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Kayodé, A.P.P.; Hounhouigan, J.D.; Nout, M.J.R.; Niehof, A.

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Household production of sorghum beer in Benin: technological and socio-economic aspects

A.P. Polycarpe Kayodé,^{1,2} D. Joseph Hounhouigan,¹ Martinus J.R. Nout² and Anke Niehof³

¹Département de Nutrition et Sciences Alimentaires, Faculté des Sciences Agronomiques, Université d'Abomey-Calavi, Cotonou, Bénin

²Laboratory of Food Microbiology, Wageningen University, Wageningen, the Netherlands

³Social Sciences Group, Wageningen University, Wageningen, the Netherlands

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Correspondence

Martinus J.R. Nout, Laboratory of Food Microbiology, Wageningen University, PO Box 8129, 6700

EV Wageningen, the Netherlands.

E-mail: rob.nout@wur.nl

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Abstract

This study evaluated the sorghum brewing microenterprises in Benin with emphasis on the beer quality, the social significance of the product as well as the income generated. *Tchoukoutou*, the Benin opaque sorghum beer, has important social functions as it fosters the cooperative spirit and remains an ancestral beverage widely used for traditional ceremonies. The manufacturing process consists of malting (soaking, germination and sun drying), brewing (mashing, boiling, filtration) and fermentation. The beer is sour with a pH of 3.2 and contains a relatively high but variable level of solids and crude protein. Most of the consumers appreciate an opaque, sour and pink-coloured beer. The consumers related many of the beer properties to health effects. Participants can link the perceived qualities of the beer to the grain's functional properties, and this leads to the classification of the farmers' sorghum as varieties of top, medium and low quality for brewing. The profits from *tchoukoutou* production range from 2365 to 17 212 fcfa per month (1 euro = 656 fcfa) for the producers, depending on beer yield and quantity of raw grain transformed. The generated income is used for household needs and part of it is invested in children's education.

Introduction

Food insecurity persists in Sub-Saharan Africa and is partly due to inadequate food production. But more importantly, low household income and poverty limit people's access to the means to provide for their basic needs, particularly food. Seen in this way, food insecurity is a component of livelihood insecurity. Ellis (2000) defines livelihood as follows: 'A livelihood comprises the assets (natural, physical, human, financial and social capital), the activities, and the access to these (mediated by institutions and social relation) that together determine the living gained by an individual or household'. Men and women in developing countries tend to diversify their livelihood activities, sources of income and asset base to enhance their livelihood and food security. Women's income generating activities in developing countries often significantly contribute to the household income (Niehof, 2004). From her work in eastern Zambia, Peterson (1999) recorded 25 income generating activities of farmers (women and men). These were categorized by the farmers as either 'small-money' activities, 'medium-size money' activities, or 'big-money' activities, depending on the level of income generated by these activities and their contribution to livelihood sustainability. Women were especially engaged in 'small-money' and 'medium-sized money' activities, which mainly included selling raw and locally processed

crop foods such as porridge, fritters and beverages. West African women have a long and well-documented record of entrepreneurship (Mandel, 2004). They are active in food-processing microenterprises that play an important role in the local economy. The foods produced by these artisanal structures, usually referred to as 'street foods', significantly contribute to the food supply of the local – particularly the low-income – population because they are cheap and easily accessible (Ekanem, 1998).

Opaque sorghum beer, a street food product, is a popular alcoholic beverage in the northern Guinea Savannah region of West Africa. It is known as *tchoukoutou* in Benin and by various other names in other parts of West Africa (Odunfa, 1985; Kayode *et al.*, 2005). It has a sour taste, a relatively high dry matter content (5–13%) and low alcohol content (2–3%), which makes it a suitable beverage for adults and teenagers (Agu and Palmer, 1998; Briggs *et al.*, 2004). It is largely consumed by the poorest, and significantly contributes to the diets of millions of people and generates income for the women sellers who produce it at household level, using the traditional technology. The beer is originally prepared with sorghum (Guinea corn; *Sorghum bicolor*), but other starch sources like millet or maize can be used as adjuncts or as substitutes (Kayode *et al.*, 2005). In some cases as much as 30% of sorghum harvested in Africa is used for malting and brewing (Nout, 1980). The manufacturing process consists of soaking,

germination, sun drying, mashing, boiling and fermentation. Depending on the geographic location variations may occur in the process (Odunfa, 1985; Haggblade and Holzapfel, 1989).

