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Sarah Sakineh Zarin
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The role of meat quality in conservation of indigenous endangered farm animals: Case study of endangered goose breeds "Diepholzer Gans"

"Diepholzer" goose is an indigenous endangered local breed which originated in the north-west of Germany and traditionally rears on pasture. In this study, its performance and features are compared with a hybrid breed of the company "Eskildsen" as a reference. The objective of this experiment was to evaluate differences between the performances of the endangered breed and the hybrid breed especially in terms of meat quality. The aim was to identify parameters that might support conservation of the endangered breed of goose by means of on-farm strategies.

The methodology of the study entailed keeping the two breeds under the same housing and feeding conditions until they reached 30 weeks of age when they were slaughtered. The experiment was conducted at the Institute of Organic Agricultural of the University of Bonn experimental farm "Wiesengut" for Organic Agriculture. In this experiment, the influence of breed type was evaluated by determining body weight gain, feed intake, feed conversion ration, health status, and finally carcass value and the meat quality of the geese.

We observed significantly higher body weight gain and lower feed conversion ratio for the hybrid breed. Concentrate intake was slightly lower in the first month and the last three weeks as well as in total for the endangered breed than the hybrid. The absolute forage intake in the stable was lower for the Diepholzer goose. Pasture intake was almost the same for the two breeds.

Significantly lighter dressed body, breast and thigh were found for the Diepholzer breed. The muscle fraction in the breast and thigh was higher for the Eskildsen breed. The abdominal fat for the two breeds did not differ significantly. The breed did not affect the weight of wing and neck, but the tail and back were considerably lighter in the local breed. No significant differences in percentage of the dressed body and different components of carcass were noted. There were no remarkable differences in the electric conductivity and pH value except at 20 minutes *post-mortem* in breast muscle for the two breeds. Colour scale values L*, a* and b* of the two breeds were not significantly different. The drip loss of the fresh breast muscle was significantly higher for the Diepholzer. The type of breed did not affect freezing loss, cooking loss and the shear force.

No significant differences in the performance and the meat quality features of the breeds were determined. However, differences were not concluding clearly lower quality meat quality for the Diepholzer goose compared with the hybrid breed.

Fleischqualität als Beitrag zur Erhaltung vom Aussterben bedrohte Nutztierassen am Fallbeispiel der Diepholzer Gans

Die „Diepholzer Gans“ ist eine lokale, vom Aussterben bedrohte Rasse die ihren Ursprung im Nordwesten Deutschlands hat und traditionell auf der Weide gehalten wird. In dieser Studie wurden ihre Leistung und Eigenschaften mit denen einer Hybrid-Rasse der Firma „Eskildsen“ als Referenz verglichen. Ziel der Untersuchungen war es, Unterschiede zwischen den Leistungen dieser beiden Rassen in Hinblick auf die Fleischqualität zu untersuchen. Oberziel war die Beschreibung von Eigenschaften, die dazu beitragen können, die Diepholzer Gans durch landwirtschaftliche Nutzung zu erhalten.

Der Aufbau der Untersuchung sah vor, die zwei Rassen bei gleichen Bedingungen zu halten, bis sie 30 Wochen alt waren und geschlachtet werden sollten. Der Versuch wurde auf der Lehr- und Forschungsstation für Organischen Landbau „Wiesengut“, Hennef durchgeführt, die zum Institut für Organischen Landbau der Universität Bonn gehört. Es wurde der Einfluss der Rasse auf die Parameter Gewichtszunahmen, Futterverbrauch, Futterverwertung, Gesundheitsstatus, Schlachttierwert und Fleischqualität untersucht.

Es wurden signifikant höhere Gewichtszunahmen und eine bessere Futterverwertung für die Hybrid Herkunft festgestellt. Der Kraftfutterverbrauch war für die Diepholzer sowohl im ersten Lebensmonat, als auch in den letzten drei Wochen und damit insgesamt etwas niedriger als für die Hybriden. Auch die Grünfutteraufnahme im Stall war für die Diepholzer etwas niedriger. Der Futterverbrauch auf der Weide war für beide Rassen weitgehend identisch. Es wurde ein kleinerer Schlachtkörper für die Diepholzer festgestellt. Das Gewicht der Brust und der Schenkel für die Gänse der Firma Eskildsen war signifikant höher. Der reine Muskelanteil an Brust und Schenkel war für die Diepholzer Gänse geringer. Der abdominale Fettanteil unterschied sich nicht wesentlich. Die Rasse wirkte sich auch nicht auf das Gewicht von Flügel und Hals aus, allerdings waren Schwanz und Rücken der Diepholzer wesentlich leichter. Die Rasse hatte keinen Einfluss auf die Prozentanteile der einzelnen Körperteile. Es gab keine signifikanten Unterschiede bei der elektrischen Leitfähigkeit und beim pH Wert, außer bei der Messung 20 min *post-mortem* für die Brustmuskulatur. Die Farbskalawerte L*, a* und b* der beiden Rassen unterschieden sich ebenfalls wenig. Der Tropfsaftverlust war bei den Diepholzer Gänsen erheblich höher, wohingegen Gefrierverlust, Kochverlust und Scherkraft jedoch nicht durch die Rasse beeinflusst wurden.

Verglichen mit der Hybrid-Rasse war ein Unterschied der Fleischqualität zu wenig ausgeprägt, um der Diepholzer Gans eine geringere Fleischqualität zu zuweisen.

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1. Introduction

During the evolution of human beings and the extension of the area under their control, animals were domesticated and breeds developed to provide for human needs within these new environments. The purpose was to ensure the sustainability of human communities. As a result, genetically distinct breeds were developed. However, two breeds of the world's valuable domestic animal diversity are estimated to be lost every week (FAO, 2000).

Indigenous (old local) livestock breeds often have all qualities that form the basis for low-input systems and sustainable agriculture. These traits include disease resistance, high fertility, good motherly qualities, long life, and adaptability to harsh conditions as well as poor-quality feeds (Steane, 1993).

Due to the development of breeding methods such as artificial insemination which facilitate transfer of breeding material to different geographic zones, widespread cross breeding is taking place. This has gradually led to the substitution of local breeds with hybrid breeds. It is impossible for a species, breed or gene to be recreated in the future once it has become extinct (Henson, 1992).

Livestock products demands will increase rapidly in the next decades, mainly in the developing world. In order to meet the demands of human populations, which are much larger and more affluent in this century, the use and development of a broad spectrum of locally adapted domestic animal breeds, i.e. biodiversity, is required. This is necessary in association with the increase of livestock production (FAO, 2000).

Conservation of animal genetic resources has therefore been taking place, and "on-farm" conservation is a possible type of conservation. An experiment was conducted using this particular conservation technique in order to find out whether differences and advantages of an old endangered breed of geese compared with a modern breed can be detected. These possible advantages and differences may help to increase the consumption and production of this endangered breed, thereby aiding its conservation.

To investigate this, the following questions needed to be answered:

- What are the important differences in body weight gain and feed consumption between an endangered local old breed and a hybrid breed of geese in the growing period?
- Has the old breed a significantly better meat quality than the hybrid and how can this be used for conservation purposes?
- Can the advantages of meat quality be used for conservation purposes?

The trials were conducted under organic farming conditions. Organic agricultural systems with features of low input –low output encourage the use of locally bred and indigenous livestock breeds (IFOAM, 2005).

Geese were selected as experimental animals because they are excellent forage converters and can graze on pasture without being dependent on concentrate greatly, which is expensive to farmers. They are also resistant to diseases (Buckland, 2002).

The aim of this study was to compare an indigenous breed of geese "Diepholzer" which is listed in the red list of "The Society for the Conservation of Old and Endangered Livestock Breeds" (GEH) in Germany with a hybrid breed "Eskildsen mittelschwer" from Eskildsen Company as a reference.

The geese were kept in the same housing and feeding conditions in the experimental farm of the Department of Organic Agriculture; Wiesengut of the University of Bonn. The experiment was carried out within a period spanning from April 2005 to November 2005.

2. Literature review

2.1. Animal genetic resources at risk

According to FAO (2000) conservation can be defined as the management of human use of the biospheres that may yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations.

All human activities which ensure that the diversity of farm animal genetic resources is maintained are entailed in conservation. These activities include strategies, plans, policies and actions leading to better productivity in agriculture, now and in the future. After ratifying the Convention on Biological Diversity, it is very important for individual countries to establish their national conservation strategy for animal genetic resources at risk (FAO, 2000).

FAO estimated that one third of the world's recognised livestock and poultry breed are at risk of extinction. According to this estimation the numbers of farm animal breeds noticeably declined over the past fifty years (Livestock and Environment Toolbox, 2005).

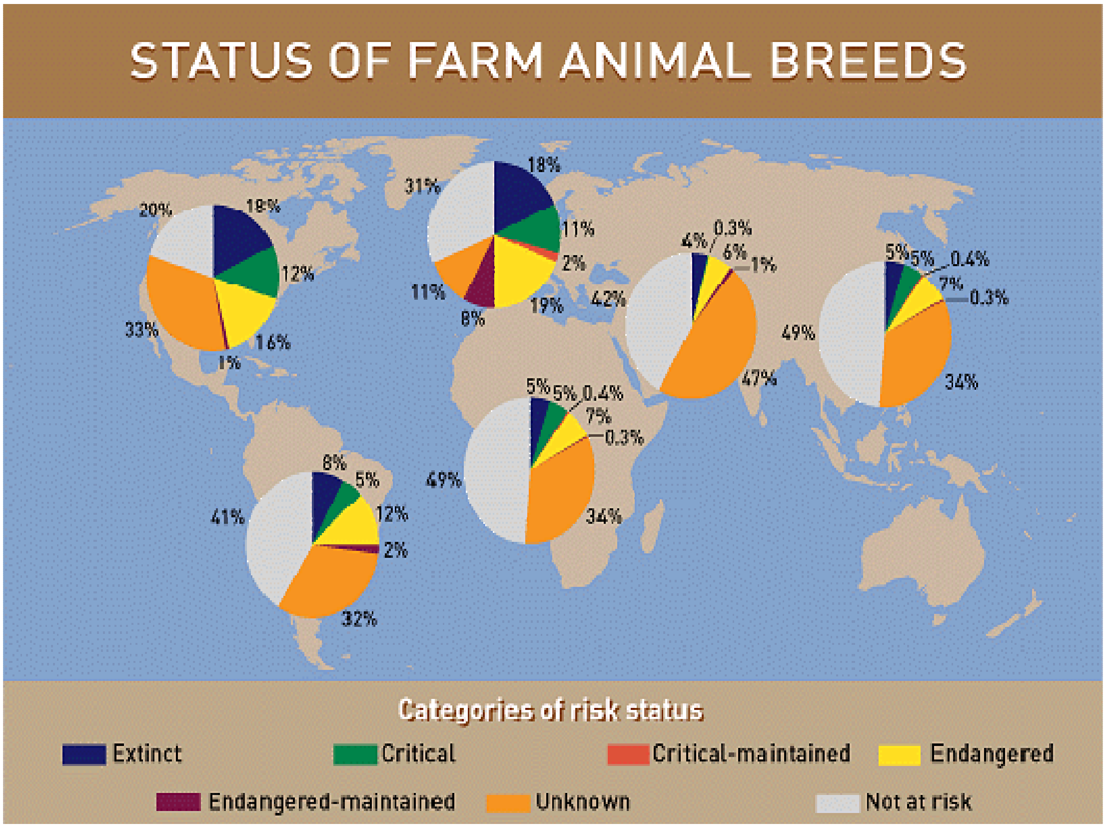


Figure 1: Status of farm animal breeds (FAO's Domestic Animal Diversity Information System, 2000)

It was reported that through surveys and updated animal genetic resources data by individual countries since 1995 the number of mammalian breeds at risk of extinction has increased from 23 to 35%. Bird breeds are faced with more loss; the total percentage of those at risk of being lost increased from 51% in 1995 to 63% in 1999. FAO warned that in the next two decades, a large number of farm animal breeds at risk of extinction (2,255 breeds) could be lost if there are only insufficient action plans (FAO, 2000).

