Research Article
Volume 13:7, 2022

Journal of Veterinary Science & Technology

ISSN: 2157-7579

Open Access

Mini Review on Comparison of Production Process and Nutritive Value of *Atella* and Brewers' Grain; In Ethiopian Context

Badasa Jalata*

Department of Nutrition, Addis Ababa University, Addis Ababa, Ethopia

Abstract

A shortage of proteinaceous feed supplements in Ethiopia is very common. To overcome this problem non-conventional type of feeds are recommended and presented in this review article. It is shown the gaps, processes and ways the proteins source feeds can be valorized in the semi-urban and rural community of the country.

Keywords: Vitamins • Protein sources • *Atella* • Metabolizable energy

Introduction

In Ethiopia, there is a shortage of cereal grains, protein sources, vitamins and mineral supplements required to formulate balanced rations [1]. This situation warrants to review agricultural and agro-industrial by products and incorporation of suitable ones into ruminant rations. Some of the cereal grain by-products, particularly fermentation residues from alcoholic drinks and beverages are abundant in some parts of the country [2]. The Ethiopian local beer by products such as *Atella* is produced in large amounts entire the year. *Atella* is a residue of home brewed beer in Ethiopia both in urban and rural area. It is mainly used for animals individually or in combination with other feed sources. Peoples feed *atella* their cows to get more milk yield while others to fattening animals.

Non-conventional feed sources

The most common non-conventional feeds for smallholder dairy farms in Ethiopia are identified as vegetable left overs, *atella*, cactus cladodes and pods of cactus pear. They are credited for being non-competitive in terms of human consumption, low price, farm feeds and processing by-products or waste products able to serve as a form of waste management in enhancing proper sanitation. Most of the non-convectional feed sources like *atella* are good sources of protein. It may have similar or even higher Metabolizable Energy (ME) and OM digestibility than conventional forages, if uniformly and well mixed among each other and with other feeds [3-9]. However, the IVOMD of *atella* (63.5%) is lower than that of wheat bran (86.5%), noug seed cake (72.7%) and, industrial brewery by-products. The latter are the insoluble fraction, including protein, following the removal of the wort, and may also contain residues of maize. They have a sufficient IVOMD which help cattle to express their full genetic potential for reproduction and milk production.

General Overview of Brewers' Grain (BG) and *atella* Brewers' grains are the solid residue remaining after the processing of germinated and dried cereal grains to produce beer, other malt products, and malt vinegar. They are the main by-products of the brewing industry, representing about 85% of the total by-products produced [10]. Although barley is the main grain used for brewing, beers are also prepared from wheat, millet, sorghum, and maize. In the brewing process, cereal grains are soaked in water until they germinate and then dried to produce the malt. Next to this, the malted grains are milled and steeped in warm water, and the enzymes transform the starch into sugars (mashing/ saccharification). Finally, the resulting sugar-rich liquid (wort) is boiled, filtered and fermented to produce beer. They are collected at the end of the mashing process; once all sugars have been removed from the grain through fermentation. The residual product is a concentrate of proteins and fibre that is appropriate for animal feeding, predominantly for ruminants.

Wet brewers' grains are started using as animal feed in ancient times. Prior to the industrial revolution, farmhouses, and monasteries in Europe brewed their own beer and fed their livestock with the subsequent by-products [11-15]. These practices reformed with the industrialization of brewing and animal feeding, and they started being used by the feed industry. Brewers' grains are the most important by-products of the brewing industry used as livestock feed, due to their content of protein and fibre. It is also an excellent feed

***Address to correspondence:** Dr Badasa Jalata, Department of Nutrition, Addis Ababa University, Addis Ababa, Ethopia; E-mail: badasa43@gmail.com*

Date of Submission: 01 July, 2022, Manuscript No. jvst-22-46213; **Editor assigned:** 04 July, 2022, PreQC No. P-46213; **Reviewed:** 15 July, 2022, QC No. Q-46213; **Revised:** 22 July, 2022, Manuscript No. R-46213; **Published:** 29 July, 2022, DOI: 10.37421/2157-7579.2022.13.136

component for a dairy cow which can be combined with cheap nitrogen sources, such as urea to provide the essential amino acids.