The objectives of the present study are threefold. First, to examine the social significance of sorghum beer; second, to evaluate the quality of the product in terms of consumers' perception, nutrient content and microbiological safety; and third, to quantify the income generation potential of sorghum brewing microenterprises in Benin and their contribution to household livelihood security.

Methodology

Survey

The field research was conducted in northern Benin and took place in two stages. First, interviews were held with 135 sorghum beer processors and consumers in three communities with a rich beer-brewing tradition, namely *Natitingou*, *Djougou* and *Parakou*. The questionnaire included the following aspects:

- frequency of consumption: frequently = 4–7 times/week, regularly = 2–3 times/week, occasionally = 1 time/week and rarely = less than 1 time/week.
- quality perception: consumers gave their opinions on the importance of the quality traits of the product, that is, appearance, taste, colour and smell. Finally, we recorded consumers' opinions on the suitability of sorghum varieties for beer making.

Interviews with 10 key informants were performed to assess the social significance of the product. These informants were senior and highly experienced processors, who had been recruited on the basis of recommendations by extension workers and fellow villagers. Data were analysed using *Winstat 2.0* software.

The second stage of the field research was a case study performed in *Parakou*, involving three beer processors. Processor 1 (P1) is the head of a group of eight beer processors. They produce beer every 2 days to meet consumers' demand. P2 works in association with another processor and they produce *tchoukoutou* twice a week, while P3's brewery is a family business which produces beer once a week. Three batches of red sorghum grain were selected and purchased by the processors at the local market and were processed into beer at the three respective commercial production sites following their traditional brewing practices. At the end of the fermentation process, beer samples were collected in sterile screw-capped bottles, packed in a thermo-cooler containing crushed ice, transported to the laboratory, and immediately analysed for pH, titratable acidity and microbiological characteristics. The processors were observed while carrying out the brewing

operations. Quantitative data were collected on inputs (raw material, labour, money, equipments, water, fuel and time) and outputs (yield, by-products and sales).

The protocols used for the quantitative survey and the case study were approved by the Faculty of Agronomical Science of the University of Abomey-Calavi; informed consent was obtained from all respondents.

Microbiological analysis

Total counts of mesophilic aerobic bacteria, lactic acid bacteria (LAB), yeasts, moulds and Enterobacteriaceae were enumerated according to the method described by (Nout *et al.*, 1987).

Physico-chemical analysis

Crude protein ($N \times 6.25$), dry matter and ash contents were determined according to American Association of Cereal Chemistry (AACC) methods (AACC, 1984). pH and titratable acidity were determined as described by Nout *et al.* (1989).

Results and discussion

The social significance of sorghum beer consumption

In the study areas, two kinds of sorghum beer were identified: *tchoukoutou* and *chakpalo*. They have different appearance and taste. *Chakpalo* is a clear and sweet fluid, while *tchoukoutou* is an opaque (turbid) and acidic beer. Table 1 shows the consumption patterns for the different sorghum beers per region. *Tchoukoutou* is the most frequently consumed beer in the study regions. The frequency of consumption is higher in *Natitingou* and *Djougou*, probably because these places are the cultural origin of this beer. In *Parakou* both beers are consumed with a relatively high frequency. This is most likely related to the ethnic diversity in this city, which is also regarded as a crossroad of various communities.