2.1.1. Importance of farm animal production

Domestic animals supply, directly and indirectly, 30 to 40 percent of the total value of food and agriculture production. They support the human race in many ways, providing meat, milk products, eggs, fibre, soil and crop-fertilizer, fuel-manure and also necessary draught power. Domestic animals are reported to be very important economic resources, serving to reduce farmers' risk exposure, creating employment and even out seasonal farm labour demands (FAO-domestic animal diversity, 2000).

Animal production as organic nutrient provides a big part of the essential fertilizer for a large amount of the world's developing agriculture. Without these organic nutrients much of the soil would not remain productive. About 2 billion people world-wide depend at least partly on farm animals for their livelihood. It is estimated that more than double of today's amount of essential foods such as meat, milk and egg will need to be produced for feeding the growing world population in the next 20 years (FAO, 2000).

For most agro-ecosystems, farm animals are fundamental since they provide genetic material for the animal production system. This genetic material is critical for the flexibility of the system and consequently enables an increase in production as well as productivity.

Appropriate use of genetic resources will result in food security. In this regard, in most production environments combined animal and plant species will usually increase production and productivity of sustainable agriculture (FAO, 2000).

2.1.2. The position of developed and developing countries with regards to the protection of indigenous breeds

FAO in the world watch list (2000) reported that the food and agriculture requirements of developed and developing world consumers are mostly not comparable. Since there are noticeable differences between production systems such as product needs and prices, disease occurrence, spread and control methods and climatic condition, the use of quite different genetic resources is required for each of these different environments. This variation is desired to realize sustained production of food and agriculture (FAO, 2000).

Moreover, in the developed countries, specialized inputs to perform on specific tracks are needed. To do so, a small number of high performance breeds that have been developed over the last half century to satisfy the immediate demands of developed world consumers. The FAO (2000) reports that 400 of these finely tuned breeds, which produce mainly meat, milk and eggs, are being intensively developed, mostly in high input systems.

However, in the developing world, most of the people and agriculture sector keep using low to medium input systems. In these agro-ecosystems, focusing on locally adapted breeds will result in more sustainable outcomes than use of high production breeds which are improved according to developed world environments. In fact, indigenous breeds have evolved to survive and reproduce in their local environments even though production environment of developing countries are very stressful (FAO, 2000) such as hot, dry or humid climates, mostly facing lack of feed, unhygienic condition of stable facilities, consequently leading to health problems and constant changes in agriculture policies.

If these can be overcome, then the use of indigenous breeds should be preferred. Furthermore, old local breeds have adapted their traits to the local environment in a unique combination that makes them an asset for the country (FAO, World watch list, 2000).

2.1.3. Causes of loss of indigenous endangered breeds (Genetic erosion in domesticated animals)

Export of high production animals from developed to developing countries is the key reason for the deterioration of farm animal's diversity. Artificial insemination and embryo transfer lead to rapid replacement of indigenous breeds. Destruction of the native habitats of livestock breeds, development of genetically uniform livestock breeds and farmer/consumer preferences are basic causes of declining genetic diversity of farm animals (Livestock and Environment Toolbox, 2005).

Furthermore changes in cropping patterns are among the major factors leading to the removal of indigenous farm animals. The switching to certain cash crops causes, crop residues which used to be an important component of fodder to disappear. Also the availability of straw is reduced because of the adoption of hybrid wheat with its short stalks. Due to irrigation, two or three crops per year are possible which, that leads to elimination of the possibility of grazing on stubble or browsing on trees in the fields (Sansthan *et al*., 2005)

Commercial interests are also considered as important pressures on livestock diversity. Moreover, the following criteria are determining the direction of shifting to high productive animals: growth performance (productivity), pest and disease resistance, ease of handling, adaptation to current levels of technology, and to a minor extent consumer choice (Livestock and Environment Toolbox, 2005).

Based on reports from the Livestock Environmental Toolbox (2005) causes of genetic erosion are pointed out as: lack of appreciation of the value of indigenous breeds and their importance in niche adaptation as well as encouragement of introducing exotic and more uniform breeds from industrialised countries.

Other elements which lead to erosion of genetic resources represented below:

- Decline in economic viability of traditional livestock production–systems;
- Livestock populations which rely on veterinary services and improved feeding conditions;
- Multipurpose local species and breeds replaced by those with higher milk, meat, egg production (including cross-breeds and pure-bred exotics);
- Predominance of sires from a few selected breeds in widespread cross-breeding programmes can lead to loss of features expressed by specialised breeds;
- Failure to carry out methods such as freeze semen, ova and embryos, or lack of refrigerant, inadequate maintenance of frozen semen from breeds that are not needed;
- Socio-political instability such as wars can lead to livestock owners moving their stock out of their usual area, thus increasing the possibility of mixing with other breeds thereby potentially losing a location-specific breed;
- Natural disasters such as floods, drought or famine can result in whole breeds dying out.

These trends are supported by:

- Policies which support high performance varieties, uniformity of product and use of chemical controls (e.g. subsidies, credit, market standards);
- The focus of producers on short-term income;
- Disparities exist in resource distribution and lack of respect for local knowledge and livestock management practices.

(Livestock and Environment Toolbox, 2005)

2.1.4. Consequences of loss of indigenous breeds

The important consequences of the decline in farm animal diversity are loss of tolerance to different environmental conditions and decrees in disease resistance. In addition, due to domination of uniform industrial agriculture technologies, local knowledge about diversity is rapidly reduced. Furthermore loss of indigenous breeds certainly affects the capacity of human society to live in large areas of the world in a sustainable manner as well as the use of vegetation in the more extreme environments (Livestock and Environment Toolbox, 2005).

2.2. Why conserve domestic animal diversity?

Genetic diversity of livestock is vital for sustainable animal husbandry and is part of our world heritage. Nowadays questions of intellectual property right, socio-economics and even of ecology are becoming more pressing. The breeds which are adapted to the local ecosystem and production systems have the potential to provide great benefits to the local economy, ecology and culture. They are adapted to locally and seasonally available feed and forage. They are mainly resistant to a range of diseases and pests and, fit for low input production systems (Idel, 2004).

Farmers in response to environmental change, threats of disease, new knowledge of human nutrition requirements, changing market conditions and societal needs, can select stocks or develop new breeds in the presence of animal genetic diversity. The situation of the above mentioned factors are all extremely unpredictable. Only future food demand is predictable (FAO, Press Release, 2000).

The increasing demand for a broad range of products, both locally and globally, requires a dynamic, adaptable, adjustable livestock system. Sustainability in these different environments will require different genetic types (FAO, World watch list, 2000).

However, the loss of farm animal diversity is forever and cannot be reversed (FAO, 2000).

2.2.1. Strategies for conserving animal genetic resources

There are two basic approaches for conservation of farm animal diversity, they are *in situ* and *ex situ* conservation (Hammond *et al*., FAO, 2000).

The *in situ* conservation incorporates all measures that aim to maintain breeding populations, including those involved in active breeding programs in the agro-ecosystem where they either developed or are now normally found. These are combined with husbandry activities that are undertaken to ensure the continued contribution of these resources to sustainable food and agricultural production, now and in the future (FAO, World watch list, 2000).

Ex situ conservation of farm animal genetic diversity includes *in vivo* and in *vitro* types. *In vivo* means conserving living animals out of environments which they developed in and in *vitro* is the conserving of genetic materials out of their environment artificially including: interlaid, the cryo-conservation of semen, oocytes, embryos, cells or tissues. In case of farm animal diversity *ex situ* conservation and *ex situ* preservation are considered to be synonymous. Long-term storage of animal germplasm using cryo-conservation is not possible for all of the important animal livestock species (FAO, 2000).

Recognition of the roles and values of animal genetic resources has been arising (increasing) over the latest decades and it has led to the initiation of conservation efforts. Many countries have attempted, or are attempting, to conserve some of their most important breeds using both *in situ* and *ex situ* conservation measures. However, conservation efforts for animal genetic resources are not improved fast as conservation efforts of plant genetic resources (FAO, World watch list, 2000).

2.3. Goose as a case study of conservation

Geese are of the Family *Anatidae* and the Genus *Anser,* and are generally accepted as one of the first animals to be domesticated. It is estimated that they were domesticated in Egypt about 3000 years ago, or even earlier. Despite this, geese have never been exploited commercially as much as chickens or even ducks have been (FAO, 2002).

The wild Greylag goose (*Anser anser*) which are considered originating from Europe and the wild Swan goose (*Anser cygnoides*) which are thought to have their origins in Asia are two main types of domestic geese. Crossbreeds between the domestic breeds which have originated from these two species of wild geese are fertile and have resulted in a number of recognised breeds (FAO, 2002).

96 breeds or genetic groups of geese have been identified by the FAO although there are probably more. Today many of these breeds, even though they are important world germplasm resources, have little economic importance. In addition to these breeds, both old and new, there are a number of commercial cross-breeds made available by companies specializing in goose breeding (FAO, 1995).

2.3.1. Cause of loss of diversity in geese

In the past, geese were kept traditionally for different purposes such as animals for offering, additional sources of meat; its feathers were used for writing purposes and the down for pillows and covers. Since geese in those days had to travel from producers to the consumers on foot, light country varieties were encouraged and mostly bred. In the 20th century, the goose quill was replaced with new ting instruments introduced by industrialization. Also, changes in eating habits led to a reduction in the demand for goose. However, there is a remarkable reduction in goose production and cannot be ignored. This change was preceded by gradual disappearance of the large flocks. Today in many places only pairs or small flocks are kept (Breeds of livestock, 1997).