Atella is a major local by-product of tella production in Ethiopia with a potential value as a low-cost nonconventional feedstuff for livestock. It is a residue, which is a kind of brewers' grain that has high moisture content, and relatively similar protein content but lower fibre content than most brewers' grains [16-19]. Even though the principles of alcoholic fermentation remain the same, there is a difference in the nutritive value of *atella*, and BG attributed to the difference in the type of raw materials, and processing methods used. This requires quantifying the nutritive value of non-conventional feeds such as *atella* and agro-industrial by-products such as brewers' grain as nutritionists seek to manipulate undegraded intake protein and fibre carbohydrate concentrations of dairy cattle rations.

Materials and Methods

Malt preparation

Malt is produced by sprouting barley grains and growing the young seedlings for four to six days under carefully controlled conditions to about 60%-75% modification of the grain. After thorough drying (kilning), rootlets are removed. The resultant product is a source of various hydrolases, primarily α and β-amylase, together with desired flavor components and substrates necessary for producing a fermentation medium suitable for making fermented beer.

Mashing

It starts with the mixing of the grist and cold brewing water, and hot water is added to raise the temperature to 95°F (35°C) for an acid rest. Thick portions of the mash are drawn off at three different times over for more than four hours. Each portion (decoction), is heated to saccharification temperature, then boiled gently, and finally returned to the main mash container to step up the main mash's temperature. The first decoction raises the temperature to around 127°F (53°C) to break down the larger proteins; proteolysis, which began during malting, is continued during mashing that at the final stage 35%-40%of initial barley protein has been converted into polypeptides and free amino acids. The second addition increases the mash temperature to 143°F (62°C) for starch conversion; and the third takes the temperature to about 163°F (73°C) for mash-out. The whole mashing process requires 148°F-152ºF (65°C) for 45 minutes. The boiling of the mash during decoction breaks down the protein matrix that surrounds the starch, and it makes more accessible to starch-degrading enzymes in the malt, which may balance the fully unmodified malt.

Hop addition

Pilsner Urquell boils the wort for two hours and uses three additions of whole hops at a proportion of 350 g/hL. Hops are initially added to the sweet wort before it arrives a boil; extra hops are added approximately 80 minutes before the end of the second boil, and the final hop is added about 25 minutes earlier the end of the boil. Hop addition is done gradually in subsequent of steps with various periods of boiling (15-60 minutes). Hop aromatisation have a benefit to mask beer staling, i.e. a complex set of organic chemical changes that occur in beer over time, transforming its flavor and causing it to diverge from the desired and expected flavor and appearanceduring storage.

Fermentation

The boiled wort is then cooled and aerated. The primary fermentation undertakes in closed stainless-steel fermenters. The brewers pitch approximately 0.5 L of a concentrated yeast suspension per hectoliter of hopped wort, which multiplied to about 15 million yeast cells/mL. The yeast is pitched at 39°F (4°C), and primary fermentation lasts 2 to 4 weeks. The temperature can rise to a maximum of 52°F (11°C) before the fermentation is stopped the young beer from each of the fermenters is combined for lagering.

The lagering phase

In the past, Pilsner beer was lagered for three months in 25 hL wooden barrels kept in a network of sandstone tunnels beneath the brewery. The modern practice adds the blended beer to 56 stainless steel tanks, each holding 3,300 hL, for 35-40 days of lagering.

Results and Discussion

The beer is filtered with an up-to-date diatomaceous earth candle filter and packed in the bottles (Table 1).

