BNJAR

Blue Nile Journal of Agricultural Research (BNJAR)
Vol. 2, Issue. 2, *December*, 2021, pp. 74-82

Journal homepage: https://www.arari.gov.et/index_bnjar.php

Effect of Substitution of Wheat Bran and Soybean Cake Mixture with Dried Breweries Grain on Milk Yield and Composition of Crossbred Dairy Cows Fed Natural Pasture Hay as Basal Diet

Ashenafi Kebede[1]*, Tesfa Getachew[1], Tefera Mekonen[1], Beneberu Teferra[1] and Liulseged Alemayehu[1]
[1*]Debre Birhan Agricultural Research Center, P.O. Box 112, Debre Birhan, Ethiopia
Corresponding author email: ashuktsige1977@gmail.com

Received: August 13, 2021
Revised: November 22, 2021
Accepted: December 22, 2021
Available online: December 29, 2021

Keywords: *Cost-benefit, Cross-bred cow, Breweries grain, Milk*

ABSTRACT

The objective of this experiment was to evaluate the effect of substitution of commercial concentrate mix with dried breweries grain on milk yield, milk composition, of crossbred dairy cows fed natural pasture hay as a basal diet, and cost-effectiveness of dried breweries grains as dairy cow feed. The experimental design was a 4 ×4 Single Latin Square Design using. The treatments were: T1: Natural pasture hay adlib +100% dried brewers' grain, T2: Natural pasture hay adlib + 66.33% dried brewer grain +33.33% wheat bran and soybean cake mixture, T3: Natural pasture hay adlib + 33.33% dried brewers' grain +66.66%, wheat bran and soya bean mixture T4: Natural pasture hay adlib + 100% wheat bran and soya bean mixture. The wheat bran and soya bean mixture were made manually by mixing soya bean cake (20%), wheat bran (78%), and common salt (2%). Milk yield and composition were similar (P > 0.05) between treatments. The daily milk yield was 9.4, 8.4, 8.5, and 9.1 liters per day for treatments 1, 2, 3, and 4, respectively. The milk fat was 4.63, 4.48, 4.46 and 4.41%, protein 3.28, 3.09, 3.06 and 3.2%, solid not-fat 8.69, 8.4, 8.9 and 8.78%, and lactose 4.79, 4.47, 4.42 and 4.74% for treatments 1, 2, 3, and 4, respectively. The result of the current study shows that breweries dried grain can replace wheat bran and soya bean cake mixture with a similar effect on milk yield and compositions, and this has been supported by biological and financial evidence. Therefore, it can be concluded that the dried grain could be used as a supplement to the lactating crossbred dairy cows where breweries' grain of the brewery is available under the conditions of the present study.

1. INTRODUCTION

Ethiopia has a great potential for dairy development due to its large cattle population (65.4 million cattle) (CSA, 2020), the existence of suitable agroecologies for dairy cattle production, the large and diverse genetic resources, increasing domestic demand for milk and milk products, better market opportunities, and proximity to the international market (Tegegne et al 2013). Given the considerable potential for smallholder income and employment generation from high-value dairy products, the development of the dairy sector in Ethiopia can contribute significantly to poverty alleviation and nutrition in the country. However, the contribution of the dairy sector to the national economy is low compared to its potential, which is mainly attributed to a problem related to the supply of quality feed. North Shewa is one of the potentials milk-shed areas in the country where a large amount of milk has been collected by private and cooperative milk collection centers (Wytze et al 2012). Understanding the potential, governmental and non-governmental organizations have been making efforts to improve the dairy cow productivity through the introduction of exotic dairy breeds in the area. Currently, large numbers of crossbred dairy cows are found in the area, especially along the main roads (Admasu et al 2019). However, milk yield was not increased as expected and this could be attributed to due to poor nutrition (Admasu et al 2019). Hence, to improve the overall productivity of dairy cows, dairy cow feeding management should also get due attention.

Feed shortage in terms of quality and quantity is the main constraint regardless of the dairy production system and agroecology. Feed constraints could be seen from a different dimension in terms of quality and quantity and seasonal feed supply to meet the nutritional requirements of dairy animals. Both roughage and concentrate feeds are either too expensive or unavailable in sufficient quantity and quality to improve dairy production (Ulfina et al 2013). Crop residue and natural pasture hay constitute the main feed of dairy cows. However, these feeds are poor in quality and even unable to satisfy the maintenance requirements. Though supplementation of dairy cows with commercial concentrate improves the productivity of dairy cows, due to the shortage of agro-industrial by-products and its soaring price, the use of concentrate supplements in dairy cow feed is not widely practiced (Tegegne A. et al 2013). Therefore, alternative feed resources should be sought to minimize production costs and optimize dairy production.