2.3.2. "Diepholzer Gans"

The "Diepholzer gans" is a small goose which originates from the Diepholz area in Northern Germany. Dieopholzer goose has been bred in this region for the last 100 years. In 1925 the Diepholzer Goose was recognized as a breed and has been registered in Animal Breed Records Association. In build and appearance, this goose is closely related and similar to the gray goose (Breeds of livestock, 1997).

Figure 2: Diepholzer goose, source: Breeds of livestock, 1997

Characteristic of the Diepholzer goose

Appearance: Pure white plumage and moderately stretched trunk with straight-line, sloping back portion. No huge posterior head and a narrow neck and an upright attitude.

Weight: Gander 6 - 7 kg, goose 5 - 6 kg.
Location: Diepholz area, Bramsche and Uchte area.

Origin: Known to have existed in the Diepholz area for a long time. One of the rare poultry races, which are still listed as economic animal in the animal breed stock records.
Performance: Takes good care of the gosling, good hatchability, and excellent brooding also 30 - 40 eggs and 300-400g feather per year.
Special Charactristics: In olden days were forced to walk to the markets in Bremen and Cologne area.

Existence: 120 geese and 35 Gander in the Lower Saxony breed records and about 500 animals remain (exist) in all of Germany.
Breed records: Endangerment degree: Category II (strongly endangered) in the red list of the society for the preservation of old and endangered domestic animal races.
(GEH, 2004)

2.3.3. Pasture geese

Nowadays extensive farming and rearing on pasture are desired since producer is faced with consumer demand on new raising methods, which allow the combination of a high meat quality and animal welfare. Lower fat content of the carcass and possibility of reducing the consumption of concentrates are the other advantages of extensive fattening methods (Baéza *et al.*, 1998).
From an economic point of view it is noteworthy that the main cost of animal production occurs due to food, it is therefore profitable to reduce the cost of feed as much as possible (Fru Nji, 2002). The rearing on pasture is among the approaches trying to reduce the cost of animal production.
In addition it is reported that the use of pasture to rear geese provides many advantages: production of higher quantities of meat and fatty liver, lower lipid content with an interesting fatty acid composition for human consumption (higher proportion of polyunsaturated fatty acids) and higher protein content in breasts also firmer, stringier, darker and redder meat (Wężyk *et al.*, 2003).

2.4. An example of the successful use of indigenous endangered farm animals

Sheep meat accounts for 6 % of the world's meat consumption. The output from the sheep sector represents a small but important percentage of the output from agriculture. In Germany, sheep and goats are also used for biotope conservation, particularly endangered breeds such as the "Rhön Schaf" (Rahmann, 2000).
There are about 140 different labels of lamb meat in Germany. Meat product qualities such as low fat, low cholesterol, colour, tenderness and taste are used to promote lamb consumption and as a marketing strategy to obtain high prices. In this regard processing qualities such as

animal welfare, use of endangered breeds; biotope conservation, organic farming, and regional product are also applied (Rahmann, 2000).

A consumer survey was carried out by Rahmann (1998) in order to research how the meat quality of Rhön lamb from the “Biosphärenreservat Rhön”, Germany was perceived and evaluated by the consumers.

In the survey, 480 persons from a selected area, buying through different sale mechanisms, were provided with a standard questionnaire about their consumer habits and their expectations of environmentally friendly produced meat and their willingness to pay for it. In order to point out the marketing possibilities and also its limitations, three different kinds of meat (Rhöner pasture ox, Rhön lamb and goat meat) were utilised as the basis for the evaluation.

Results show that consumption of lamb/mutton meat is generally low in Germany. It is not the number of people who eating lamb is low but the quantity per head.

80 % of the consumers were willing to pay more for specific qualities. The interviewed persons, who were willing to pay more for special qualities, would like to have it in restaurant menus. They do not often use lamb meat in their kitchens and mostly live in cities close to the Rhön area, and have also visited the “Biosphärenreservat Rhön”. The landscape and culture of the “Biosphärenreservat Rhön” influenced their consumption of the meat.

Cooperation between shepherds and restaurants offering this meat with high prices has been important to convince consumers to pay more for the product. The processing qualities are very important for consumers. Therefore they are interested in labels and transparency of the production patterns.

In marketing, depending on the body part of the animal and preparation process, between 200 to 300 % extra charges are levied on the purchase price. However, not only the sheep owner (farmer) but also the restaurants profit from these additional charges. The results indicated that sheep owners obtained additional proceeds of 68 %, while the restaurants earned even more: 92 %.

The lamb production in the “Biosphärenreservat Rhön” is higher than the consumption. With 40 tons per year, “Rhönlamb” fills just a niche market and the total consumption of lamb does not increase. Despite being such a little market, the marketing strategy of “Rhönlamb” shows that lamb production with biotope conservation and rare breeds can be economically viable.

The example of the “Biosphärenreservat Rhön” and particularly the marketing initiative “Rhönlamm” are appropriate also for an analysis of a successful marketing strategy. Such a positive case study is transferable, though not easily, to other regions or conditions. However, it highlights the elements of successful marketing strategy for products, which cannot compete in price with other products in the market. This element is the concentration on the processing quality which is something wholesalers and importers cannot compete with. Marketing “Rhönlamm” is a beneficial use of the quality of processing as advantage for a competitive and profitable product. This is shown by the selling price of Rhön lamb meat that stands out clearly against the usual market price of lamb meat.

Successful marketing initiatives surely create new sales prospects. These products mostly replace comparable products, though at higher prices, thus making use of a monetary instead of physical increases in sales by quality improvement.

(Rahmann, 2000)

Judging from the information available on conservation of endangered farm animals and their advantages, particularly Dipholzer geese, it is evident that there has not been much research carried out using this endangered breed for conservation purposes. The reported example of successful use of the indigenous breed Rhön lamb on a regional market as a means of aiding conservation was one successful case in this regard. It encourages similar study for the Diepholzer breed in order to research the performance and advantages of an endangered breed of goose for a successful marketing in the regional and niche level as an approach for conserving this indigenous bird.

3. Material and methods

This study focuses on the comparison of two different breeds of goose kept under the same feeding and housing condition.

3.1. Experimental animals

To carry out the experiment, 100 one day old goslings were purchased from two different hatcheries in Germany.

An indigenous endangered breed "Diepholzer Gans" from three different local breeders in Diepholz, Lower Saxony, Germany was the object of study. 50 Diepholzer goslings available for this study were hatched from the farm of Bollhorst.
The hybrid geese (Eskildsen) were procured from "Königswarder" Eskildsen Company which is the biggest geese breeding company in Germany. The Eskildsen Company breeds its geese from Dietmarscher and Italian goose. These serve as a point of reference (control) in the studies. The Eskildsen geese are the lightest weight hybrid offered by the company.

3.2. Parameters studied

In order to encourage farmers, consumers and breeders to appreciate the old endangered breeds, the following parameters were studied which may result in benefits from keeping or consuming these breeds.

3.2.1. Body weight gain

In order to analyze weight development each individual bird was weighed weekly from the first until 12th week, and thereafter every two weeks and in the last three weeks, in each group the single birds were weighed weekly again.
The hypothesis regarding this parameter was that the indigenous breed has a lower final weight (and live weight gain) than the conventional breed.

3.2.2. Health Status

This parameter was studied based on the hypothesis that the local breed is more resistant to diseases and has a more robust health status than the hybrid. In this analysis, we looked for salmonella and *endo*-parasites in the faeces samples. Health problems and obvious injuries were checked while weighing animals. During the experiment faecal samples were taken to diagnose *endo*-parasites and salmonella. The Flotation method was used to isolate the parasites. In this method, a saturated saline solution with density 1.19 was used at 20 °C. Salmonella (*Salmonella typhi* and *Salmonella paratyphi*) were analysed according to "§ 35 LMBG L00.00-20" (LMBG, 1998).

3.2.3. Feed conversion ratio (FCR)

The feed conversion ratio (feed/weight gain) was studied in order to determine the amount of feed (concentrate + forage +pasture) required to gain 1 kg life weight.

Due to high cost of concentrate feed, it is of an economically advantageous to farmers if the animals consume as little concentrate feed as possible, while obtaining most of the desired weight from grazing.

This parameter was studied based on the hypothesis that hybrid breeds could use more feed than local breeds.

3.2.4. Feed analysis

500g of fresh grass and a handful of concentrate were collected weekly to be analysed later on. Analysis was carried out on feed components (which was not in the framework of this study) and also to generate dry matter of the feed.

3.2.5. Carcass Analysis

A carcass analysis was carried out in which the dressing percentages and other dressed parts were compared. A higher dressed weight is particularly important to farmers since it determines how much of the meat goes to the market.

The weight of single parts of the carcass, such as breast and legs was also measured. These two parts are important for marketing; they are marketable and also precious part of carcass. They are the parts which farmers can earn more money for.

3.2.6. Meat quality

Regarding meat quality, the consumer seeks meat which meets their expectation for a good taste and normally less fat content. Since geese compared to the other poultry have a genetic tendency towards fatness and consumers usually prefer low fat in meat and meat products, it is necessary to keenly investigate the quality, in terms of fat deposition, as well as other characteristics of the meat such as those mentioned below which were investigated in our study.

Electrical conductivity was measured because it is one of the most important indicators for meat quality. Through the conductivity factor, the amount of water in meat can be assumed (Götz, 2004). The electrical conductivity drop after slaughter is also important, if it decreases fast the quality of meat classify as a lesser. Also it is a useful parameter to estimate water holding properties of meat. It was measured by conductivity meters.

pH value was studied because the meat quality is to a high degree determined by the muscles pH and its drop with time, which in turn strongly depends on pre-slaughter conditions (stress), imposed on the animals.
Post-mortem pH was measured twice: 20 minutes and 24 hours after slaughter both in breast and leg muscles. The pH value was measured in electrochemical measurements using pH meters.

Colour is an important trait because of its direct influence on consumer acceptance and also has a high correlation with the functional characteristics of meat. At the retail level, meat colour is important because consumers relate it with freshness and overall quality. The colour was measured in two approaches: Minolta (Fig 3) and Opto value measurement. The Minolta was measured based on CIELAB colour scale. The CIELAB colour space is organized in a cub form (combination of L*, a* and b* axis's). The maximum for L* axis is 100, which represented a perfect reflecting diffuser. The minimum for L* is zero, which represents black. The a* and b* axes have no specific numerical limits. Positive a* is red and Negative a* is green. Positive b* is yellow and negative b* is blue (Hunterlab 1996).

Drip loss was measured bearing in mind the importance of loss of fluid which is containing water and protein. The drip loss was measured by the “Bag method”. In this method a piece sample of breast was weighed and put in a plastic bag which hanged in a fridge (4°C) and kept for 48 hours (Fig 3). Afterwards weight of the muscle was taken again and the difference was indicated the drip loss during time in the fridge. Freezing loss was measured based on freeze with -20°C and were kept for 1-2 weeks.

Figure 3: Minolta colour measurement (left), bag method (middle) and Instron (right)

Shear force is important because of the tenderness trait. The consumer is willing to pay more for the meat which is tender. The tenderness was measured in a shear force measurement INSTRON (Fig 3). The Instron measured the force needed to shear muscle. The more force needed, the tougher is the meat.