The relationship between gender and the frequency of consumption is found to be significant (Table 2): *tchoukoutou* is mostly consumed by men. The beer is regarded as a stimulant, especially when people want to accomplish energy-demanding work; '*tchoukoutou donne la force*', as many like to say (Van Liere, 1993).

Apart from its role as a beverage, *tchoukoutou* also has an important social function. In the northern Benin regions, a market day without *tchoukoutou* is unthinkable. Due to the higher demand

Table 1 Frequency of consumption of sorghum beers in three communities in northern Benin (in percentage of respondents)

	Tchoukoutou			Chakpalo		
	Parakou (n = 45)	Natitingou (n = 45)	Djougou (n = 45)	Parakou (n = 45)	Natitingou (n = 45)	Djougou (n = 45)
Frequency ^a						
Frequently	20	52	47	18	0	0
Regularly	4	24	22	16	2	0
Occasionally	16	11	0	35	0	4
Rarely	60	13	31	31	98	96

^aFrequently: 4–7 times/week; regularly: 2–3 times/week; occasionally: 1 time/week; rarely: less than 1 time/week.

Table 2 *Tchoukoutou* consumption by gender

	Frequently	Regularly	Occasionally	Rarely	Total	χ^2
Male	27 (60%)	9 (20%)	2 (4.4%)	7 (15.6%)	45 (100%)	16.44 ^a
Female	26 (29%)	14 (15.6%)	10 (11%)	40 (44.4%)	90 (100%)	
Total	53 (39.3%)	23 (17%)	12 (8.9%)	47 (34.8%)	135 (100%)	

^a χ^2 is significant at 0.01 level.

and appreciation of consumers, *tchoukoutou* pubs are encountered in almost all neighbourhoods. Special *tchoukoutou* markets are also held in some regions. For example, *Kilombo* and *Chakatabam* are very popular *tchoukoutou* markets in *Parakou*. These markets are held weekly and attract many customers. A *tchoukoutou* market is a place where people socialize and information and experiences are shared. At the neighbourhood level, the ambiance created by *tchoukoutou* is intense, particularly during weekends when *paten'ti* is organized. *Paten'ti* is a special event organized on Friday and Saturday nights around the *tchoukoutou* pot. It involves the *tchoukoutou* processors, a disc jockey, consumers and (female) sellers of fruits, sweets, cooked rice and *kpakuman* (cooked beef skin). The chief organizer of the *Paten'ti* is the *tchoukoutou* processor who pays for hiring the music accessories. Sometimes it is the best rendezvous place for young men and women as *tchoukoutou* also makes them feel free to express their thoughts.

Tchoukoutou is an ancestral beverage widely used for traditional ceremonies such as weddings, baptism, excision (not practised anymore nowadays), circumcision, 'tatouage', burial ceremonies and *zolari* (annual popular sorghum feast in *Djouougou* region). It is indispensable for the farm labour force as the beer fosters a cooperative spirit.

Sorghum beer processing

Tchoukoutou is produced by women using various processes. In general, as in the conventional lager beer process, the method consists of three phases: malting, mashing and fermentation. On average, 27 kg (referred to as one *winnere*: the local name of the basket used to measure the grains) of grain is processed in one batch. The grain is soaked in water overnight (9–12 h), germinated (72–85 h), sun dried (7–15 h), ground in a disc mill, mixed with water, decanted and divided into slurry and supernatant. The slurry is mashed by gradual heating until the boiling point is reached after 2 h, mixed with supernatant and allowed to sour during overnight fermentation, filtered, boiled (6–9 h), cooled, inoculated with a starter (called *kpetekpete*) harvested from the previous batch and fermented overnight (13–14 h).

