

## Performance of organic goat milk production in grazing systems in Northern Germany

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### Abstract

Organic farming has emerged from its niche. This holds true for organic goat milk, yoghurt and cheese as well. Particularly in the EU, many dairy goat farms have converted or want to convert towards organic farming to profit from the positive image and the good prices for milk (+100 % in Western Europe and Alpine regions).

High performance dairy goats demand excellent feedstuffs, a sound environment and top management. It was not clear how organic farming can fulfil these demands. The restrictive factors influencing the productivity of the animals in organic farming are as follows: limited concentrate feeding (<40 % of ration), grazing systems with seasonal and annual changes in roughage qualities due to weather conditions and the prohibition of preventive and allopathic veterinary intervention.

High performance dairy goat breeds like Alpine goats can produce about 600 to 800 kg milk with 40 to 50 kg fat and protein per 240-days under organic farming standards. The yield is limited due to roughage quality and management (health, breeding). Considering the high price (conventional: 0.38 Euro, organic: 0.70 Euro kg<sup>-1</sup>), organic goat milk is a profitable product.

*Keywords: Organic Farming, Dairy goats, milk performance, grazing system*

### Zusammenfassung

#### Milchleistung von Ziegen im Ökologischen Landbau mit Weidewirtschaft in Norddeutschland

Der Ökologische Landbau hat die Nische verlassen. Dies gilt auch für Ziegenmilch, -jogurt und -käse. In der EU haben viele Milchziegenbetriebe auf Ökologischen Landbau umgestellt, um vom positiven Image aber auch den guten Preisen zu profitieren (+100 % in West-Europa und besonders den Alpenregionen).

Hochleistungsziegen benötigen bestes Futter, eine die Gesundheit erhaltende Umwelt und bestes Herdenmanagement. Es ist nicht bekannt, ob der Ökologische Landbau diese Bedingungen erfüllen kann. Begrenzter Kraftfuttereinsatz (<40 % Futteranteil in TS) und die Weidewirtschaft (Wetter, stark schwankende Raufutterqualitäten) und die Einschränkungen bei den veterinär-medizinischen Maßnahmen (Verbot des vorbeugenden Einsatzes von Tierarzneimitteln wie z. B. Entwurmungsmitteln) wirken sich auf die Leistung der Tiere aus.

Hochleistungsrassen wie die Bunte Deutsche Edelziege können im Ökologischen Landbau mit Weidewirtschaft 600 bis 800 kg Milch mit 40 bis 50 kg Fett und Eiweiß pro Jahr produzieren (240-Tage-Leistung). Die Raufutterqualität und die Witterung haben einen großen Einfluss auf die Leistung. Bei feuchtem Wetter bzw. Regen grasen Ziegen nicht gerne, die Raufutterqualität ist durch die extremen Wachstumsphasen nicht immer in gleich guter Qualität verfügbar und die Raufutterwerbung für das Winterhalbjahr besonders bei Heuproduktion immer wieder durch unvorhersehbare Witterungsereignisse beeinflusst (überständiges oder verregnetes Raufutter). Aufgrund der hohen Preise für ökologisch produzierte Ziegenmilch (konventionell: 0,38 Euro, ökologisch 0,70 Euro pro kg) ist die ökologische Ziegenmilchproduktion ökonomisch wettbewerbsfähig.

*Schlüsselwörter: Ökologischer Landbau, Milchziegen, Milchleistung, Weidewirtschaft*

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## 1 Standards for organic goat farming in the EU

Organic agriculture is considered an environmentally sound and socially acceptable land use system with “natural” food production (FAO, 2000). Organic farming is a food production label and is becoming more and more popular throughout the world (Organic Monitor, 2008). In 2006, about 30.4 million hectares were certified according to organic standards and the world market volume was 38.6 billion US-\$ (Willer et al., 2008). The EU and the US are the biggest markets with an annual growth of 10 to 20 %.

Principles and norms define the entire course of production, processing, packaging, transporting and marketing of organic products (IFOAM, 2005; FAO/WHO, 1999). The most important governmental organic farming standards are 2092/91/EEC (from January 1<sup>st</sup>, 2009: 834/2007/EC) of the EU, the NOP (USA) and JAS (Japan) (Schmid et al., 2007). They precisely lay down the production and manufacturing requirements for agricultural produce and foods labelled as organic products. All organic goods produced and sold must meet the national governmental standards set by these regulations. The standards of organic agriculture cover conversion periods, stock densities, breeding, feedstuffs and feeding, standards in animal welfare, health and hygiene and inspection and certification (Rahmann, 2004).