The hypothesis in terms of meat quality parameter was that the Diepholzer breed will reach a remarkably better quality than the hybrid one.It should be noted that more information regarding these parameters is discussed in chapter 5 of this study.

3.3. Experimental site

The project was carried out at the experimental farm of the department of Organic Agriculture; Wiesengut in Hennef of the University of Bonn, Germany. Site characteristics are presented below:

- Coordinates: 7°17' East, 50°48' North
- Mean temperature during months of the experiment: 15°C
- Precipitation during months of the experiment: 624 mm

- Humidity during months of the experiment: 77%

3.4. Experimental management

The animals were raised for 30 weeks. Possible pasture to obtain the desired meat was a necessity. The taste of a goose kept in pasture for a long time was estimated to be different from that which is fattened only by concentrate.

Importance of good market for St. Martin or Christmas, feeding by pasture, a non-costly system, using endangered breed as a process quality (living label for farm, long live on grassland) and a better meat quality were the most important reasons to choose this system of keeping. It seems that consumers are willing to pay for the process quality (happy and natural life of bird on pasture/animal welfare) which may lead to a better taste.

The experiment was performed in four feeding phases: 0-4 weeks of age (starter phase), 5-12 weeks of age (growing phase), 13-27 weeks of age (maintenance phase) and 28-30 (fattening phase).

During the experiment, the birds were visited regularly by a veterinary from the Animal Health Service of North Rhine Westphalia.

Five birds died during the entire study. The reasons of their death were limited to each individual bird as follows: broken wing, broken leg, accident in the green house (induced injury), milt problem (unknown reason) and inflammation in throat.

The experiment was carried out over a period of 30 weeks (from 14 April 2005 until 09 November 2005). The animals were slaughtered in "Schlachterei Ritte" slaughter house at 30^{th} weeks of age.

3.5. Experimental design

100 unsexed one-day-old goslings (50 were Diepholzer obtained from three different local breeders, and 50 were Eskildsen all obtained from Eskildsen company) were the base for these studies.

Each breed was randomly divided into two groups of 25 animals. Each of the two groups from Diepholzer was assigned to group A or B, while each of the two groups from Eskildsen breed were assigned group C or D. All animals in the same group were labelled with the same colour leg band and an individual number.

In the first two months of the experiment, animals from each breed (A+B and C+D) were kept together in same pen. After 2 months the animals were allotted according to their groups (either A, B, C or D) into separate experimental pens and 5 animals from each group were selected and taken out either due to health reason or randomly for purpose of balancing the number of animals.

3.6. Housing design

During the experiment birds were kept in three different houses:
In the first month (gosling phase), they were kept in an area of 19.6 m^2 which was divided into two pens (9.8 m^2 per breed).
In the second month, a stable was provided in an area 5.10 m x 5.80 m per each breed, in which the animals had more space. The animals were kept in this second stable from the 5th week until the end of the 7th week of keeping.
In the beginning of the 8th week, the geese were moved to the main house near to the grass field. The stable was built upon a green house tunnel, which is open at fore sides. In case of bad (very rough) weather condition, the fore side was protected by a wind net. The geese were kept in this house until the end of the study. Each green house was divided in two pens and each group of A, B, C and D systematically allotted into one of the four pens. Since the experiment was based on same housing conditions but the green houses was assumed to have different conditions, group A/C was allotted to one green house and B/D to the other one.

Table 1: Recommended space per goose at different ages (Köhler, year unknown)

Age (weeks)	0-4	5-11	12-26	27-30
Space/goose	0.05-0.1 m^2	0.1-0.2 m^2	0.2-0.3 m^2	0.3-0.5 m^2

3.7. Pasture design

The grass/red clover mixture field was sown in August of 2003 with a mixture of the following seeds: Italian ryegrass (*Lolium multiflorum*), bastard ryegrass (hybrid), perennial ryegrass /English ryegrass (*Lolium Perenne*) plus red clover (totally: 71% the three type of ryegrass and 29% of red clover). In the second year of planting the grass field was harvested three times and was used for silage. During the third year of cultivation (year of this study), the grass was harvested once at the end of May and afterward the grass field was used as pasture for the geese. Since it was a plain grass field, there were no shades under which the animals could perch, shades were built afterwards.

The grass field (pasture) was completely randomized into four blocks; each block consisted of four sub-blocks in an area 33m x 18m for each sub block (in total 16 sub blocks) (Fig 4). The grass field was divided in block and sub blocks because it was not homogeneous and each group should have a share of the same grass quality found in the different blocks.

Grazing on the sub blocks was organised according a rotation approach for each group A, B, C and D of the geese. According to grass availability the geese were transferred to the next block and the previous block was cut. While grazing the geese ate mostly the grass, and the red clover was always left behind, therefore cutting offered the grass the opportunity of growing again without being shadowed by the clover.

In order to find out the amount of consumption of the grass on the grass field, four cages were provided in each sub block which was used as a reference (control) for sampling. Always after each move of the geese to the next block, the grass under each cage plus the grass from same area like the cage randomly around the cages were cut. Weight of pasture samples and dry matter data were collected to analyse consumed grass later on.

Sub blocks	Block I	Block II	Block III	Block IV
	Nr. 1A	Nr. 5C	Nr. 9B	Nr. 13A
	Nr. 2C	Nr. 6B	Nr. 10C	Nr. 14D
	Nr. 3B	Nr. 7D	Nr. 11A	Nr. 15C
	Nr. 4D	Nr. 8A	Nr. 12D	Nr. 16B

Figure 4: Pasture partitioning

3.8. Feeding

Concentrate and fresh grass formed the basis of the experimental diet. The starter concentrate (Bioland Gänse Alleinfutter), bought from organic feed mill "Meyrhof zu Bakum" contained the following components: wheat, triticale, field pea, maize, faba bean, maize gluten, soybean, potato protein, brewers yeast, mono-calcium phosphate (MCP), calcium carbonate, Sunflower oil and poultry premix. The organic products were from organic farms or production lines.

Fresh grass was also part of the ration and was provided by the grass field. Feeding with fresh grass in each breed was started when the animals were 6 day old.

Ration of starter diet was: 19% crude protein and 11.9 MJ ME. In the first month of the experiment (gosling phase) diets were provided *ad libitum*. From 5th week age the concentrate supply was limited as shown in Table 2. Crushed sea shells were always provided *ad libitum* as a source of supplement minerals (such as Ca, P, and K etc).

Table 2: Available concentrate per bird and day at different ages

Age (weeks)	0-4	5	6	7	8	9	10	11	12	13-21	22-26	27-30
Feed per bird and day (g)	*Ad lib.**	175	190	190	190	170	160	140	120	75	100	125

* *Ad libitum*

At 8 week of age due to lack of good quality of fresh grass noticeable by minimal weight gain of the Eskildsen, most probably caused by management problems (the good quality grass patches were harvested for the purpose of silage production) let to the geese being fed for 3 days on concentrate (210 g per bird and day).

In addition to the above rations, Oat was added at a level 1/3 the amount of diet consumed from the 5th until the 12th week of age (growing phase).

From the 8th week onwards, a new diet (maintenance diet): 15.9% crude protein and 12.2 MJ ME was balanced which included the following components: faba bean, potatoes protein, wheat, barley, bat and mineral supplement.

The feed was based on feed components available in Wiesengut (see table 3). The grains were all milled in a hammer mill through a 6 mm sieve. Then the milled material, were mixed with other ingredients including potato protein and mineral. Mixing was done manually. The composition of the maintenance diet is represented in Table 3.

Table 3: Composition of maintenance diet (maintenance phase)

Components	Mixed feed (g/kg)	Total per 18 weeks and 80 birds (kg)
Faba bean	225	54
Potao protein	41	10
Barley	214	51
Wheat	500	120
Mineral	20	5
Total	1000	240

From the 28th week onwards, a fattening diet was balanced which contained amount of 13% crude protein and 12 MJ ME, and was provided *ad libitum* for the last 3 weeks of age and the animals were retained in the stable all the time until slaughter. In this diet feed was based on the components available in Wiesengut. The grains were all milled in a hammer mill through a 6 mm sieve which was the biggest available sieve. Mixing was done manually. The components of the fattening diet are shown in Table 4.

Table 4: Components of fattening diet

Components	Mixed feed (g/kg)	Total per 23 days and 76 birds (kg)
Faba bean	340	297
Maize	250	219
Oat	259	226
Wheat	120	105
Mineral	31	27
Total	1000	874

A sufficient number of automatic drinkers and feeders were provided in each house. The recommended space (Köhler, year unknown) for feeder and drinker per animal at different ages is shown in Table 5. Also, one rack of fresh grass was available in each pen for each one of four treatments from the 6th day of the experiment until the end.

Table 5: Recommended space of feeder and drinker per animal at different ages (Köhler, year unknown)

Age (weeks)	0-4	5-11	12-26	27-30
Feeding space (cm)	3–5	10-15	10-15	15
Drinking space (cm)	1	2	2	2

Feed was provided on daily bases and feed consumption was also measured on a daily basis. In order to analyze the feed, samples of fresh grass and concentrate were collected at end of each week.

Since difficulties in walking were noticed with some of the animals in the herd we suspected poor development of the leg bones. As a consequence, C-phos (a mineral feed) and also URSOVIT D3 were administered several times according to the prescription of the veterinary until the problem was resolved.

At 5 weeks of age the geese were taken outside around 4 hours per day to enable them to adapt to grazing on the grass fields and to the extensive farming condition. The plan for keeping them outside was limited by weather conditions and personnel availability. Since the personnel were not available during weekends, the animals were not sent out of the stable on the weekends although whenever the personnel were available the geese were grazing on the grass field in weekends as well. Otherwise during weekends fresh grass was available *ad libitum* in the stable in a rack. While they were on the field, grass was available freely.

3.9. Temperature

Used temperature plans are represented in Table 6.

Table 6: Recommended temperature in the first three weeks of keeping (Köhler, year unknown)

Age (days)	Under the heat source °C	In stable °C
1-3	31-29	26
4-7	30-28	24
8-12	27-25	22
13-18	24-22	18
19-21	21-18	18

After one month of experimentation, the temperature in the houses was the same as out-side except on certain afternoons when it was about 8 degree warmer inside the greenhouses than outside.

It should be noted that the average of temperature inside the green houses was 18°C. The warmest month was July with average of 27°C and the coolest month was November with average of 10°C.

3.10. Data collection and statistics analysis

The daily feed offered and refused was measured and recorded. The initial and weekly body weights (in maintenance phase every two weeks) of each bird, mortality and disease-related problems were collected.

Feed intake was calculated from the daily feed (concentrate + forage) and offered and refused in each phase. Pasture consumption on the grass field was measured regularly after each move of the geese to the next block (movement of the geese to the next block was depend on the grass quality) by sampling trough putting 4 cages in each sub-block of the grass field.