The choice of the type of sorghum is crucial as it will determine, together with other factors, the success of the beer brewing. Processors often claim that not all sorghum varieties are suitable for beer production. The storage duration of the grain is an important criterion to which processors pay special attention when choosing the grain for brewing, particularly in the period of September–December, when the grains have been stored for longer than 6 months. Insect damage to the grain, detectable by the presence of holes or floury dust, is an efficient indicator that grains have become unsuitable for brewing. Other important selection factors for brewing sorghum include: size and colour of the grain, wort

quantity and quality (mainly sugar content) and to a lesser extent the origin of the grain (Kayode *et al.*, 2005).

Kayode *et al.* (2005) identified many farmers' varieties of sorghum in northern Benin and grouped them according to their ability to yield a good quality beer. The first category comprises the varieties that are very good for brewing, including *chabicoouma*, *chassisoya* and *agbani*. The first-rate varieties are generally used as a reference by which to judge the other varieties. They are brown, floury and have big grains. They give a high yield of wort with very good properties, that is, sugary and opaque. Generally, processors use the wort properties as an indicator of the quality of the beer, the sweetness being the major criterion. The sweeter the wort is, the better the beer will be. Another advantage of these varieties is their relatively high availability, presumably due to some favourable agronomic properties. After storage, all of them are still good for brewing as they germinate well. Moreover, they yield well with soils that have a low fertility and some (*chassisoya*) are resistant to *Striga*, an obligate parasitic plant that attacks the roots of agronomically important crops, including sorghum. Second-rate varieties are: *wawira*, *soniya*, *mousselman*, *mouhoulouman*, *talemoula* and *fissouka*. These varieties are also suitable for *tchoukoutou* processing, although some factors limit their utilization. The white colour of some (e.g. *mouhoulouman*, *talemoula*) is not favoured for beer processing. These varieties are always mixed with red sorghum otherwise the beer would become too white; consumers prefer pink/red beer because they believe coloured beer is healthy (Kayode *et al.*, 2005). Other varieties are too hard and thus prolong the processing time. This is the case with *soniya* and *wawira* which require 2–3 days of soaking time instead of 1, prior to germination. In addition, more inoculum is needed for a quick fermentation of their wort. Finally, the third group comprises the varieties unsuitable for brewing. These are *sotakama*, *kassassahan*, *kangnanra* (yellow varieties) and *natisoya*. The main shortcoming of *natisoya* is that it yields a less sugary wort. Another limitation is that it loses its germinative power after a short storage period. However, because it is an early maturing variety some processors used it, just after harvesting, to produce a beer of 'bad quality' as they say.

Tchoukoutou production is not a highly labour-intensive activity but it takes a long time (Table 3). Seven to 10 days are required to complete a process cycle. Given this constraint and also because of the investment needed, processors usually team up in groups to fulfil the consumers' demand. This kind of association is mostly based on family relationships. For instance, P1 belongs to a group of eight processors, and P2 associated with a friend from her village to be able to produce beer twice a week. P1 is the head of the group and has invested in the main process equipments. Her two daughters, two sisters and three friends from her village are the members of her group. P1 was previously a member of a group

Table 3 Time duration (h) for sorghum grain processing into tchoukoutou

Unit operation	P1 (25 kg)	P2 (31 kg)	P3 (27 kg)	Average	Working hours (h)	Labour ^a demand (full-time equivalent – fte)
Soaking	11	9	13	11	2.0	0.25
Pregermination	13	13	24	17	0.5	0.06
Germination	72	61	48	60	4.0	0.50
Drying	16	15	7	12	3.0	0.38
Milling	0.25	0.25	0.25	0.25	0.25	0.03
Suspending/settling	1	1	1	1	1.0	0.13
Boiling/saccharification	1.75	1.25	1.75	1.5	1.5	0.19
First fermentation/saccharification	12.5	10	12.75	12	1.0	0.13
Filtering	3	0.5	0.5	1.3	0.75	0.09
Boiling	9.5	8.0	6.5	8.0	5.0	0.63
Cooling	2.75	2.5	2.5	2.5	0.5	0.06
Second fermentation	13.0	14.0	13.0	13.3	1.5	0.19
Total	155.75	135.5	130.25	139.85	21.0	2.63

^a1 fte = 8 working hours.