Brewery grain is rich in CP (20%) (Seyoum et al 2007) and has high digestibility (Fekede et al 2015). Brewery grain has a higher level of CP (~27% CP) and is a good source of bypass protein (Fekede et al 2015). Moreover, it contains easily fermentable fibers (Hersom 2006). Currently, in Debre Birhan city breweries, grain has been produced from two brewery factories (Dashen and Habesha beer), and dairy producers have been using breweries grain to supplement dairy cows. However, the effect of substituting a concentrate mixture made of wheat bran and soybean cake with dried brewers' grain in dairy cow feed on milk yield and composition is not well documented. Therefore, the objectives of this study were to evaluate the effect of the substitution of commercial concentrate mix with dried brewers' grain on milk yield and composition of cross-bred dairy cows and the cost-effectiveness of using dried brewery grain in dairy cow feed.

2. MATERIALS AND METHODS

2.1. Description of the Study Area

The experiment was carried out at the Debre Birhan Aggricultural Research Center. The area is located in the central Highlands of Ethiopia at about 120 km north-east of Addis Ababa, at an altitude of 2800 meters above sea level. The geographical location of Debre Birhan is 09º 35' 45" to 09º 36' 45" north latitude and from 39º 29' 40" to 39º 31' 30" east longitude (NSRC 2006).

2.2. Experimental Animals and Their Management

Four lactating crossbred dairy cows (local zebu x Holstein Fresian) with 62.5-75% blood levels were selected from the dairy cattle herd of Debre Birhan Agricultural Research Center and used for the study. Cows with 2-3 months of lactation were selected and used for this study. The daily milk yield ranged from 8-10 liter/day. The cows were treated for external and internal parasites. The cows were randomly assigned to one of the four treatments at each period so that every cow gets one of the four treatments across four periods without replication within the period. The cows were kept indoors and fed individually.

2.3. Feed Preparation and Feeding

The natural pasture was harvested in October–November/2019 at DBARC, cured, baled, and kept under the shad until the experiment. Brewery grain was bought from Habesha brewery factory; air dried and used for this study. The wheat bran and soybean cake mixture were made manually by mixing soya bean cake (20%), wheat bran (78%) and common salt (2%). The supplements were iso-nitrogen with (23.7 % CP based on the CP concentration of the concentrate mixture. Natural pasture hay was fed adlibtum and supplement was offered according to milk yield; Daily 0.5kg of concentrate was supplemented for every liter of milk produced. The daily allowance was

divided into two equal portions and the first half was fed at 10:00 am and 4:00 pm. The cows were milked by hand twice daily at 05:00 am and 5:00 pm.

2.4.Chemical Analysis of the Feed

The feed samples were dried at 60^{O}C in a forced draft oven for 48 hours and ground to pass through a 1mm mesh screen size. The ground samples were stored in airtight plastic containers pending chemical analysis. Dry matter (DM), ash, and crude protein (CP) were analyzed according to the procedures of AOAC (2005). Neutral detergent fiber (NDF), acid detergent fiber (ADF), and acid detergent lignin (ADL) were analyzed using the procedures of Van Soest and Robertson (1994).

2.5.Experimental Design and Treatment

A single 4 × 4 Latin square design was used for the study. There were four treatments and four periods. Each period consisted of 14 days of adaptation and 7 days of the measurement period, and the experiment was conducted for a total of 84 days. Experimental animals were randomly assigned to one of the four treatments at each period so that each animal gets all the treatments at the end of the experiment. The treatments were;

T1= Natural pasture hay adlib +100% dried breweries grains

T2= Natural pasture hay adlib + 66.33% dried brewery grains +33.33% wheat bran and soybean cake mixture

T3= Natural pasture hay adlib + 33.33% dried brewery grains +66.66% wheat bran and soya bean mixture

T4= Natural pasture hay adlib + 100% wheat bran and soya bean mixture

2.6.Data Collection and Analysis

Milk yield was measured for seven

consecutive days following 15 day acclimatization period. For each period and cow, the average seven-day milk yield was used for analysis. A milk sample was collected on the 7th day of the data collection period for each period. Milk yield and composition data were analyzed using a mixed model of SAS (9.4). Milk composition analysis (fat, protein, lactose, nonfat solids and density) analysis was performed at Debre Birhan university laboratory using a lacto scan (Milkotronic-ultrasonic milk analyzer, Milkotronic Ltd). The milk sample was collected during the morning and evening milking time, well shaken using a magnetic stirrer, and a duplicate sample was tested.