At the end of the experimental period, 50 % of the birds (20 geese from each breed) were randomly chosen for carcass analysis. The carcasses were dressed and separated in different parts: breast, leg, back, neck, tail and abdominal fat. Each part of an individual goose was weighed and the average weight for each group and each breed was recorded. Furthermore the precious parts of the dressed body (breast and leg) were de-skinned, de-boned and the weight of the different parts/components such as bone, muscle, skin, fat and subcutaneous fat were measured and averages for each group and each breed were calculated.

In the slaughter house, at 20 minutes after slaughtering, pH value, electric conductivity and dressed warm weight of carcasses were measured. Also, 24 hours after slaughter cold dressed weight, pH, and electric conductivity of all killed animal were recorded. Regarding meat quality the data from colour measurement in analysed dressed birds were recorded.

Drip loss and shear force of the meat in laboratory of animal husbandry institute of the Bonn University were measured and the data recorded.

The carcass analysis and meat quality as well as body weight gain data was analyzed using the statistical analysis system (SAS) program, for analysis of variance. The “Tukey-test” was used to determine significant differences among mean values at the 0.05 probability level.

It should be noted that we could not carry out the statistical analyses on feed intake parameter due to the only two possible repetitions which were the mean of each group, and this was insufficient for any statistics analyses.

4. Results and discussion

In the current investigation the feed intake, body weight gain, feed conversion ratio, carcass analysis and meat quality were measured in the Diepholzer geese as well as in the conventional breed "Eskildsen mittelschwer". The results of these studies and a comparison between the two breeds are presented below.

4.1. Feed intake

Although we could not carry out the statistics analyses on the feed intake parameter due to only two possible repetitions of treatments, the values are relatively robust. This is because the mean values were calculated from up to 40 birds.

4.1.1. Mixed feed (concentrate) intake

Concentrate consumption in the two goose breeds was measured at each feeding-phases and average calculated for each group and each breed. The concentrate feed consumed in the entire life of the two breeds of geese was numerically not much different. However, the concentrate consumption tends to be higher for the Eskildsen breed (Table 7).

Table 7: Amount of consumed concentrate per goose in different feeding phases

	Concentrate (kg) per goose in FM*			
	Diepholzer		Eskildsen	
Age (weeks)	Feeding phase	Cumulative	Feeding phase	Cumulative
0-4	2.07	2.07	3.32	3.32
5-11	8.38	10.45	8.64	11.97
12-26	9.27	19.72	9.28	21.25
27-30	9.97	29.69	10.66	31.91
Total	29.69		31.91	

*FM: fresh matter

4.1.2. Forage (green feed) intake

As shown in Table 8, the amount of forage consumed in the stable during the entire life time was numerically different between the two breeds of goose (the absolute forage intake is numerically larger for the Eskildsen). A Diepholzer goose consumed 49 kg forage in its entire life in stable which is less than 63 kg consumed forage for the Eskildsen breed. Furthermore the cumulative forage intake for the Eskilden at the end of each feeding phases had a clear tendency for higher consumption (Table 8).

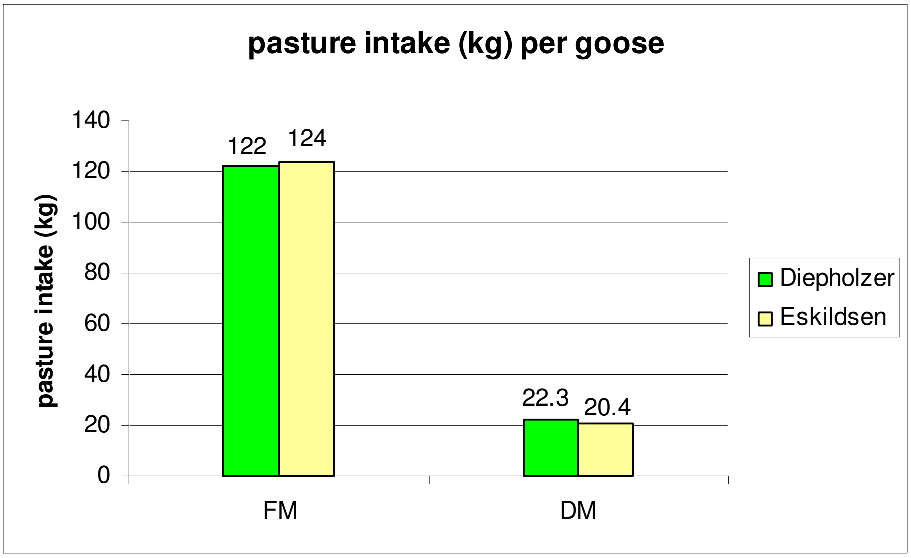
Table 8: Consumed amount of forage per goose in different feeding-phases

	Forage (kg) per goose in FM			
	Diepholzer		Eskildsen	
Age, weeks	Feeding phase	Cumulative	Feeding phase	Cumulative
0-4	1.89	1.89	2.58	2.58
5-11	10.51	12.40	16.49	19.07
12-26	31.29	43.69	37.64	56.71
27-30	5.28	48.97	6.47	63.18
Total	48.97		63.18	

*FM: fresh matter

4.1.3. Pasture (green feed) intake

To estimate the amount of green feed consumed on grass field, the pasture intake was measured through cage sampling in the pasture. An average was calculated for each group and breed. As shown in Fig. 5, the mean of consumed grass during grazing on the grass field for a Diepholzer goose was 122 kg in fresh matter and 22.3 in dry matter while an Eskildsen goose consumed almost 2 kg more in fresh matter and nearly 2 kg less in dry matter. This may be the case because of different sub-blocks, or could because the hybrid breed rather grazed on fresh and young growing grass than on old grass and red clover.



FM: Fresh matter DM: Dry matter

Figure 5: Pasture intake of Diepholzer and Eskildsen geese on the grass filed

The concentrate intake for the two breeds increased parallel to the age of the geese. The consumed concentrate feed in the entire life was not largely different, meaning that the energy freely obtained from concentrate was comparable in both breeds. It can also be seen in Table 7 that the breeds consumed the same amount of concentrate in each feeding phases except for the first month and the last three weeks in which concentrate was offered *ad-libitum* and its consumption is slightly higher for the Eskildsen.

However, it seems that the potential of the Diepholzer to convert concentrate into body weight is limited (see 4.2.).

The forage intake increased as the age of the geese increased but in the last three weeks of keeping it dropped for both breeds. Due to *ad-libitum* offer of concentrate in the last three weeks it seems that the birds obtained their energy mostly from concentrate.

There seems to be no difference in pasture intake between the two breeds.

4.2. Body weight gain

Growth rate was measured based on the weight of individual animals. The mean values of body weight gain of each group and each breed were calculated and are represented in Fig 6. This results show that the Eskildsen attained 6264 g as the final weight which is remarkably higher than Diepholzer with 5557 g.

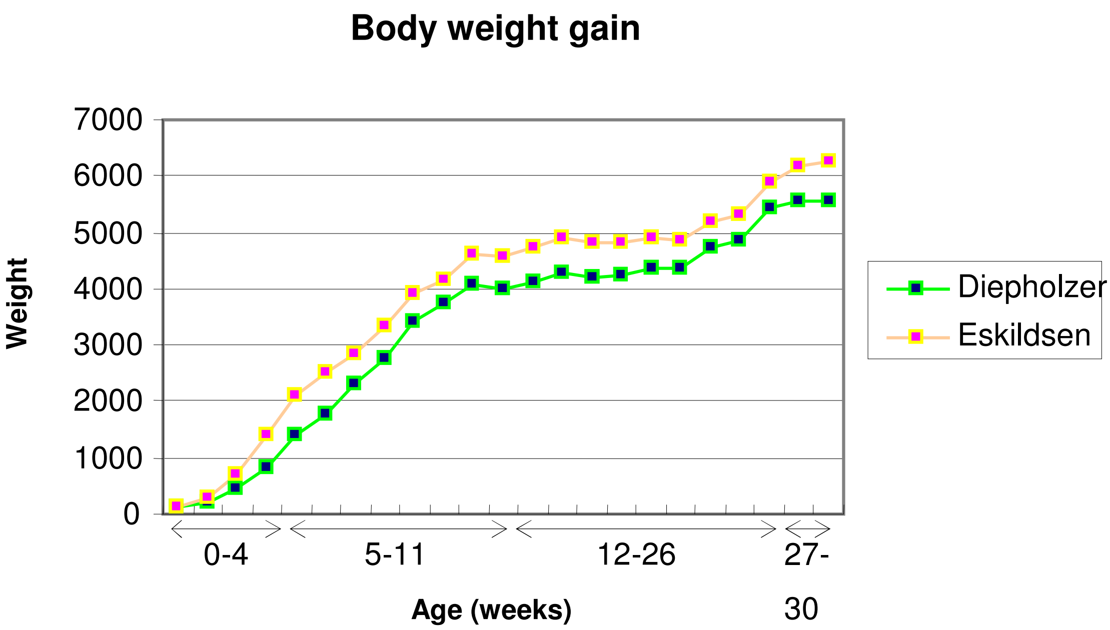


Figure 6: Body weight gain of Diepholzer and Eskilden geese

A comparison of body weight gain between the breeds shows that they developed their weight in nearly same rate from the beginning until the end (they increased their weight at almost the same pace). They put on weight fast until they were 12 weeks of age (end of growing phase). From 5-7 weeks of age, as the amount of concentrate offered increased, the Eskildsen put on weight faster which seems to be due to higher consumption of concentrate (more energy intake). At 12 weeks of age, the weight of the local breed was 3.99 kg and the hybrid's 4.58 kg. This weight falls within the range of 4.3-6.8 kg at the end of 12 weeks of age for light to heavy categories reported by Köhler (2005).

As can be seen in Fig. 6, the weight gain curve dropped after 12 weeks of age for a period of 1-2 weeks when they started to graze on the grass field. This might partly be due the poor quality of the pasture at this time. On the other hand the reduction of concentrate from 120 g per day to 75 g might have also had an impact. Afterwards they maintained their body weights until 26 weeks of age when concentrate was offered *ad libitum.*

This data is not surprising because according to Kunst (1995), grazing on the pasture results in a significantly lower energy intake.

The body weights dropped slightly in both breed at the end of July and in beginning of August. This may be due to high environmental temperature, especially in the stable where in certain afternoons the temperature were up to 8° warmer. Under high temperature conditions the geese consumed less feed, which is the main reason for dropping body weight (Kunst, 1995).

In the presence of *ad libitum* concentrate in the last three weeks of keeping both breeds started to put on weight again. But it seems that the local breed reached its potential weight and if feeding with concentrate was continued for a longer period the Diepholzer may have maintained their weights while the hybrid seemed to have the potential to increase their weight.