### 1.1 Farmland-related animal husbandry

Livestock plays an important role on organic farms, e.g., in nutrient cycling. Landless animal husbandry is not organic and thus prohibited. The limited livestock density does not exceed 170 kg nitrogen ha<sup>-1</sup> a<sup>-1</sup> and is measured in livestock units (1 LU = 500 kg live weight). About 13.3 adult goats ha<sup>-1</sup> a<sup>-1</sup> are allowed (2092/91/EEC, Annex I B 7. and Annex VII).

### 1.2 Feedstuff and feeding

Organic goats have to be fed with 100 % organic feedstuff (Table 1). Ruminants have to be fed with a minimum of 60 % of roughage (50 % is allowed only in the first three months of high lactation). Organic feeds can be purchased from other organic farms. A maximum of 40 % (purchased) and 60 % DM (own production) of “in-conversion feedstuff” (after 12 months of conversion) is allowed. Permitted organic feedstuffs are listed (positive lists). Only single components, but not processed and mixed feeds, are considered in 2092/91/EEC Annex II.

Table 1:

Feeding recommendations for dairy goats (Drochner et al., 2003)

	DM (kg)	nXP (g)	MJ ME	Ca (g)	P (g)
Minimum body maintenance	1.4	85	9.7	3.6	2.7
per liter milk (3,5 % fat, 3,1 % protein)	0.4	75	4.4	2.2	1.4
5 <sup>th</sup> month gestation	1.5	200	13.0	6.6	3.4

Protein lactation and gestation with 75 % solubility in rumen; nXP = 50 % utilisation for milk protein  
Energy demand per liter milk 3,7 % FCM: 4,4 MJ ME (+0,047(F-40)) with F = g fat per kg milk

A long discussion in the design of the regulation was the feeding of young stock. Kids have to be fed 45 days with “natural milk, preferably maternal milk.” It is not established whether “natural milk” must originate from the same species; only that the physiological needs have to be fulfilled. Organic cow milk is accepted for kid rearing.

In organic farming it is not permissible to use anything produced using GMOs (genetically modified organisms) or derivatives. This includes feed for livestock (conforming to definition of animal feeds in 471/82/EEC) and has been valid since September 24, 1999. Fermentation-supports for silage-making are allowed as long as they do not contribute to animal nutrition. Permissible minerals, vitamins and pro-vitamins for animal feed are listed in Annex II. Artificially produced vitamins are allowed in winter for ruminants. Only vitamins derived from raw materials occurring naturally in feedstuffs are allowed for herbivores (70/524/EEC).

It is not obligatory, but recommended, that ruminants should graze on pastures (“free-range”) and not be fed in stables as long as the animal, weather and pasture conditions are suitable. Conventionally kept livestock from extensive grazing systems (950/97/EC) can graze on organic pastures as long as no organic livestock is present. For this grazing period, non-organic livestock must follow the rules of organic livestock keeping. This grazing has to be accepted and approved by the certification body.

Final indoor fattening of kids is possible if this period is less than one fifth of the animal’s life, and a maximum of three months of the fattening animal’s life. Every animal has the possibility of permanent access to feedstuff and water. That means that a minimum of one feeding place per goat has to be available.

### 1.3 Animal health and veterinary treatments

The guiding principle of animal health is to prevent disease rather than to cure or treat it. Robust, adapted and disease-tolerant livestock ensure fit and healthy animals. Local breeds are considered to fulfil these targets. Preventive treatments with “chemically-synthesised allopathic veterinary medicinal products” or antibiotics, as well as

oestrus synchronisation, are forbidden. Vaccinations are allowed even when the vaccine is produced with the use of GMOs. Treatment of parasites and vaccinations are not considered as "chemically-synthesised allopathic veterinary medicinal products". De-worming can be done after a veterinarian has recommended that a heavy infection requires treatment. With such a recommendation, the whole flock of small ruminants can be de-wormed. This is not possible under the US-Organic standards (USDA-NOP).