Processes	Tella		Pilsner beer	
	Duration	Temp (°C)	Duration	Temp (°C)
Soaking	2-3 days	UC	2 days	12-22
Germination	3-5 days	UC	3-5 days	22
Kilning	-	Sun drying	24-48 h	22-110
Mashing, baking of unleavened bread	-	UC	45 min	64.4-66.2
Addition of lager yeast	N/A	N/A	-	11.1
Primary fermentation	4-5 days	UC	14-28 days	11.1
Secondary fermentation	2 days	UC	28-46 days	0.6-4.4
Tertiary fermentation (barley flour, gesho) mixture and followed by anaerobic fermentation	2 days	UC	N/A	N/A
Subsequent hop Addition	N/A	N/A	15-60 min	-

Table 1: Comparison of the major steps of industrial pilsner beer and local beer (tella) process time-temperature treatment.

Tella preparation protocol

The process of tella making is mainly based on the natural microflora present in the substrates, utensils used, and the environment of the households. The protocols of maize/sorghum tella making are:

- Soaking of the barley in the moist water
- Then germination of the barley for about 3 days
- Kilning of the germinated barley on the smoke roof of the house/ sunlight
- Malt (bikil) preparation, by grinding the dried germinated sorghum, or maize
- Preparation of gesho powder (Rhamnusprinoides) to make a powder from leaves or shreds of stem. Gesho has some antibacterial effects against some groups of bacteria in addition to imparting the characteristic bitter taste to tella
- Making barley, maize, sorghum flour into dough and baking to an unleavened bread (kita)
- Breaking kita into small pieces. The extent of baking or roasting regulates the color of tella from light yellow to dark brown.

The fermentation process has modified to three phases from four stages described. At the first stage, leaves of dried gesho are soaked in water for 4-5 days. The second stage starts by mixing unleavened bread pieces (kita) and malt (bikil) into the gesho leaf-soaked water with new powders of gesho leaves and stem [20]. In some areas, herbs are added at this stage. This is ferment for 2 days or more. At the third stage, the powder of the gesho leaves pounded stem, and barley flour is mixed into thick slurry to ferment for 2 days or more. At this final phase, the container is filled with water to the brim, and the slurry is varied thoroughly. The container/clay jar is then sealed with mud to make an anaerobic condition and left fortwo days or more. Tella is consumed directly or after filtration.

In general, to prepare approximately 20 L of tella, 5 kg of maize/ sorghum flour, 460 g of gesho powder, 550 g of barley malt (bikil), and 15 L of water are needed. The final alcohol content of tella is 2%-4%, while that of the filtered drink is 5%-6% (Figure 1).

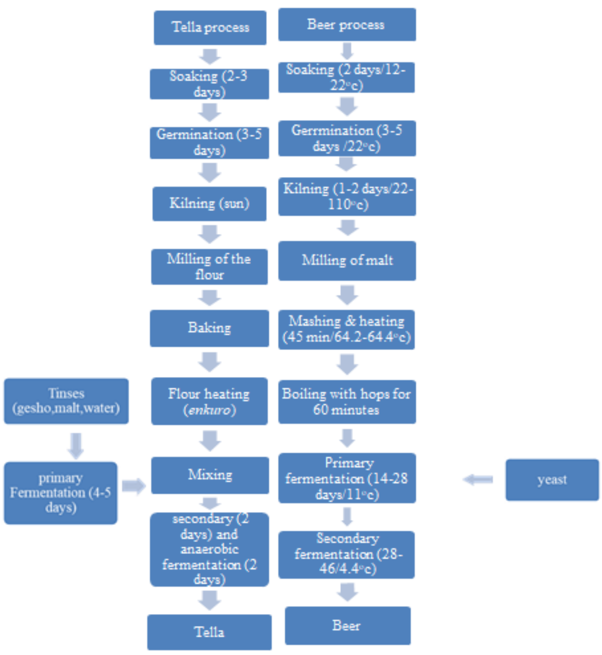

Figure 1: The production process of the Ethiopian traditional local beer (tella) and industrial beer.