Köhler (2005) reported that the pasture geese in the end of 28 weeks of age may attain between 4.5 – 8.5 kg as final weight which differs from light to heavy breeds. In another study, Ristic *et al.* (2004) reported 6.3 kg for Moorhof Schwerk (heavy class of goose weight) and 5.3 for Karlvon berg (light class) at the end of 16 weeks of age. Wężyk *et al*. (2003) reported 6.37 kg for W11 strain and 6.68 kg for W33 for body weight gain in end of 17 weeks of age. The result of Wężyk *et al*. (2003) was based on female and male so the average of both was taken since in this study treatment was not based on gender. It should be noted that the above mentioned studies were not based on organic farming conditions.

Comparing the results of this study to the above mentioned studies, our experimental birds performed well in their weight category.

Regarding the higher total forage intake of the hybrid breed and also the slightly higher cumulative concentrate consumption at the end of 26 weeks of age, it was expected that the Eskilsen breed would gain more weight. It should be noted that both breeds were in good health and similar husbandry conditions during the entire experiment.

4.3. Feed Conversion Ratio (FCR)

Feed Conversion Ratios (FCR) were calculated taking the ratio of feed intake in dry matter to weight gain. This was done weekly (except maintenance phase in which it was done every two weeks) and also for the entire experimental period.

As can be seen in Table 9, the FCR of the local breed is higher, meaning that the local breed needs 0.8 kg more feed to obtain one kg weight.

Table 9 gives the result of feed (concentrate, forage and pasture) intake in dry matter in all feeding-phases of keeping. An Eskildsen goose consumed, in total, 27.9 kg concentrate in dry matter in its entire life while a Diepholzer goose consumed 25.9 kg in its entire life. 10.7 kg forage intake in dry matter for the hybrid breed is also higher than 8.4 kg for the local breed. The percentage of concentrate intake in each feeding-phase and in total was calculated based on the sum of feed (mixed feed + green feed) which is presented in Table 9.

Table 9: Feed intake and FCR in different phases in dry matter and in kg

Age (weeks)	0-4		5-11		12-26		27-30		Total	
Breeds	Diep.[1)]	Esk.[2)]	Diep.	Esk.	Diep.	Esk.	Diep.	Esk.	Diep.	Esk.
Concentrate DM[3)] (kg)	1.8	3	7.4	7.6	8.0	8.0	8.7	9.3	25.9	27.9
Forage DM (kg)	0.3	0.4	2.5	3.5	4.9	5.9	0.7	0.9	8.4	10.7
Pasture DM (kg)	0.0	0.0	0.0	0.0	22.3	20.4	0.0	0.0	22.3	20.4
Sum (kg)	2.2	3.4	9.9	11.1	35.5	34.5	9.4	10.2	56.9	59.2
FCR[4)]	1.5	1.6	2.5	2.4	6.5	5.8	1.7	1.6	**10.2**	**9.4**
Concentrate (%)	85.2	87.0	75.0	68.7	22.6	23.3	92.3	91.3	45.6	47.2

[1)] Diep.: Diepholzer [1)] [2)] Esk.: Eskildsen [3)] DM: Dry matter

[4)] FCR: Feed conversion ratio for each feeding phase

A comparison of the FCR in different feeding-phases shows that at 12-26 weeks of age, when concentrate was limited to 75 g per goose and day and the geese also were grazing on the pasture, they needed a larger amount of feed, which was mostly forage to put on one kg of weight while in the first month and the last 3 weeks of keeping, when the unlimited concentrate was offered, the FCR is almost the same and less than in the period of 12-26 weeks of age. This means that if we feed the geese mostly based on forage, a large amount of forage is needed to obtain one kg of weight. It should be noted that the birds were grazed on pasture 4 hours per day from 5-12 weeks of age in which the consumed pasture was not measured most probably affected the FCR of this period.

A comparison of consumed forage (green feed in stable), in the entire life as well as in all feeding-phases, and pasture (green feed on grass field) in dry matter shows that Diepholzer consumed almost the same grass on pasture and less in stable than Eskildsen.

In this study the mixed feed (concentrate) intake in dry matter for Eskildsen in the first month and last three weeks of keeping are higher than for the Diepholzer while between 5-11 and 12-26 weeks of age it is almost the same. Considering that in the first month and in the last three weeks concentrate was offered *ad libiltum,* the Eskildsen consumed more concentrate than the local breeds in presence of unlimited amount of offered concentrate.

There was no big difference in the percentage of the consumed amount of concentrate in total and different feeding phases in the two breeds except between 5-11 weeks of age (growing phase), when the percentage of consumed concentrate was higher for the Diepholzer. This is an interesting result since we assumed that local breeds consume less concentrate than conventional breeds.

Also the FCR of the concentrate was calculated and it was almost the same, 4.67 kg for the Diepholzer and 4.45 kg for the Eskildsen. This shows that the two breeds need almost the same amount of concentrate to obtain one kg weight, and with the availability of the mixed feed the two breeds performed almost the same. Pingel (2004) reported 4.30 kg for FCR of concentrate at the end of 17 weeks for fattening geese (Gänsmast).

The most costly feed for a farmer is the concentrate. On the other side it provides the most energy required for growth. For both breeds our results show that whenever the geese consume more concentrate they put on more weight (see 4.2. and 4.1.).

4.4. Carcass analyses

4.4.1. Percentage of dressed weight

The percentage of warm and cold dressed body was calculated as a proportion of the live weight. The results are presented in Table 10. As can be seen, the weight of both warm and cold dressed body is significantly lower for Diepholzer. But the percentage of warm and cold dressed body did not show significant differences.

Table 10: Weight and percentage of dressed warm and cold carcasses

	Live body	Dressed warm		Dressed cold		Without neck*	
	(kg)	(kg)	(%)	(kg)	(%)	(kg)	(%)
Diepholzer	5.56 [SD]	3.51 [SD]	63.06	3.48 [SD]	62.59	3.30	59.4
Eskildsen	6.26 [SD]	4.20 [SD]	67.09	4.16 [SD]	66.45	3.96	63.3

SD: Significant difference *Cold dressed body weight without neck

A comparison of dressed weight in the two breeds shows that the Diepholzer had more refuse than the hybrid breed.

As can be seen in Table 10, the mean of cold dressed weight of the endangered breed without neck is 3.3 kg and the hybrid is 3.7 kg. Compared with results put forward by Golze *et al.* (2002), who found 2.87 kg cold dressed weight (without neck) for light breeds and 3.62 kg for heavy breeds (28 weeks age), our results show a good performance for our experimental birds.

4.4.2. Components of carcass

As can be seen in Table 11, there were no significant differences between the two breed in the weights of wing, neck and abdominal fat. Furthermore the weights of back, breast, thigh and tail were significantly different. The percentages of different parts of carcass were calculated from the dressed cold weight of analysed carcasses and the results are shown in Table 11. There were no significant differences in the percentage of carcass components.

Table 11: Components carcass in g and percentage of cold dressed weight

		Carcass Components						
		Wing	Neck	Back	Breast	Thigh	A.*fat	Tail
Diepholzer	g	502.8	185.7	623.0^{SD}	1287.1^{SD}	758.0^{SD}	189.0	42.6^{SD}
	%	14.0	5.2	17.3	35.8	21.1	5.3	1.2
Eskildsen	g	535.6	199.2	702.0^{SD}	1501.0^{SD}	857.6^{SD}	223.5	54.3^{SD}
	%	13.1	4.9	17.1	36.6	20.9	5.5	1.3

SD: Significant difference * Abdominal fat

Comparisons of the results of the carcass components between the two breeds show that the back and tail as well as the breast and thigh were significantly lighter for the local breed than for the hybrid. Since the Diepholzer reached a lower slaughter weight, the smaller components are reasonable.

Golze *at al*. (2002) reported 24.4% thigh of cold slaughter weight (28 weeks age) without neck while our results show 22.21% thigh for Diepholzer and 21.99% for Eskildsen which is from cold dressed weight without neck. Our results for thigh percentage are lower than in the above mentioned study. Furthermore, the result of thigh proportion for the Diepholzer was not expected since this local breed is from an old breed which used to walk 20 km to markets and we expected a bigger leg proportion of carcass for the Diepholzer. That might be due to keeping them over the time in the stable which may have led to a reduction of potential muscle development.

The results in Table 11 show that the Diepholzer breed has no markedly differed abdominal fat deposition in g, which was expected to be less. Golze and *et al.* (2002) reported 5.4 % abdominal fat in light breed which is the same result as ours.

Pingel (2004) reported 3.9% (average of male and female) of carcass for abdominal fat at 10 weeks of age (fattening geese). Compared to our result, it showed a slightly higher percentage for abdominal fat.

4.4.3. Breast and thigh

Due to the importance of precious parts (breast and thigh) of the meat for marketing, we measured the weight and calculated percentage of cold dressed weight for both breeds, and the results are presented in Table 12.

Table 12: Weight and percentage of muscle in breast and thigh

	Breast	Breast muscle		Thigh	Thigh muscle	
	(g)	(g)	(%)	(g)	(g)	(%)
Diepholzer	1287.1	687.8	53.44	758.0	463.3	61.12
Eskildsen	1501.0	801.3	53.38	857.6	503.1	58.67

The muscle fraction in the breast for the two breeds is numerically almost the same while the muscle fraction of thigh in Diepholzer tends to be higher.

Golze *et al.* (2002) reported 62.5% thigh muscle and 71.6 % breast muscle for light category of geese (28 weeks age). Our results show that the percentage of breast muscle for Diepholzer was 53.44% and for the Eskildsen 53.38% which are the same, but remarkably lower than in the above mentioned study. The difference maybe that our study was carried out based on organic farming conditions or the limited diet (limited amount of concentrate between 5-26 weeks of the keeping in our study), or maybe even the lower amount of energy in the balanced diets (some costly but important components of the balanced diet were not used). Different methods used for dissection could be another possibility for this difference.

However, the percentage of thigh muscle for the Diepholzer is almost the same as in the result of Golze *et al.* (2002).

4.4.4. Health status

Salmonella was tested and only one case, which was in the first day of keeping for the Diepholzer breed, was recorded. It may have been caused by the hatchery process.

Different gastrointestinal worm eggs were diagnosed three times for the Diephozer breed and two times for the Eskildsen in faecal samples collected during maintenance and fattening phases.

Apart from some little injuries in wings and legs for the two breeds, the birds were in good health during the studies. However, the type of breed did not affect the health status in this study.

4.5. Meat quality

More information regarding this parameter is discussed in chapter 5 (general discussion).

4.5.1.1 Electric Conductivity and pH value

Table 13 gives an overview of the recorded pH value and electric conductivity of the geese which were measured twice: 20 minutes and 24 hours after slaughter in both breast and thigh muscles. The mean values of each group and breeds were calculated. As shown in Table 13, there were no significant differences for pH and electric conductivity except 20 minutes after *post-mortem* for the breast. The pH_{24} (24 hours after *post-mortem*) of thigh for the Diepholzer is tends to be slightly higher than the Eskildsen and closer to neutral value.