If an animal is sick, a veterinary treatment is allowed (animal welfare). This has to be checked and carried out by a veterinarian. Natural methods of disease treatment are to be preferred as long as they help the animal. If these natural treatments do not help, chemical-synthesised allopathic treatments are allowed (even antibiotics). The withholding period is twice as long (minimum of 48 hours) as requested for the applied drugs. If an animal has been treated more than three times with chemical allopathic drugs, the products can not be sold under the "organic" label. Only one chemical allopathic treatment is allowed for livestock for which the production period is less than one year (kid meat). All health-related data have to be noted in a herd book and be presented at inspection.

#### *1.4 Husbandry management practices, transport and slaughtering*

The breeding of ruminants should take place with natural mating. Artificial insemination is allowed, but not embryo transfer, oestrus synchronisation, etc. Male breeding stock has to be kept on the farm, requiring extra farm resources (space, labour and feeds).

Animal cruelty of any kind is prohibited. Dehorning of goats is not allowed and may only be performed under special circumstances, regulated by the certification authorities (e.g., hygiene, animal welfare or bio-security aspects). Castration of male stock is allowed to maintain traditional animal husbandry practices. The castration should be done at a very young age (<1 month), or under anaesthesia by a veterinarian.

Ruminants have to be kept in groups to meet their social needs. How social needs can be fulfilled via farm conditions has not been defined. The transport of livestock is not clearly defined either. Stress-reduced loading, transporting and unloading of livestock without the use of allopathic tranquilisers, electrical shockers or similar tools is required.

#### *1.5 Housing and stocking rates*

If grazing is not possible, and goats have to be kept indoors, a permanently accessible open-air run is obligatory. Free movement stables with permanent access to open-air runs are organic standard for all livestock. Only with

permanent summer pasture grazing is an outdoor run not necessary. The tethering of goats is prohibited. The minimum indoor space of an adult goat (net) is 1.5 m<sup>2</sup> and 0.35 m<sup>2</sup> for a kid. The out-door run should have a minimum of 2.5 m<sup>2</sup> for adult goats and 0.5 m<sup>2</sup> for kids (2092/91/EEC Annex VIII 1). A maximum of 50 % of the stable surface can be slatted or grid floor, the rest has to be a flat and non-slippery surface. The boxes have to be strewn-in with organic materials (e.g., straw or wood chips; peat is difficult in terms of environmental issues).

#### *1.6 Conversion, inspection and certification*

Comparable to cash crop production, the conversion period for grassland for ruminants is 24 months. The conversion period starts after the last conventional utilisation. After 12 months without prohibited treatments, grassland is viewed as "in-conversion feedstuffs/feed materials". Livestock has a conversion period as well. After 6 months of being kept under organic standards, goats are considered as converted (2092/91/EEC Annex I B 2.1.1. and 2.2.1.).

It is possible to convert just one branch of the farm to organic production, e.g., only the goat milk production. If there is a clear spatial separation (farm land, feed and dung storage as well as stables), the same animal species can be kept organically and conventionally by one farmer. This is very often done under NOP. A clear separation is needed to avoid contamination (e.g., prohibited disinfectants or feedstuffs/feed materials which are not in the 2092/91/EEC Annex II) and mixing of inputs (e.g., feeds and dung).

For example, goat milk can be sold under the label "organic" 18 months after the start of conversion: after 12 months 60 % DM (dry matter) of own "in-conversion feedstuff" is available and 40 % DM can be purchased (e.g., concentrates). After further six months with this feed, goats are converted and milk can be declared as "organic".

All organic farms, processors, traders and merchants are inspected annually by an independent certification body. Inspected products can only be declared organic if all standards and norms are fulfilled.

## **2 Organic goat milk production**

Since 2003, between 44 and 65 dairy goats were kept at the experimental station of the German Federal Institute of Organic Farming to assess the production potential of high performance goats under the standards of organic farming. The goats were kept in modern stables, had seasonal access to pasture and received only farm produced feedstuff.