Chemical composition and nutritive value of wet brewers' grain and *atella*

Brewer's grain: BG is one of the most important by-products used as livestock feed. It consists of the extracted residues of the grains used in the brewing industry and is characterized by a high energy value and protein content. BG has a lignocellulosic material containing about 170 g/kg cellulose, 280 g/kg non-cellulosic and non-starch polysaccharides, or arabinoxylans. Fresh brewers' grain has a low DM content (250 ± 31.3 g/kg fresh weight) and high protein and fiber contents (218 ± 34.2 and 618 ± 63.9 g/kg DM, respectively). They are widely used in ruminant feeding as a forage or concentrate feed replacer and have an estimated Metabolizable Energy (ME) value of 11.5 ± 0.65 MJ/kg DM.

Atella: Several studies have been conducted on the chemical composition and nutritional effect of *atella* on dairy cattle, small ruminants and poultry, but there is only one work available on the degradability and digestibility of *atella* on dairy cows.

Atella consists of protein, fat, carbohydrates, vitamins, minerals and yeast formed during fermentation. It is mainly used as a protein supplement, and soluble carbohydrates, which would enhance microbial assimilation of ammonia in the rumen [21-25]. The chemical composition of atella varies between different authors based on the source and ingredient composition of tella. From the authors, Negesse (2009)found 535 g/kgNDF, 336 g/kg ADF, 214 g/kg lignin, 187 g/kg CP, 15 g/kg non-protein N (NPN), 53 g/kg Ether Extract (EE) and phytate, 507 g/kg DOM and 191 g/kg VFA concentration. However, the composition may vary due to ingredient types and proportion. The crude protein content of brewery *atella* ranged from 165 g/kg for millet, sorghum, and barley to 242 g/kg for barley, and millet. It indicates that nutritional value is influenced by the raw materials, grain types and the preparation process. The moisture composition (200-300 g/kg DM) of *atella* and wet brewers' grains are similar as recovered from the brewing process.

The digestibility of CP is higher for pure *atella* supplemented for sheep as compared to other supplemented feeds (coffee pulp, poultry litter, wheat straw, and hay) and similar result of higher nitrogen digestibility in sheep supplemented with *atella* compared with faba bean, field pea, and rough pea hulls. The higher digestibility may be due to higher intake of dietary protein since CP intake is usually associated with better CP digestibility (Table 2).

Author	Chemical composition (g/kg)						
	DM	OM	CP	EE	NDF	ADF	lignin
(Demeke, 2007)	920	604	218	715	540	290	11
(Nurfeta, 2010)	-	507	187	53	535	336	-
(Mekasha et al., 2003)	132	980	210	-	595	212	-
(Almaz et al., 2012)	938	964	212	-	347	214	-

(Negesse, 2009)	-	533	336	53	535	336	-

Table 2: Summary of the chemical composition of *atella* taken from different authors.

However, lower feed intake, weight gain and Protein Efficiency Ratio (PER) value for atella than brewers' grain. The lower nutrient digestibility of *atella* supplement compared with other supplements like brewers' grain is possibly due to the low palatability, low voluntary intake, and poor digestibility of the diet [26-28]. Heating applied during roasting of the flour could make the proteins in *atella* more resistant to ruminal degradation and reduce digestibility, by the formation of a nutritionally unavailable dark-colored amino-sugar complex or Maillard reactions. Sun-dried *atella* have lower DM and OM digestibility than fresh (wet) *atella*. The moisture content of atella could be attributed to the difference in the physical and chemical characteristics of *atella*. The higher neutral detergent soluble levels in *atella* as compared with malt sprout could also contribute for lower digestibility of *atella* (Table 3).