Table 4 Consumers' quality preferences for sorghum beers (% of respondents^a)

	Appearance		Taste					Colour		
	Opaque	Clear	Very sweet	Sweet	Neutral	Acidic	Very acidic	Pink	Red	White
Tchoukoutou (<i>n</i> = 82)	86	14	4	16	7	100	22	88	78	3
Chakpalo (<i>n</i> = 24)	6	69	30	97	0	40	0	96	100	0

^aSum >100 because several answers were possible.

n, number of people interviewed on the beverage for the quality aspects.

directed by the wife of her older brother. From this group she gained the knowledge of brewing and part of the money used to purchase her own equipments. Because of her accrued experience she supervises the process and the other members usually refer to her for advice. Each processor in the group has her turn in such a way that when someone is at the germination step, another one is soaking for a new processing cycle. The processing takes place at the household level, usually at the home of the head of the group who manages the space for processing. Typically a brewing 'enterprise' includes a sprouting area (6–10 m²) (in some cases a space is arranged in the sleeping room for sprouting), and a kitchen with provisions for the use of big pots. The family kitchen is usually situated next to the brewing kitchen. Another kind of social organization of beer production is represented by processor (P3), where beer is exclusively produced by the family, that is, the mother and her daughters or other close relatives who may have their own occupations (e.g. going to school, farming, selling small necessities) but occasionally help their mother in brewing.

There is some ethnic specialization related to brewing activities. Like most of the *tchoukoutou* brewers in *Parakou*, the three processors observed originated from the north-western part of Benin where *tchoukoutou* is believed to have come from. *Chakpalo* is exclusively brewed by *Idatcha* women from the central part of the country, where this beer is believed to have originated.

Quality as perceived by consumers

Consumers expressed a strong preference for *tchoukoutou* compared with *chakpalo* and clearly differentiated between both beers

in terms of quality attributes (Table 4). Most consumers prefer an opaque *tchoukoutou*. The beverage should be acidic with a colour ranging from pink to reddish. To the question 'why do you prefer these specific quality attributes?' consumers give diverse answers. Some argue that opaque beer appeases hunger. The reasons for drinking brown or reddish beer are health-related beliefs. Because it is a general belief that beer brewed from maize (a white beer) causes headache, consumers indicated that the pink colour of a beer guarantees that it was brewed from sorghum.

Another important quality aspect of *tchoukoutou* is the alcohol content. A beer with high alcohol content is preferred. Actually the alcohol content of opaque sorghum beer ranges between 2% and 3% (Agu and Palmer, 1998; Briggs *et al.*, 2004). But considering the relatively big volume of beer consumed daily, consumers can ingest considerable quantities of alcohol. During the harmattan season (a cold period) the authors observed some consumers adding *sodabi* (a local distilled alcohol) to *tchoukoutou* to make it more powerful, as they say. The odour of the beer is also perceived as an important attribute by some consumers. Some consumers claim to be able to infer the overall quality of *tchoukoutou* by its odour (Kayode *et al.*, 2005). Finally, a minority of consumers appreciate a bitter beer because they believe that such beer 'fights against malaria' and 'cleans the blood'.

To meet consumers' quality demands, processors make use of certain food-processing practices. To produce bitter beer, the yellow varieties (bitter varieties) are used as hops would be used in a European lager beer. For this purpose, grains are either crushed with the malt or the ears of bitter varieties are immersed in the wort during cooking. Other processors grind them after the grain is