Organic goats obtain high prices in Germany. The price structure for organic goat milk is different from price structure for cow milk. There are seasonal price differences (all per kg): transition period (Mar/Apr, Sep/Oct = +0.205 Euro,

summer period (May to Aug = +0.19 Euro) and winter period (Nov to Feb = +0.29 Euro). Bonuses are paid for fat (+0.07 Euro per %) and protein (+0.085 Euro per %). A bonus is also paid for low somatic cell counts (SCC) (<0.6 million SCC = +0.01 Euro) and for long delivery contracts (5 years = +0.01 Euro). An average of +0.70 Euro/kg organic goat milk is paid (without VAT, free dairy plant). Reductions can be made for transport (-0.05 to 0.10 Euro/kg) and when bacteria and/or SCC are too high: bacteria (>100,000 germs/ml: 1<sup>st</sup> month = -0.02 Euro, 2<sup>nd</sup> month = -0.04 Euro and 3<sup>rd</sup> month = -0.06 Euro and so on... In summer months, milk with more than 1 million SCC is penalized with -0.01 Euro in the 1<sup>st</sup> month, -0.02 Euro in the 2<sup>nd</sup> month and -0.03 in the 3<sup>rd</sup> month. In winter the limit is 1.4 million SCC. More than 2 million SCC are generally penalized with -0.02 Euro and -0.02 Euro more in each additional month. Milk delivery has to stop when SCC is above the tolerance level for more than 4 months.. If inhibitors (antibiotics) or cow milk are detected, the farm can be sued for damages.

### 2.1 Feeding

In Trenthorst about 30 ha grassland are available for roughage feeding. The ground covering is classified as *Cynosurion cristati* with 80 to 98 % grass species. Dominating species are *Poa trivialis* (biomass-share of 3 to 30 %), *Alopecurus pratensis* (2 to 30 %), *Festuca pratensis* (1 to 5 %) and *Taraxacum officinale* (0.1 to 15 %). The goats graze from May to November. Surplus grass is used for hay production. In winter this hay was fed *ad libitum*. The quality of grass and hay was between 9 and 10 MJ ME with 140 – 150 nXP. The goats can select, therefore about 50 % of the roughage is not used. The energy and protein quality of the roughage intake could not be measured. In relation to the milk yield, the goats got between 500 and 800 g concentrate per day via transponder feeding and partly while milking in the barn. About 180 kg of concentrate are used per lactation and goat (without dry season ration). The concentrate feed was made from wheat, oat and peas in different relations (between 12 and 13 MJ ME and 150 and 165 nXP). Minerals are fed *ad libitum*. Fresh water is always available. Throughout the lactation the fat-protein-relation was between 1.00 and 1.15.

### 2.2 Reproduction

The breeding was done naturally, with some exceptions with artificial insemination for breeding buck production. First mating is done with 1.5 years and the lambing season is in February/March. On average between 1.98 and 2.21 kids are born per mother (Table 2). The average herd age (without young stock) increased during the experiment from 3 to 4.9 years (1 – 2.9 lactation numbers).

Table 2:

Herd performance and lambing rates

	n	Lactation number					Average Lactation years	Lambing rate in %
		1.	2.	3.	4.	5.		
2003	44	44					1.00	176
2004	54	17	37				1.71	196
2005	53	13	11	29			2.27	194
2006	55	10	12	11	22		2.85	212
2007	65	20	9	11	7	18	2.91	221

### 2.3 Milk production

The milking was done in a milking barn with modern equipment. The lactation yield was measured by the milking equipment and verified by monthly milk control (IDF B2-method: lactation and 240-days yield). The milk yield increased with the average age of the herd (average lactation years). The annual differences in milk yield are due to weather and roughage qualities. 2005 was a wet summer, the goats did not like to graze and the hay quality was bad as well. The summer weather in 2006 was excellent for goats grazing. The milk, fat and protein yield increased significantly, the summer 2007 was extremely wet, the milk yield dropped back to the level of 2005 (Figure 1). Important was the high milk yield early in the year (Figure 2).