Table 13: Electric conductivity and pH of breast and thigh at 20 minutes and 24 hours *post-mortem*

	Electric conductivity (mS) [1]				**pH**			
	Breast		Thigh		Breast		Thigh	
	20 min [2]	24 h [3]	20 min	24 h	pH_{20}	pH_{24}	pH_{20}	pH_{24}
Diepholzer	3.77 SD	3.33	3.77	2.56	6.91 SD	5.74	6.77	6.10
Eskildsen	3.45 SD	3.09	3.63	2.40	7.07 SD	5.77	6.78	6.06

[1] Milli Siemens per cm [2] 20 minutes *post-mortem* [3] 24 hours *post-mortem*

SD: Significant difference

Higher electrical conductivity at 20 minutes after *post-mortem* for the local breed seems to indicate less value for the meat quality than the hybrid.

The pH of breast and thigh muscles in both 20 minutes and 24 hours after slaughter seems to indicate almost the same value for the breeds. Golze (2000) reported 6.33 for thigh pH_{24} and 5.76 for breast pH_{24}. The comparison between the mentioned study and our results showed that the breast pH_{24} is almost the same but the thigh pH_{24} in our experimental birds is different (tends to acidity). This could have been induced by pre slaughter stress which affects most the leg muscle (Kunst, 1995).

Baéza *et al.* (1998) reported 6.66 for pH_{20} and 5.59 for pH_{24} in breast muscle (slaughtered at 26 weeks of age). This means that our geese performed better in case of breast pH since their value was closer to the neutral value (7) of pH compared to the mentioned results.

4.5.2. Colour

The meat colour was measured with two objective measurements, Minolta Chroma Meter and Opto. Measurement was carried out with three repetitions on the breast muscles and the averages of groups and breeds were calculated. There were no significant differences in Minolta scale for the two breeds.

Table 14: Minolta lightness (L*), redness (a*), yellowness (b*) and opto value colour

	Minolta			
	L*	a*	b*	Opto value
Diepholzer	33.13	20.56	0.25	89.96
Eskildsen	32.61	20.77	0.62	90.80

As shown in Table 14 the lightness (L*) tends to category of dark meat in the two breeds. Furthermore the redness (a*) is remarkable positive and is the same in two breeds. Yellowness (b*) is also positive but less positive in the Diepholzer (there were more negative values for b* in the individual goose of the local breed). These mean that the meat of our experimental birds tends to dark, red and less yellow which is opposite of a light, less red and less yellow meat. Golze *et al*. (2002) in their study found 32.8 for Minolta lightness which is almost the same as our result. The Opto value which indicates the colour form the range of light to dark also reached the same value for the both breeds.

4.5.3. Drip loss and shear force

Drip loss, freezing loss, cooking loss and shear force of each breed were measured.
The mean of each group and each breed was calculated (Table 15).
The results show that drip loss is significantly higher for the Diepholzer than for the Eskildsen. Furthermore the two experimental breeds performed almost the same regarding freezing loss, cooking loss and shear force.
It should be noted that percentage of drip, freezing and cooking loss and shear force were calculated of the same sample of breast muscle.

Table 15: Drip loss, freezing loss, and cooking loss and shear force of the breast meat of the geese

	Drip loss (%)	Freezing loss (%)	Cooking loss (%)	Shear force (kg)
Diepholzer	1.1	3.2	23.6	3.7
Eskildsen	0.8	3.2	23.2	3.8

Higher drip loss in the local breed means that they lost more fluid from their meat which is mainly consisting of water and protein, than the hybrid.

There were neither significant differences in the freezing loss nor the cooking loss between the two breeds, meaning that cooking and freezing have the same impact on the meat of both breeds and they both lost the same portion of weight (mass).

Also the shear force did not show remarkably difference between both breeds. This means that the meat of both breeds needed the same amount of force to be cut. Golze (2000) reported 2.5 kg shear force for light breeds and 4.2 kg for heavy breeds of pasture geese. Comparing this with our results, our experimental animals needed almost 1.2 kg more force to be cut in comparison to the light breeds. Since lower shear force results in better tenderness (Kunst, 1995) therefore our experimental animals were less tender.

Note that in our experiment the units of the shear force measurement was Newton but it converted to kg through divide Newton to 9.80665.

5. General discussion: The role of meat quality for conserving the endangered breeds

To our knowledge, the performance of the indigenous breed of geese "Diepholzer" and its meat quality has not been examined, thus the purpose of this investigation was to quantify differences in performance of the endangered local breed, particularly in meat quality compared to a hybrid breed of geese "Eskildsen".

In this study, it was assumed that a successful marketing of the meat of endangered breeds on the level of regional and niche markets is one of the important tools to increase the demand for this meat, which could implicitly improve the threat of extinction faced by the endangered farm animals. Their meat quality was predicted as a property that could enable them to compete with hybrid breeds in the regional market.

One of the objectives in this study was that, if the Diepholzer produced significantly better meat quality, a successful marketing of Diepholzer meat could trigger and assist the conservation of this breed. This marketing approach was assumed as a strategy which might increase demand and subsequently increasing the animal stock.

5.1. Meat quality and the advantages of meat of the "Diepholzer Gans"

A definition of meat quality related to poultry is a difficult task since quality lies in the eye of the beholder (Northcutt, 1997). Among the meat features which influence the initial and final quality judgement by consumers before and after purchasing a meat product, the following are most important: appearance, texture, juiciness, wateriness, firmness, tenderness, odour and flavour (Cross *et al.*, 1986). Furthermore, quantifiable (scientific/experimental) properties of meat such as water holding capacity, shear force, drip loss, cook loss, pH, shelf life, collagen content, protein solubility, cohesiveness, and fat binding capacity are essential for judging the value of meat quality (Santiago Anadón, 2002).

However, the expectations of consumers for the product and process quality are relatively high (Rahmann, 1992). Finally, the consumer, producer, processor and retailer all have their specific expectations for the quality attributes of poultry. But the ultimate authority will always be the consumer (Northcutt, 1997).

Moreover, the meat quality is a complex which is influenced by a vast number of factors. Rymkiewicz-Schymczyk *et al.* (2003) reported that the quality of poultry carcasses depends on the content of particular tissue components- meat, bones and fat. Both poultry breeders and producers should aim their activities at increasing carcass meatiness and reducing fatness.

Based on the above mentioned literatures in terms of meat quality definition, seems that there is no standard definition of meat quality and it is not simple to define a quality which meets all the aspects of the poultry meat. The factors of meat quality all seem to be important to indicate a meat as being of good quality. Amongst these various aspects of meat quality sensory and technological aspects focused on quantifying some features of the meat quality of the Diepholzer in comparison to Eskildsen. It should be noted that the sensory and technological aspects are not major features for the meat quality but they gain more attention due to the producer and consumers demand (Hambrecht, 1994).

In the case of goose meat quality it seems that there are no optimum range targets and meat quality classes. But in pork meat quality classes, the most prominent defect is called PSE condition. In this condition the meat is pale, soft and exudative and consumers reject such meat because of bad dapperness and its high cooking loss (Hambrecht, 1994).

The sensory and technological aspects indicate most the PSE.

According Hofmann, 1987 and Russo 1988 the sensory quality include: colour, tenderness, juiciness, taste, absence of off-odours (e.g. boar taint), texture, intramuscular fat contents. Technological aspects are: water holding capacity (WHC), pH, conductivity, fat consistency (amount of unsaturated fatty acids) and maturity of the tissues.

Within the scope of this study following traits among all of the above mentioned features for the sensory and technological traits were investigated: electrical conductivity, pH, colour, drip loss, freezing and cooking loss and shear force.

Electric conductivity

Electric conductivity is an electrical resistance measured between two electrodes, e.g. in a liquid. The lower the resistance is, the higher the conductivity and vice versa. Substances such as salt dissolved in water lower the electrical resistance and thus increase conductivity. Furthermore based on another definition of electrical conductivity from Wikipedia (2006), electrical conduction is an electrical phenomenon where a material (solid or otherwise) contains movable particles with electric charge, which can carry electricity. Electrical conductivity is a measure for this phenomenon.

Based on electric conductivity the water content of the meat can be estimated. The higher the conductivity indicates the more water in the meat. Also it can be an indicator for PSE meat. It should be noted that the electric conductivity drop with time is a very important indicator of the conductivity in order to assume the meat quality. The time for this estimation should be considered longer than the pH value drop with time (Götz, 2004).

In this study, the type of breed did not affect the electric conductivity in the thigh muscle but a significant difference in the electric conductivity of breast at 20 *post-mortem* was found, which for the conventional breed was lower. Due to the fact that less conductivity indicates less water in the meat, and that less water is seen in most circles as better quality, it seems that in this case the Eskildsen performed better than the Diepholzer.

pH value

pH measures the degree of acidity of the meat and it is ranged between numbers of 1 and 14, where number 1 indicates high acidity and 14 high alkalinity. The neutral value of pH is 7 and is found in live bodies. Higher or lower values reduce the quality of the meat. It is reported by Pingel (2004), and Kunst (1995), that pre-slaughter stress often results in increases pH values, especially in the leg meat. Also higher pH-values make meat more perishable (Kunst, 1995). Furthermore it is reported that in pigs a rapid decrease of pH (pH value of 5.4-5.6 immediately after slaughter) causes the PSE condition. This rapid decrease is also due to pre-slaughter condition and stunning (FAO, 2002).Also, Baéza *et al*. (1998) found that neither the age nor the feeding system had a significant effect on *post-mortem* pH of geese breast.

According to the above mentioned studies it seems that the pH value and its decrease in time are highly related to pre-slaughter condition rather than to type of breed.

Furthermore, significant differences for pH values for both breeds in leg and breast muscle 24 hours after slaughter were not found, but there was a significant difference in pH at 20 minutes after slaughter for breast between the breeds (see Table 13) which for the Diepholzer was slightly lower than the neutral value of pH and for the Eskildsen was slightly higher than the neutral value.

Considering the fact that the pH drops with time and the speed of the drop is a very important indicator of pH value for the meat quality, the drop in pH after 24 hours was calculated. The decrease of pH for the Diepholzer was 1.17 in breast muscle and 0.67 in the thigh. For the Eskildsen the decrease was 1.30 in breast and 0.72 in thigh. Baéza *et al*. (1998) reached almost the same result for the pH drop in breast which was 1.07. Comparison of this result with the mentioned study shows a slightly smaller pH drop for the Diepholzer than the conventional goose.

However, since it seems that there is no clear recorded optimum pH range for goose meat and also considering both breeds had almost the same pH value at 24 hours *post-mortem*, it could be concluded that type of breed did not affect the pH value.

Colour

In poultry meat as well as in other species, colour variations get considerable attention from researchers because of their direct influence on consumer acceptance and the high correlation with the functional characteristics of meat. Poultry is the only species known to have muscles with marked differences in colour, and the meat has been classified as either white or dark. These marked differences are largely due to muscle biochemistry and histology (Santiago Anadón, 2002).