Measurement	BG (g/kg DM)c	Tella *Atella* (g/kg DM)
Dry Matter	156 ± 23a	132b
Organic matter	980	980
Crude Protein	259 ± 28	210
Crude fiber	158 ± 21	201c
NDF	563 ± 57	595
ADF	219 ± 31	212
Lignin	54 ± 19	50b
Ether extract	67 ± 22	62c
Hemicellulose	383	38.3ab
Ash	46 ± 9	45
OM digestibility, ruminants Nitrogen digestibility,	630 ± 40	548
Ruminants (%)	70.2 ± 6.9	74 – 81bc

Table 3: The comparison of chemical composition, in-vitro organic matter digestibility of wet brewers' grain and *atella*.

Animals consume energy to maintain basal metabolic function, homeostasis, feed uptake and walking. This energy requirement can be generated by feeding non-conventional feed sources like brewers' grain through supplementation with pasture (Table 4).

Ruminant nutritive values	g/kg DM
Gross energy MJ/kg DM	19.7 ± 1.8
Energy digestibility, ruminants (%)	63.2
DE ruminants, MJ/kg DM	12.4
ME ruminants, MJ/kg DM	9.9

Table 4: The energy supply of Brewers'grain for ruminants' nutrition (g/kg DM).

Brewers' grain mainly composed of 17 amino acids including the major amino acids (cysteine, lysine and methionine). However, the composition of these amino acids varies with the microbial species used in the degradation process.

Amino acids	His	Iso	Leu	Lys	Met	Phe	Thr	Try	Val
Percent of protein (mean ± Sd)	1.8 ± 0.4	4.2 ± 1	8.2 ± 1	8.2 ± 1	1.5 ± 0.4	5.3 ± 0.5	3.2 ± 0.3	1.2	4.8 ± 0.8

Table 5: Amino acid composition of Wet brewers' grain.

Conclusion

Although the production process including the principles of alcoholic fermentation of tella and beer are similar, there seems a difference in the chemical composition and nutritional value of their by-product i.e, *atella* is lower than brewers' grain. This difference might have occurred due to the raw materials and production methods used.

Conflict of Interest

The authors have no conflict of interest.

Acknowledgement

I thank Prof. Dr. ir Veerle Fievez for supervision and advice in all phases of the preparation of the paper.

References

1. Alemayehu Tadesse, Matovu M, Tesfay Y, Breusers M and Fievez V (2016) Balanced feeding could improve the productivity of cross-breed dairy cattle in smallholder systems. Conf. Solidarity in a Competing World-Fair Use of Resources, Tropentag 2016, Vienna, Austria. 19-21.
2. Almaz A, Tamir B and Melaku S (2012) Feed intake, digestibility and live weight change of lambs fed finger millet (eleusinecoracana) straw supplemented with atella, noug seed (guizotiaabyssinica) cake and their mixtures. Agri Tropica Subtrop. 45: 105-111.
3. Ayenew YA, Wurzinger M, Tegegne A and Zollitsch W (2009) Performance and limitation of two dairy production systems in the North western Ethiopian highlands. Trop Anim Health Product. 41: 1143-1150.
4. Bartle SJ, Kock SW, Preston RL, Wheeler TL and Davis GW (1987) Validation of urea dilution to estimate in vivo body composition in cattle. *J Anim Sci*. 64: 1024-1030.
5. Berhanu A (2013) Microbial profile of Tella and the role of gesho (Rhamnus prinoides) as bittering and antimicrobial agent in traditional Tella (Beer) production. Int Food Res J. 21: 357-365.
6. Blair R (2011) Nutrition and feeding of organic cattle. Oxfordshire, UK, CABI. 285.
7. Burger WC, LaBerge DE (1985) Malting and brewing quality. *Barley*. 367-401.
8. Crawshaw R (2003) Co-product feeds: Animal feeds from the food and drinks industries. J Sci Food Agri. 83: 362-362.