Model for data analysis

The data was analyzed using the following model;

$$Y_{ijk} = \mu + P_i + C_j + T_k + PT_{ik} + E_{ijk}$$

Eq.1

Where:

Y_{ijk} = dependent variable, μ= the overall mean, P_i = the effect of period i, C_j = the effect of cow j, T_k = the effect of treatment k, PT_{ik} = the interaction between period i and treatment k, E_{ijk} = the residual error.

Cost-Benefit Analysis

Data such as supplementary feed cost, initial and final milk yield, and milk price per liter were taken. The labor cost for drying the breweries grain was considered. The cost-benefit analysis was performed to assess the economic advantage of the different treatments. The market price of milk was estimated from the local market during the experiment execution time. Fixed costs such as feeding troughs, feeding pen, etc., and grazing on natural pasture was free of charge and common for all experimental cows. Here, fixed costs are not included in the gross margin analysis since they are unrelated to higher levels of milk production, and they do not affect the optimal combination of variable inputs. This estimation is consistent with Mburu *et al*., (2007) and Mumba *et al*., (2011). The authors estimated the gross margin by excluding the fixed costs of dairy farms and were not considered for analysis.

For the calculation of the variable costs, the expenditures incurred on various feedstuffs were taken into account. The cost of the supplementary feeds was computed by multiplying the actual intake per day by the prevailing prices. The gross margin is the difference between the Gross Return (GR) and the Total Variable Cost (TVC).

$$GM = GR - TVC$$

Eq.2

The gross margin is not profit because it does not include fixed or common costs such as depreciation and interest expenses that have to be met regardless of the production volume. The main use of the gross margins is recognition of the individual treatment performance.

Benefit-Cost Ratio (BCR)

Eq.3

The benefit-cost ratio is given by the ratio of gross return to total variable costs.

$$BCR = \frac{GR}{TVC}$$

Eq.4

If the ratio is less than one, then the costs exceed the benefit. However, if the ratio is more than one, then the benefits exceed the costs (Jehanzeb, 1999).

3. RESULTS AND DISCUSSIONS

3.1. Chemical Composition of Experimental Feeds

The chemical composition of feeds used in the present study is shown in Table 1.

Natural pasture hay had high fiber (NDF 75.59% and ADF 61.24%) and very low CP% (6%), indicating poor quality. The CP content of natural pasture hay was below 7%, which required meeting the maintenance requirement of ruminants (CSIRO 2007). Furthermore, the NDF and ADF content of natural pasture hay was above the level that can limit voluntary feed intake (Harper and McNeill 2015). In the current study, the highest CP was recorded for soybean cake (48 %) and dried breweries grain (23.73 %), respectively, indicating that both can be used as a protein supplement (Ranjhan 2001 and Seyoum *et al* 2007). The chemical composition of wheat bran is comparable with previous reports (Seyoum *et al* 2007), soybean cake and wheat bran had the lowest fiber (NDF and ADF) values, respectively. Since fiber in dried brewery grains is easily fermentable (Taminga et al 1990 and Ojowi et al 1997), the higher NDF and ADF content of DBG could not limit feed intake. Compared to wheat bran, the ME content of DBG is low and it should be supplemented with an energy supplement for optimum production. However, the CP content of DBG observed in the current study can satisfy the CP requirement of a lactating cow under the condition of the current study (NRC 2001).