roasted. The flour obtained is then stored and added to the wort during cooking. A larger mesh basket or bag is used to permit the infiltration of suspended solid matter to enhance the opacity of the beer. From the opacity point of view, consumers distinguished two kinds of *tchoukoutou*. *Kotouman*, a very opaque *tchoukoutou*, is perceived as different from *chololo* (relatively less opaque *tchoukoutou*). The use of a sticky solution, obtained from a watery extraction of the bark of *sarikibou* (a wild tree) during the decantation process is responsible for the lesser opacity of *chololo*. Indeed, *sarikibou* is used to accelerate the decantation process. As it contributes to the precipitation of small solid particles, it contributes to a better filtration. The alcohol content of *tchoukoutou* is produced by yeasts (Nout, 1980; Sefa-Dedeh *et al.*, 1999). Here the inoculum (*kpetekpete*) used – kept in a calabash – consists of yeasts harvested from a previous batch. The microorganisms are kept alive by replacing the supernatant on a daily basis. When we asked a processor what would happen if the water was not regularly renewed for the inoculum, she replied: '*kpetekpete* loses its strength and will not make the beer effervescent anymore', meaning that the yeasts would have died.

Microbiological quality

Tchoukoutou is a sour beverage with a pH of 3.2 ± 0.2 , and a titratable acidity of 0.8 ± 0.1 (in percentage lactic acid equivalent). The product contains a relatively high but variable level of solids and crude protein. The major microorganisms involved in the fermentation of the beverage are LAB and yeasts (Table 5). The LAB produce lactic acid and other organic acids lowering the pH of the product from about 6.5–3.6 (Hounhouigan *et al.*, 1993). If the pH of a food product is below 4.0, the growth of diarrhoea causing pathogens is inhibited (Nout *et al.*, 1989; Motarjemi and Nout, 1996). Consequently, it can be argued that beverages like *tchoukoutou* are less likely to be a source of pathogenic bacteria and are safe, even under conditions of poor hygiene. Our result confirms this as the Enterobacteriaceae family of bacteria are below detection level in the product (Log cfu/ml <1). Indeed, consumers rarely complain about stomach troubles or diarrhoea after consuming *tchoukoutou*. By contrast, *chakpalo* is fermented to a lesser extent, and frequent stomach pains resulting from its consumption are an important factor in its lesser popularity.

Table 5 Nutritional and microbiological attributes of *tchoukoutou*

	Processor 1	Processor 2	Processor 3
Physico-chemical attributes			
Crude protein (% dm)	3.7	7.9	6.8
Dry matter (% wb)	13.5	12.1	4.8
Refractive index (%)	17.5	14.0	7.0
pH	3.0	3.4	3.1
Titratable acidity (% lactic acid)	0.5	0.8	0.6
Microbiological attributes (Log cfu/ml)			
Total count	nd	8.2	7.8
Yeasts	8.5	7.9	7.8
Lactic acid bacteria	nd	7.9	7.6
Enterobacteriaceae	<1	<1	<1

dm, dry matter; nd, not determined; wb, wet basis.

Hygienic quality

The hygiene of sorghum beer processing practices may have important health risk implications for the consumers. Extensive growth of moulds was observed on the sprouted grains after 3 days of germination. These fungi may include *Aspergillus* spp., a genus harbouring mycotoxigenic species encountered in the study areas (Setamou *et al.*, 1997). Aflatoxins are quite stable and when present in malted grain, they may persist in the beer.

Yields and profits

The yield of *tchoukoutou* beer, shown in Table 6, varied from 170 to 456 l with an average of 282 l per 100 kg of dry grain. In terms of dry mass balance, an average 24% of the total processed grain is recovered in the beer.

Dilution with water is the main factor explaining the large variation observed in beer yield. This is further confirmed by the input quantification (Table 7) which showed that P3, with the highest beer yield, makes use of the largest quantity of water; almost twice the quantity as used by P1 who had the lowest beer yield. The boiling time is also likely to correlate with the yield, with longer boiling resulting in lower yield. As can be observed from Table 6, the average beer yield on dry matter basis is 24% which is quite low. The most important losses of dry matter occurred during the germination (10–19%), mashing/filtration (27–44%) and the second filtration after the fermentation (12–39%). Spent grain (residue) is valorized as animal feed. In most cases, sorghum processors rear pigs that are fed with the by-products. The animals are sold to generate income. The yield of the beer is linkable to its quality, and this determines the price of the product.