9. Demeke S (2007) Comparative nutritive value of Atella and industrial brewers grains in chicken starter ration in Ethiopia. Livestock Res Rural Dev. 19.
10. Ensminger PA (1997) The history and brewing methods of Pilsner Urquell Divining source of the world's most imitated beer, Brewing Techniques.
11. Fuller MF (2004) The encyclopedia of farm animal nutrition. CABI Publishing Series. 606.
12. Goering HK, Gordon CH, Hemken RW, Waldo DR and Van Soest PJ, et al (1972) Analytical estimates of Nitrogen digestibility in heat damaged forages1. *J Dairy Sci*. 55: 1275-1280.
13. Huige NJ (1995) Brewery by-products and effluents. In: W.A. Hardwick (Ed.), Handbook of Brewing, Marcel Dekker, New York. 501-550.
14. Lee M, Regu M and Seleshe S (2015) Uniqueness of Ethiopian traditional alcoholic beverage of plant origin, tella. J Ethnic Foods. 2: 110-114.
15. Matovu M (2016) Feed and feed supply characterisation on Peri-Urban smallholder dairy farms with improved breeds in the Tigray region, Northern Ethiopia.
16. Mekasha Y, Tegegne A and Rodriguez-Martinez H (2007) Effect of supplementation with agro-industrial by-products and khat (catha edulis) leftovers on testicular growth and sperm production in ogaden bucks. J Vet Med Ser. 54: 147-155.
17. Mekasha Y, Tegegne A, Yami A and Umunna NN (2002) Evaluation of non-conventional agro-industrial by-products as supplementary feeds for ruminants: In vitro and metabolism study with sheep. Small Ruminant Res. 44: 25-35.
18. Mekasha Y, Tegegne A, Yami A, Umunna NN and Nsahlai IV (2003) Effects of supplementation of grass hay with non-conventional agro-industrial by-products on rumen fermentation characteristics and microbial nitrogen supply in rams. Small Ruminant Res. 50: 141-151.
19. Merchen N, Hanson T and Klopfenstein T (1979) Ruminal bypass of brewers dried grains protein. *J Anim Sci*. 49: 192-198.
20. Mussatto SI, Dragone G and Roberto IC (2006) Brewers' spent grain: Generation, characteristics and potential applications. J Cereal Sci. 43: 1-14.
21. Negesse T (2009) Nutrient composition, volatile fatty acids production, digestible organic matter and anti-nutritional factors of some agro-industrial by-products of Ethiopia. SINET: Ethiopian J Sci. 32: 149-156.
22. Negesse T, Makkar HPS and Becker K (2009) Nutritive value of some non-conventional feed resources of Ethiopia determined by chemical analyses and an in vitro gas method. Anim Feed Sci Technol. 154: 204-217.
23. Nurfeta A (2010) Feed intake, digestibility, nitrogen utilization, and body weight change of sheep consuming wheat straw supplemented with local agricultural and agro-industrial by-products. Trop Anim Health Prod. 42: 815-824.
24. Opstaele F, Rouck G, Clippeleer J, Aerts G and Cooman L (2010) Analytical and sensory assessment of hoppy aroma and bitterness of conventionally hopped and advanced hopped pilsner beers. J Inst Brew. 116: 445-458.
25. Sogbesan AO and Ugwumba AAA (2008) Nutritional values of some non-conventional animal protein feedstuffs used as fishmeal supplement in aquaculture practices in Nigeria. Turk J Fish Aquat Sci. 8: 159-16.
26. Tadesse A, Yayneshet T (2011) Comparative chemical composition evaluation of local brewery and liquor by-products made from different ingredients. *J Drylands*. 4: 307-309.
27. Tesfay G (2014) Dairy cattle production system in the central zone of Tigray: In the case of Aksum and Adwa. *Global J Anim Sci Res*. 2: 151-158.
28. Willaert R (2007) The beer brewing process: Wort production and beer. Handbook Food Products Manufacturing. 2: 443.

How to cite this article: Jalata Badasa. "Mini Review on Comparison of Production Process and Nutritive Value of Atella and Brewers' Grain; In Ethiopian Context ." *J Vet Sci Technol* 13 (2022) : 136.