Table 1: Chemical Composition of Experimental Feeds (% DM basis)

Chemical composition (%)	**Hay**	**DBG**	**WB**	**SBC**
DM	88	92.5	88.96	89.4
Ash	8.6	6.9	5.02	4.9
CP	6	23.73	15.87	48
NDF	75.59	65.23	41.16	13
ADF	61.24	31.2	15.03	7.2
ADL	31.11	11.11	10	4

DM = dry matter; CP = crude protein; NDF = neutral detergent fiber; ADF = acid detergent fiber; DBG=Dried Brewer's grain, WB=Wheat Bran, SBC= Soya bean Cake

Milk Yield and Composition

There was a similar (P > 0.05) milk yield among experimental diets (Table 2), indicating that the milk yield could not be affected by the substitution of concentrate mix with DBG fed to lactating crossbred dairy cows. Despite lower ME concentration of DBG than concentrate mix, milk yield was not reduced as the level of DBG increased in the diet, which might be due to the existence of highly fermentable fiber in DBG (Ranjhan 2001) and higher rumen undegradable protein contained in DBG (Kassem 2002). Because feed intake was not measured, it is difficult to evaluate whether CP and ME intake were satisfied or not, which is the limitation of the current study. Similar (P > 0.05) milk compositions were observed between treatments (Table 2).

In agreement with the current findings, Firkins et al (2002) and Said Mahnken (2010) reported similar milk protein and fat for Holstein cows fed with different levels of BSG inclusion. Similarly, Dhiman et al (2003) reported similar milk fat, protein, and solid not-fat (SNF) when dried and wet brewers grain was used as a protein source in the ration of Holstein-Frisian dairy cows. In contrast (Al-Talib et al 2014) and Polan et al 1985) who reported differences in milk protein and fat between dried breweries grain and a control diet that contain soya bean meal in the rations. In disagreement with the current findings improved milk fat was reported for dairy cows supplemented with dried breweries grain than in the control group which was supplemented with soya bean meal and maize grain (Belibasakis and Tsirgogianni 1996). Moreover, Kaset (2000) noted an increase in milk protein and fat in Holstein dairy cows when supplemented with dried brewers' grains compared to the control group. The discrepancy among the studies might be due to differences and the composition of the feed. The similar milk composition observed in the present study suggested the substitution of concentrate mix that was made with a mixture of soybean cake and wheat bran with dried grain from breweries.

Table 2: Effect of supplementation of different proportions of commercial concentrated and dried brewery grains on milk yield and composition of crossbred dairy cows

Treatments	Milk yield (L/day)	Milk composition				
		Fat (%)	Protein (%)	Lactose (%)	SNF (%)	Density (%)
1	9.40	4.63	3.28	4.79	8.69	30.83
2	8.40	4.48	3.09	4.47	8.4	29.46
3	8.51	4.46	3.06	4.42	8.9	30.13
4	9.10	4.41	3.2	4.74	8.78	31.13
SEM	0.81	0.2369	0.10112	0.1263	0.2202	0.5989
Sig	ns	ns	ns	ns	ns	ns

T1= Natural pasture hay adlib +100% dried brewery grains, T2= Natural pasture hay adlib + 66.33% dried brewery grains +33.33% wheat bran and soya bean cake mixture, T3= Natural pasture hay adlib + 33.33% dried brewery grains +66.66% wheat bran and soya bean mixture, T4= Natural pasture hay adlib + 100% wheat bran and soya bean mixture, SEM= standard error of the mean, SNF= Solid nonfat, ns=non-significant

Cost-Benefit Analysis

The financial analysis of the experiment is computed and described for each treatment (Table 3). The benefit-cost ratio (BCR) is a ratio used in a cost-benefit analysis to summarize the overall relationship between the relative costs and benefits of a proposed project. The main cost that determined the profitability of milk production was the feed cost compared to the non-feed cost (Table 3). Aganga et al (2005) reported that under intensive and semi-intensive livestock production systems, a large proportion of costs are feed costs which are similar to this study.

Table 3: Cost-Benefit analysis for different feeding treatments

Specific Items and their cost	**Units**	**T1**	**T2**	**T3**	**T4**
Average initial milk yield	Lt/cow/day	8.50	8.50	8.50	8.50
Average final milk yield	Lt/cow/day	9.39	8.40	8.49	9.10
Average milk increment	Lt/cow/day	0.89	-0.10	-0.01	0.60
Milk price	Birr/liter	17.30	17.30	17.30	17.30
Gross Return (GR)	Birr/cow/day	162.45	145.32	146.88	157.43
Amount of feed per day	kg/cow/day	4.25	4.25	4.25	4.25
Price of supplement feed per day	Birr/cow/day	13.56	15.76	19.97	24.22
Cost of supplement feed per day	Birr/cow/day	57.63	66.98	84.87	102.94
Amount of hay per day	kg/cow/day	11.25	11.25	11.25	11.25
Price of supplement hay per day	Birr/cow/day	5.38	5.38	5.38	5.38
Cost of supplement hay per day	Birr/cow/day	60.53	60.53	60.53	60.53
Total Variable Vost (TVC)	Birr/cow/day	118.16	127.51	145.40	163.46