Table 7 shows that the beer from P1 is the most expensive (355 fcfa/kg; 1 euro = 656 fcfa). One litre of beer 1 is at least twice as expensive as beer 3. Indeed, beer 1 meets consumer preferences best (Table 4) because of its high opacity, high acidity and probably high alcohol content (see Table 5).

The profitability of the three processes was estimated taking into account the different inputs and outputs. The calculation was done for each individual processor on a monthly basis assuming four processing cycles per month. Even though the processors

Table 6 Mass balance of *tchoukoutou* processing (kg dry matter)

	Processor 1	Processor 2	Processor 3
Raw grain	100	100	100
Soaked	92	95	98
Germinated	79	76	88
Mashed/filtred	35	48	61
Boiled	35	45	53
Fermented/filtred	23	27	22
Beer yield (l) ^a	170	220	456
Beer dm content (%) ^b	13.5	12.1	4.8
Beer yield (kg dm)	23	27	22
Spent grains (kg dm)	77	73	78

^aVolume of beer obtained per 100 kg of dry raw grain; ^bDry matter content of the beer.

Table 7 Estimated cost, gross margins and net processing margins of *tchoukoutou* production per month

Item	Price (fcfa/kg)			Quantity (kg)			Value (fcfa)*		
	P1	P2	P3	P1	P2	P3	P1	P2	P3
Input									
<i>Variable cost</i>									
Sorghum grain	88	65.15	74	100	122.8	108	8 834	8 000	8 003
Water	1.47	1.47	1.47	564	793.6	1054	829	1 167	1 549
Fuel							8 000	8 000	8 000
Milling	15	11.7	14	80	102.4	112	1 200	1 198	1 602
Total variable cost (a)							18 863	18 365	19 154
<i>Fixed costs</i>									
Depreciation charges									
Durable equipments ^a							745	630	567
Small equipments ^b							283	475	158
Processor salary/month ^c							30 000	30 000	30 000
Total fixed cost (b)							31 028	31 105	30 725
Output									
Gross output/month ^d	355	276	155	147.2	241.6	468	52 256	66 682	72 540
Selling out (%)				100	100	80			
Gross output/month ^d (c)	355	276	155	147.2	241.6	374.4	52 256	66 682	58 032
Profitability									
Gross margin/month (c – a)							33 393	48 317	38 878
Net processing margin/month c – (a + b)							2 365	17 212	8 153

^aDurable equipments are: basin, buckets, pot, jar, mortar and pestle. Their depreciation charge is calculated on the basis of 5 years life duration; ^bSmall process equipments are: calebashes, basket, polythene bags, oilclothes, sieve, mixing device. Their depreciation charge is calculated on the basis of 6 months life duration; ^cThe salary is attributed on the basis of SMIG (official minimum wages) which is 27 000 fcfa; ^dAssuming four processing cycles in a month.

*1 € = 656 fcfa.

P1, P2, P3 denote processor 1, processor 2 and processor 3 respectively.