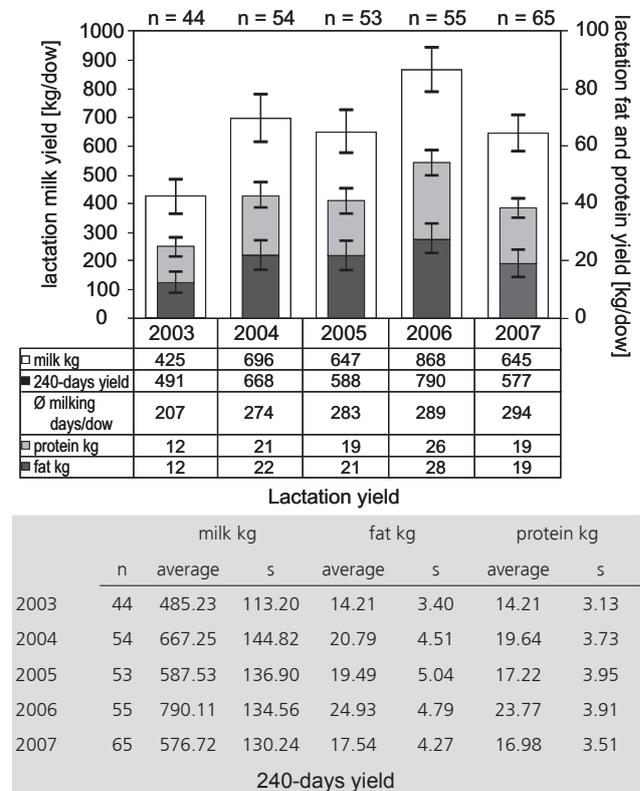


Figure 1:

Milk, fat and protein yield in organic goat milk production

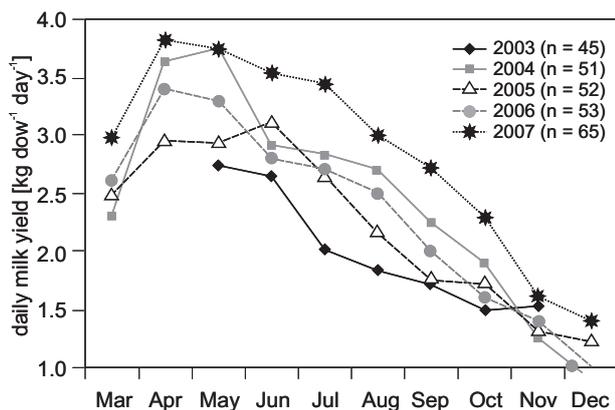


Figure 2:  
Average daily milk yield of organic goats 2003 to 2007

## 2.4 Health

Somatic cells can indicate mastitis. Somatic cell counts of goat milk are not comparable to cow milk. 100,000 somatic cells  $\text{ml}^{-1}$  in cow milk is defined as healthy udder. Goat milk can have more than one million SCC and the udder health is okay. Therefore no international SCC standards are defined for udder health. Only some cases (2 to 6) of clinical mastitis occurred per milking season, particularly in the first two months of lactation. The somatic cell counts SCC have changed throughout the season and years (Figure 3). This does not necessarily refer to sub-clinical mastitis (Aulrich & Barth, 2008). Organic dairy factories pay extra for goat milk with less than 600,000 SCC (+0.01 Euro/kg) and penalize milk with more than 1.0 million SCC in summer and 1.4 million SCC in winter (KTBL, 2008). Above 2.0 million SCC, -0.02 Euro/kg are charged.

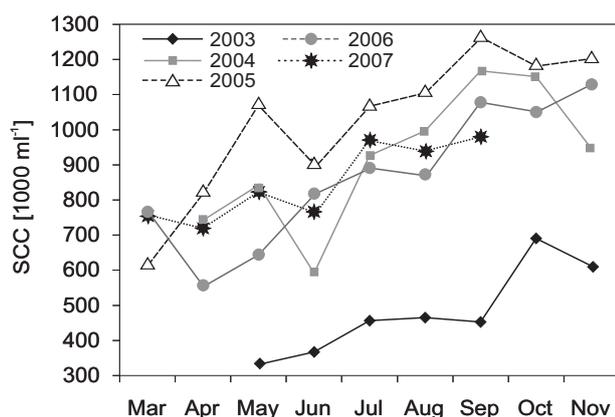


Figure 3:  
Seasonality of somatic cell count of the bulk milk 2003 to 2006

## 2.5 Conclusion

At the experimental station of the Institute of Organic Farming between 44 and 65 German Brown Alpine goats have been kept since 2003 to assess the milk production potential under the standards of organic farming (EU 2092/91/EEC resp. 834/2007/EC). The goats were kept in modern stables, had seasonal access to pasture (May to November) and received only farm-produced feedstuffs. In average 650 kg milk yield  $\pm$  100 kg in 240 days was possible with high performance goats in organic grazing systems in Northern Germany. This is about 25 % less than comparable conventional dairy goat farming. The weather conditions in summer and the roughage quality have the main impact on the organic dairy goat milk yield. Usually, conventional farms do not keep dairy goats in grazing systems and do not have a minimum daily intake of roughage. Goats do not like wet conditions and reduce feed intake on pasture. Concentrates can supplement the deficit, because organic farming standards do not allow more than 40 % of concentrate in the daily rations.

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