Gross Margin (GM)	Birr/cow/day	44.29	17.82	1.48	-6.03
Benefit Cost Ratio (BCR) on variable costs		1.37	1.14	1.01	0.96

T1= Natural pasture hay adlib +100% dried brewery grains, T2= Natural pasture hay adlib + 66.33% dried brewery grains +33.33% wheat bran and soya bean cake mixture, T3= Natural pasture hay adlib + 33.33% dried brewery grains +66.66% wheat bran and soya bean mixture, T4= Natural pasture hay adlib + 100% wheat bran and soya bean mixture,

The cost-benefit analysis showed that the total replacement of the wheat bran and soybean cake mixture by DBG reduces the cost of production. The net return was increased when the replacement levels of dried brewery grain increased from 0 - 100% replacement. The average daily cost of feed also decreased with increasing DBG levels due to the reduction in the cost per kg of dietary DM. The current result was in line with Andressa Faccenda *et al.* (2017) reported that the total replacement of soybean meal with DBG reduces the cost by \$0.04 kg^{-1} of dietary DM. The average daily cost of feed also decreased with increasing DBG levels due to the reduction in the cost kg^{-1} of dietary DM and the decline in DM intake. Therefore, T1 could be used as a supplement to hay and customary cow grazing and can obtain a GM of approximately 44.29 Birr Day^{-1} in the highlands of North Shewa of the Amhara region, Ethiopia.

4. CONCLUSION AND RECOMMENDATION

The substitution of a concentrate mixture made with a mixture of wheat bran and soybean cake with dried grain from breweries resulted in similar milk yield and composition. Moreover, the cost-benefit ratio treatment supplementation of sole dried breweries grain has a benefit-cost ratio value of 1.37 which indicates that supplementation of lactating dairy crossbred cows with dried breweries grain estimated benefits outweigh its costs. Additionally, farmers using T1 could expect ETB 1.37 benefits for each ETB 1 of costs. Therefore, based on the cost-benefit result, supplementation of sole dried breweries grain is recommended in areas where breweries grain is available under the condition of the current study.

REFERENCES

Admasu L, Gebeyehu G, Ashenafi M, Gezahegne M and Tilaye D (2019). Socio-Economic Characteristics of Urban and Peri-Urban Dairy Production Systems in Selected Districts of North Shoa Zone Milk Shed Areas, Ethiopia. Advances in Biological Research 13 (1): 24-29.

Aganga A, Letata P and Tsiane M (2005). Molasses urea block as a supplementary feed resource for r ruminants in Botswana. J. Animal Vet. Adv. 4 (5); 524-528, 05.

Ali A, AL-Talib, Abdul-Nassir Th, AL-Khashab, Mozhir K and Almahdawi (2014). Effect of introducing dried brewer's grains in the diets of dairy cows on milk production and its composition, Euphrates Journal of Agriculture Science-6 (3): 50-64

Andressa F, Maximiliane A, Deise D, André S, Tatiane F, Everline I, Fernando A and Cibele R (2017). Use of dried brewers' grains instead of soybean meal to feed lactating cows. Brazilian Journal of Animal Science 46(1):39-46.

AOAC (2005). Official Methods of Analysis of Association of Official Analytical Chemists, 18th edition

Belibasakis N and Tsirgogianni (1996). Effect of wet brewer's grains on milk yield, milk composition and blood components of dairy cows in hot weather. Animal Feed Science and Technology; 57(Issue 3): 175-181.

CSA (Central Statistic Agency) (2020). Agricultural Sample Survey 2019/20. Report on Livestock and Livestock Characteristics (Private Peasant Holdings), Central Statistical Agency (CSA), Addis Ababa, Ethiopia. In Report on livestock and livestock characteristics: Vol. II (Issue March).

CSIRO (2007). Nutrient requirements of domesticated ruminants. CSIRO Publishing, Collingwood Australia. 270p.