don't attribute wages to themselves, the authors did so to each of them on the basis of the Benin minimum wages in order to measure labour costs. Apart from the raw grain, the most expensive input in *tchoukoutou* processing is the fuel, which alone makes up to 43% of the total variable cost. A lot of wood is used during the boiling process which lasts the whole day. Among the food-processing activities in the study area, *tchoukoutou* making probably consumes the most firewood. There is some evidence that these practices are a threat to forest preservation. The net processing margin from *tchoukoutou* production is in the range of 2365–17 212 fcfa per month, and the profits depend on beer yield and quantity of raw grain transformed (Table 7). It is noteworthy that P3 with the highest beer yield didn't generate the highest profit because the excessive dilution of the beer fetched a low sales price and of the beer, only 80% could be sold. Leftovers are served free to friends or relatives, or are enriched with starchy ingredients, fermented again and distilled to yield *sodabi* (strong alcoholic liquor). The money generated by the process is the property of the processor who conducted the brewing. In case of group production, each member pays the person who has provided the equipment (the head) an amount of 200 fcfa as a contribution to the equipments depreciation. The money gained is used for different purposes. Primarily, it is used for meeting the basic needs of the family, that is, food and clothing. Usually, part of it is regularly – often weekly – deposited in an account with a 'tontinier' (ambulant banker). Generally, this 'tontine' – deposit account – lasts no longer than a year. The money can be with-

drawn whenever needed, such as in case of emergencies like illness or burial ceremonies of relatives. Another important reason for saving money is to be able to finance children's education. For example, P1, whose husband has died years ago, paid for the sewing lessons of her daughter while P2 invests in her son's school fees. In this way and following the classification of Peterson (1999), *tchoukoutou* brewing can be regarded as a 'medium-size money' activity.

Conclusion and perspectives

The brewing of traditional beer, *tchoukoutou*, is an important activity for West African rural women to diversify their household's livelihood portfolio. The microenterprises are generally profitable, providing jobs and income to many rural women in northern Benin. The product is gaining interest and the brewing activity has expanded beyond its area of origin. *Tchoukoutou* brewers are increasingly active in major cities of Benin. We foresee further expansion in the future. Beer brewing is clearly a gendered activity. First, the cultivation of the raw ingredient, sorghum, is based on a gendered division of labour with women being responsible for sowing and harvesting. Second, women transform it into beer and sell it. Men drink it, while women gain money to sustain their household's livelihood. This clearly demonstrates the prominent role of women in the economic cycle of this crop product. While income generation by women not necessarily leads to their empowerment, because that depends also on women's

control over the allocation of the money generated (Ardener, 1995), the cases discussed here show that some processors invest the money they earn into their children's education. Furthermore, they are the ones who deposit the money with the 'tontinier' and decide on when to draw it out and for what purpose. In this way, the economic activities of the processors contribute to meeting women's strategic gender needs, not just their practical gender needs that only relate to sustaining their family and child care (Moser, 1994). Research in a fishing village in Indonesia has shown that when women play an important role in the local economy (in this case as fish traders and fish processors) they also have a strong social position and decision-making power beyond the domestic domain (Niehof *et al.*, 2005).

Both 'etic' and 'emic' approaches were applied to apprehend the significance of the beer quality. 'Emic' refers to a 'logico-empirical system whose phenomenal distinctions are built up out of contrasts and discriminations, significant, meaningful, real, accurate, or in some other fashion regarded as appropriate by the actors themselves', 'etic' to 'phenomenal distinctions judged appropriate by the community of scientific observers' (our italics) (Harris, 1968). In the emic statements, consumers related many of the beer properties to health effects. The beliefs that 'bitter beer cleans the blood and fights against malaria', 'pink beer is healthy', or 'sweet beer can result in stomach pains', form altogether an emic representation of the product, based on long-term experience with sorghum cultivation and processing and consumption of the product. Interestingly, the producers and consumers could link the perceived qualities to functional properties of the grain, yielding an emic classification of the farmers' sorghum varieties as being of top, medium or low quality for brewing. In the etic perspective it was possible to document quality aspects of the sensorial and nutritional quality of the beer. Etic and emic approaches occasionally match well; for instance, the high consumers' preferences for opaque beer and the relation of this attribute to hunger appeasement are confirmed by the laboratory analyses which revealed the relatively high dry matter (nutrient) content of the desired product. In view of the selection of functional sorghum varieties for quality, health and well-being, further research and merging anthropological and life science data will be needed to discover relations between emic aspects and measurable attributes. The results of such research can guide the selection and breeding of sorghum varieties.

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