa. McCall (2001) indicated that, although the financial returns to labor in household-scale brewing are usually poor, brewing constitutes the third-highest household income source in Burkina Faso (after farm produce sales and wage labor).

***Dolo* retailers**

Large retailers had higher costs of 62 to 70% and higher profits of 64 to 84% compared to medium

and small retailers (Table 3). *Dolo* retail sales in large category generated greater profit per unit cost with lower risk than the two other categories (Table 3). Results of this study indicated that small *dolo* retailer categories made profits less than the IMGS in Burkina Faso, in contrast to large and medium *dolo* retailers.

Improving the *dolo* supply chain

Malt and *dolo* processors and retailers who participated in the survey mentioned that the principal supply source for their production, conservation and distribution equipment, and the raw material for malt and *dolo* production (sorghum grain, mucilage and yeast) was local suppliers (data not presented). A few surveyed individuals also purchased equipment and/or raw material in other provinces in Burkina Faso or in neighboring countries. Equipment and raw materials were indicated to be readily available throughout the year, but their high cost limited accessibility and acquisition. To improve the *dolo* supply chain, the participants in the survey proposed diverse strategies (Table 4).

Among these strategies, the most frequently mentioned were: (1) access to credit (mentioned by all members of the supply chain) for farmers to produce quality sorghum grain and women processors to purchase equipment needed for malt and *dolo* processing, conservation and distribution, (2) organization of malt and *dolo* production, and marketing systems to the benefit of all members of the supply chain, increase profit of all supply chain members, and provide training to improve all supply chain members production skills. Further investigations are also needed to assess the economics of the sorghum grain production by farmers and the pasteurization possibilities for *dolo* to give the product a longer shelf life.

Conclusion

Results from this economic study showed differences in costs, sales and profits in the *dolo* chain from one group of members to another and from one category to another within each group. The study also indicated that, although equipment and raw materials were readily available throughout the year, their high cost limited accessibility and acquisition. Actions should be undertaken by policymakers and developers to make credit available for farmers to produce quality sorghum grain and women processors to purchase equipment needed for malt and *dolo* processing, conservation and distribution, thus, increasing profits. Other important aspects to consider when designing programs to improve the *dolo* supply chain are the organization of malt and *dolo* production, marketing systems and suitable training programs to the benefit of all members to improve production skills and increase profit per unit cost in all *dolo* activities. The study provided a better understanding of key problems that need to be solved in order to improve the *dolo* supply chain and thus, increase the economic potential of grain sorghum in Burkina Faso and neighboring countries. Murty and Kumar (1995) indicated that a commercialized traditional product has a greater chance of being popular and culturally acceptable than an exotic or novel product.

ACKNOWLEDGEMENTS

We would like to thank USAID Grant No. DAN 1254-G-0021 through INTSORMIL, the Sorghum and Millet Collaborative Research Program, and the Institute of Environment and Agricultural Research (INERA), Burkina Faso, for their financial and administrative support for this study.

REFERENCES

Aisien AO, Muts GCJ (1987). Micro-scale malting and brewing studies of some sorghum varieties. *J. Inst. Brew.*, 93: 328-331.
 Badu-Apraku B, Okoruwa AE, Kling JG, Kim SK (1995). Improvement of maize genotypes with appropriate quality characteristics for industrial

processing and use. *In* J.M. Menyonga, B. Taye, C.C. Nwasike, P.M. Sedego and E. Tenkouanoeds (Eds.). Processing and industrial utilization of sorghum and related cereals in Africa. OAU/STRC-SAFGRAID, Ouagadougou, Burkina Faso, pp. 247-272.
 Beta T, Rooney LW, Waniska RD (1995). Malting characteristics of sorghum cultivars. *Cereal Chem.*, 72: 533-538.
 Bramel-Cox PJ, Kumar KA, Hancock JD, Andrews DJ (1995). Sorghum and millets for forage and feed. *In* D.A.V. Dendy (Ed.). Sorghum and Millets: Chemistry and Technology. American Association of Cereal Chemists, Inc., St. Paul, MN, USA, pp. 325-364.
 Demuyakor B, Ohta Y (1993). Characteristics of single and mixed culture fermentation of pito beer. *J. Sci. Food Agric.*, 62: 401-408.
 EtokAkpan OU, Palmer GH (1990). Comparative studies of the endosperm-degrading enzymes in malting sorghum and barley. *World J. Microbiol. Biotechnol.*, 6: 408-417.
 Hagir BE, Babiker EE, Abdullahi El Tinay H (1999). Changes in chemical composition, grain malting, starch and tannin contents and protein digestibility during germination of *sorghum cultivars*. *Food Chem.*, 64: 331-336.
 Kayode PAP, Adegbiidi A, Hounhouigan DJ, Linnemann RA, Nout MJR (2005). Quality of farmers' varieties of sorghum and derived foods as perceived by consumers in Benin. *Ecol. Food Nutr.*, 44: 271-294.
 Maunder AB (2002). Sorghum worldwide. *In* J.F. Leslie (Ed.). Sorghum and millet diseases. Iowa State Press, Ames, IA, USA, pp. 11-17.
 McCall M (2001). Brewing rural beer should be a hotter issue. *Boiling Point*, 47: 23-25.
 Ministry of Budget and Finances (2006). Decree N° 2006-655/PRES/PM/MTSS/MFB, December 29, 2006 defining the Inter-professional minimum guaranteed salaries. Ministry of Budget and Finances, Ouagadougou, Burkina Faso, p. 1.
 Murty DS, Kumar KA (1995). Traditional uses of sorghum and millets. *In* D.A.V. Dendy (Ed.). Sorghum and Millets: Chemistry and Technology. American Association of Cereal Chemists, Inc., St. Paul, MN, USA, pp. 185-221.
 Novellie L, Taylor JRN (1993). Beverages from sorghum and millet. *In* R. Macrae, R.K. Robinson, and M.J. Sadler (Eds.). Encyclopedia of Food Science, Food Technology and Nutrition. Academic Press, London, pp. 1781-1786.
 Ogbonna AC, Obi SKC, Okolo BN (2003). Modifications of the methods for the extraction of carboxypeptidase and proteinase activities from sorghum malts. *J. Inst. Brew.*, 109: 51-56.
 Palé S, Taonda SJB, Bougouma B, Mason SC (2010). Sorghum malt and traditional beer (*dolo*) quality assessment in Burkina Faso. *Ecol. Food Nutr.*, 49: 129-141.
 Palmer GH (1989). Cereals in malting and brewing. *In* G.H. Palmer (Ed.). Cereal science and technology. Aberdeen University Press, Aberdeen, pp. 167-168.
 Saul M (1981). Beer, Sorghum and Women: Production for the Market in Rural Upper Volta. *J. Int. Afr. Inst.*, 51: 746-764.
 Subramanian V, Murty DS, Rao NS, Jambunathan R (1992). Chemical changes and diastatic activity in grains of sorghum (*Sorghum bicolor*) cultivars during germination. *J. Sci. Food Agric.*, 58: 35-40.
 Taylor J, Dewar J (2000). Fermented products: Beverages and porridges. *In* C.W. Smith (Ed.). Sorghum: Origin, History, Technology, and Production. John Wiley and Sons, Inc., New York, pp. 751-795.
 Taylor JRN, Boxd HK (1986). Free α -amino nitrogen in sorghum beer mashing. *J. Inst. Brew.*, 37: 1109-1117.