Fekede F, Getu K and Getnet A (2015). Nutritional qualities of agro-industrial by-products and local supplementary feeds for dairy cattle feeding. Ethiop. J. Agric. Sci. 26(1) 13-26.

Firkins J D I, Harvantine J, Sylvester M and Eastridge (2002). Lactation performance by dairy cows fed wet brewers grains or whole cottonseed to replace forage. Journal of dairy science; 85 (Issue 10): 2662-2668.

Harper K and McNeill D (2015). The Role NDF in the Regulation of Feed Intake and the Importance of Its Assessment in Subtropical Ruminant Systems (the Role of iNDF in the Regulation of Forage Intake). Agriculture, 5(3), 778–790. https://doi.org/10.3390/agriculture5030778

Hersom and M J (2006). "By-product feed utilization for forage diets". In: 55th Annual Florida Beef Cattle Short Course, Gainesville: University of Florida Institute of Food and Agricultural Sciences. pp 5–14.

Jehanzeb (1999). Economic Efficiency of the Agrarian Structure in the North West Frontier Province of Pakistan: An Econometric Analysis. Ph.D. thesis, Department of Economics, The University of Peshawar.

Kaset and Warasan (2000). Effect of dried brewers' grains levels in diets on milk yields and milk composition in Holstein Friesian dairy cows. Journal of Agriculture; 16(1); 83-91.

Kassem M, Thomas P and Chamberlain D (2002). Food intake and milk production in cows given barley supplements of reduced ruminal degradability. Recent Technologies in Agriculture Proceedings of the 2nd Congress, Special Ed. Faculty of Agric. Cairo University, 27-30 October, 564- 570.

Mahnken and Christa Lynn (2010). Utilization of wet brewer grains as a replacement for corn silage in lactation dairy cows' diets, Master of Science thesis Department of Animal Science and Industry, College of Agriculture, Manhattan, Kansas, USA.

Mburu LM, Gitu K W and Wakhungu J W (2007). A cost-benefit analysis of smallholder dairy cattle enterprises in different agro-ecological zones in Kenya highlands. Livestock Research for Rural Development. Volume 19, Article #95. Retrieved November 14, 2018, from http://www.lrrd.org/lrrd19/7/mbur19095.htm.

Mumba C, Samui K L, Pandey G S, Hang'ombe B M, Simuunza M, Tembo G and Muliokela S W (2011). Economic analysis of the viability of smallholder dairy farming in Zambia. Livestock Research for Rural Development 23, No 137. http://www.lrrd.org/lrrd23/6/mumb23137.htm.

NSRC (National Soil Research Center) (2006) Soils of the farms of Debre-Birehan agricultural research center and its testing sites, Technical report NSRC, Addis Ababa,

Ethiopia, 57p.
NRC (2001). The nutrient requirement of dairy cattle: Seventh revised edition, The national academic press. https://doi.org/10.17226/9825
Polan C, Herrington T, Wark W and Armentano L (1985). Milk production response to a diet supplemented with dried brewers grains or soybean meal. Journal of dairy science; 68(Issue 8): 2016-2026.Protein. J. Anim. Sci. 49:192.
Seyoum B, Zinash S and Dereje F (2007). Chemical composition and nutritive values of Ethiopian feeds. Research report 73, Ethiopian Institute of Agricultural Research Addis Ababa, Ethiopia 24p
Tegegne A, Gebremedhin B, Hoekstra D, Belay B and Mekasha Y (2013). Smallholder dairy production and marketing systems in Ethiopia: IPMS experiences and opportunities for market-oriented development, IPMS (Improving Productivity and Market Success) of Ethiopian Farmers Project Working Paper 31. Nairobi: ILRI.
Ulfina G, Jiregna D, Alganesh T, Shiv P and Late M (2013). Dairy production potential and challenges in Western Oromia milk value chain, Oromia, Ethiopia. Journal of Agriculture and Sustainability 2: 1-21.
Van Soest P (1994). Nutritional Ecology of the Ruminants, Cornell University Press, New York, USA 476p.
Wytze B, Dawit M, Binyam K, Mahlet Y and Jan L (2012). The Major Ethiopian Milksheds; Wageningen, Wageningen UR (University & Research Centre) Livestock Research, Livestock Research Report 735, 245 blz.