In this study the type of breed did not affect the colour of breast muscle. But Northcutt, (1997) found that poultry meat colour is affected by factors such as bird age, sex, strain, diet, intramuscular fat, meat moisture content, pre-slaughter conditions and processing variables.

Furthermore comparison of our results with those of Baéza *et al*. (1998) study (reared on pasture with addition of maize and slaughtered after 26 weeks) showed that our geese had less yellowness, more redness and less paleness. Less yellowness could be explained by the fact that our geese were fed a smaller amount of maize per day. Higher redness and less paleness may be due to the components of the diet (including the composition of pasture) or maybe because of more activity.

Drip loss

Drip loss is defined as fluid, mainly consisting of water and proteins, expelled from a piece of meat without mechanical force other than gravity. Furthermore, high losses of fluid in form of drip may affect financial output, nutritional value, consumer appeal and/or technological properties of porcine meat.

If the meat loses more fluid, the quality reduces. In addition to that, Santiago Anadón (2002) reported that tenderness, juiciness, firmness, and appearance of meat improve as the content of water in the muscle increases, leading to an improvement in quality and economical value.

In the present study the Diepholzer showed a significantly higher percentage of drip loss which leads to less quality and the type of breed did affect the drip loss significantly. Baéza *et al*. (1998) showed that neither the age nor the feeding system had a significant effect on *post-mortem* juice loss of breasts, concretising the fact that the breed plays a more important role.

However, in terms of drip loss the hybrid goose performed significantly better than the local breed (see 4.5.3.). This may be considered as a disadvantage to the local breed.
The freezing and cooking loss did not appear to be significantly different in the two breeds.

Shear force (Tenderness)

The consumers relate the quality of poultry meat to its texture. It should be noted that whether or not poultry meat is tender depends upon the rate and extent of the chemical and physical changes occurring in the muscle as it becomes meat (Northcutt, 1997).
The type of breed did not affect the tenderness in our study but compared with the results of Golze (2000), their meat was less tender (see 4.5.3.).

The above mentioned traits for the meat quality indicate that on the one hand, no significant differences between the endangered breed and the hybrid in respect of electric conductivity and pH at 24 hours *post-mortem* in breast and also at 20 minutes and 24 hours *post-mortem* in the leg muscles was found. In addition to that, there were no recorded significant differences in terms of colour, freezing loss, cooking loss and shear force. These may be considered as good potentials for the meat quality of the Diepholzer.
On the other hand, the electric conductivity and pH of breast at 20 minutes *post-mortem* and also drip loss were significantly different for the two breeds. Considering the importance of drip loss in meat quality, the Diepholzer stands in a disadvantageous position.

Based on these results it can be concluded that the Diepholzer goose had no significant advantages in terms of meat quality but drip loss was considered as a disadvantage for this endangered breed.
It seems as if the endangered breed did not produce better meat which means our hypothesis in this case could be rejected. Nevertheless, we found almost the same meat quality, and the performance of the Diepholzer goose makes it possible to present them in market. Also, since meat quality is a complex phenomenon which is highly correlated with genotype and the pre and post-slaughter conditions it is a difficult task to judge and conclude as clearly that the meat of the Diepholzer is indeed of lower quality.
This leads us to consider the carcass value of the Diepholzer to quantify and determine the further advantages or disadvantages of this breed in comparison with the hybrid with regards to meat quantity.

Carcass value

The carcass with higher percentage of meat is an important factor in terms of marketing, because it makes the meat more marketable. Furthermore, the producers also would like to have higher carcass percentages. The heavier and larger amount of meat has a higher benefit from an economic perspective.

In this study the dressed body weight for the Diepholzer was lower than the Eskildsen which could be a disadvantage for the local breed. The Diepholzer obtained a significant lighter breast and leg as well as smaller back and tail than the conventional goose. On the contrary, percentage of dressed body (warm and cold) and carcass component from the cold dressed body was not significantly difference between the two breeds.

However, in this study the type of breed affected the carcass value. The hybrid breed had a bigger carcass, breast and legs.

Based on the results of this study, it seems that the Diepholzer does not have better traits (qualitative or quantitative) that could encourage their marketability over the hybrid breed. Also, based on our results, marketing of the Diepholzer meat based on better quality to encourage conservation by means of on-farm strategy is likely to be impossible.

The local breed had the tendency to consume almost the same amount of concentrate as the hybrid breed and less forage. The hybrid realised higher FCR than the conventional breed.

Further traits of meat quality such as taste, flavour and fat deposition which are supposed to be better for the Diepholzer still need to be investigated. Maybe a combination of these traits and the other potentials of the Diepholzer might arm it to compete with the hybrid breed in regional markets.

5.2. Results of some studies on meat quality of endangered breeds

Due to outstanding traits that could redefine the quality of the Diepholzer meat, it is necessary to review the other studies on meat quality of endangered farm animals. It appears to be difficult for meat of the endangered breeds to compete on the market in the presence of hybrid breeds, especially on the level of national and international (standard) qualifications. For the purpose of promoting the meat of endangered breed in the market, process quality may help to enable them to compete at least in regional and niche markets. In this regard, Rahmann (2000) carried out some a study on the marketing analysis of the endangered breed of “Rhön” sheep at the regional and niche level (see 2.4 for the result of the study) which was successful. Before the study of Rahmann (2000) took place, two different investigations by Demise *et al*. (1995) and Quanz (1996) were conducted to quantify meat of the endangered breed and compare it with the conventional breeds. The aim of these studies was to obtain process and product qualities of meat of the endangered breed. These objectives were examined by studying lamb through biotope conservation. In these studies carcass (dressed meat) quality was more emphasized than the process quality.

Quanz (1996) compared the slaughter value of 5 different muttons: Schwarzkopf (SKF), Heidschnucke (HS), Rhön (RH), Merino Landshcaf (MI) and a crossbreed (TE x MI) with evaluation of Europe classification under different feeding intensities. According to this classification, the crossbreed of TE x MI obtained the highest value and the Rhön sheep placed almost last in this evaluation.

Evaluating of meat quality according to European standard, Quanz (1996) found that the sheep fed under intensive farming condition have a better meat quality than the sheep fed under extensive condition. Also crossbreeds lambs perform better than landscape sheep.

Moreover, Quanz (1996) reported the result of sensory traits evaluation of the meat for the above mentioned breeds of lambs. In this evaluation, the taste and the flavour of the meat on some feeding conditions were very similar for different races (except SKF).

Also, the breeds with a higher amount of meat and lower fat deposition (SKF and TE x MI) were evaluated less favourable than the landscape races of HS, RH and MI.

The feeding intensity has apparently a significant influence on the important trait of meat quality of the lambs. Meat of lamb from the extensive system showed better results than sheep from intensive and semi-intensive systems regarding tenderness. Also water holding capacity was lower, but conductivity was the best in the extensive farming conditions. Juiciness and taste were however judged as less valuable. However, the semi-intensive system showed the best result.

Demise *et al*. (1995) investigated slaughter value of extensively fed SKF lambs in the "Landschaftpflegehof Lenzen". They reported that muscle growth of the lambs, which were fed by an extensive system, was low since the slaughter weight did not reach the standard. The meat of this lamb had, however, a high content on certain essential, but not all fatty acids. Yet, Demise *et al*. (1995) showed that the daily weight gain of the lamb extensive farming system was not satisfactory.

These above mentioned reports show that the meat quality of the local breed of Rhön under extensive farming system was good in terms of tenderness and it also contained more fat which renders more flavour to the customer. Yet, it did not obtain a good rating in European classification. Also the carcass value and body weight gain were not satisfactory.

The results of the above studies just like the result of this study, indicate that the old endangered breeds do not produce meat that meets up with the European classification standards. The target aim here is not to get the Diepholzer to the big markets (national and international) but to the regional and niche markets. The potential traits such as taste and flavour for better performance which should be investigated in the further studies, could still provide these endangered breed with a marketing possibility. Less carcass value and body weight gain for the endangered breed than conventional breed were recorded in this study just as in the studies mentioned above.

Despite the fact that the meat quality of the endangered breed seems to have failed as a tool for better marketing and hence, on-farm strategies seemingly failed as methods to support conservation, there are still chances for the meat products of these breeds to be promoted and compete with the conventional breeds through other meat traits, such as taste and flavour.
A chance for maintaining and improving the Diepholzer maybe achieved through the promotion of existing values such as the customers' willingness to pay more for the endangered products out of interest in trying to save the endangered breed. In addition, other aspects of process quality (animal welfare, biotope conservation, organic farming, and regional product) should also be considered for future investigations to improve the situation of this endangered breed.

6. Conclusion and outlook

According to the objectives and under the conditions of this experimental study, it is concluded that during the period of evaluation the hypotheses of less feed consumption, lower FCR and significantly better meat quality for the Diepholzer goose are rejected. In this study, a better performance in the feed conversion ratio, growth rate and carcass values for the conventional goose than the old endangered breed were recorded. Also the meat quality of the Diepholzer was not significantly better than the Eskildsen in terms of the examined features. Nevertheless, we found almost the same meat quality, and the performance of the Diepholzer goose makes it possible to present them on market. Also, since meat quality is a complex phenomenon which is highly correlated with genotype and the pre and post-slaughter conditions for any individual animal it is a difficult task to judge and conclude clearly that the meat of the Diepholzer is of lower quality.

Despite the fact that the meat quality of the endangered breed seems to have failed as a tool for better marketing and hence, on-farm strategy seemingly failed as a strategy to support conservation, there might be still chances for the meat product of these breeds to be promoted and compete with the conventional breeds through other traits such as taste and flavour of endangered breeds meat.

For the aim of conserving the endangered breed, the *ex situ* strategy of conservation, and also other features of *in situ* conservation strategy such as biotope conservation, should be considered for the further study. The process quality such as animal welfare, biotope conservation, organic farming, regional product (Rahmann, 2000) which considers additional benefits to obtain higher prices as well as promotion of existing values, could be thought for conserving the Diepholzer goose.

The experiment attempted to highlight the potential use of the Diepholzer and their meat features. However, according to the results of this experimental study, below there are some recommendations that could be improving further investigation on the Diepholzer:

- To search for further possible potentials of meat quality for the Diepholzer compared to hybrid breeds.
- Undertaking a marketing analysis for the indigenous goose is recommended to realize economic advantages or disadvantages of the Diepholzer compare to the conventional goose (such as Rahmann (2000) for the Rhön lamb), while also answering the following question:

What dose it cost to produce 1 kg Eskildsen meat and 1 kg of the Diepholzer meat?

- To observe the interaction of the pasture geese with the other farm animals. (This is due to the observation that geese more grazed on the grass than on the red clover on the pasture in this study, while other farm animals such as cow are more interested in grazing the red clover).

Lastly, in Germany or in any other country around the world, in which the old local farm animals are at the risk of being lost, it would be helpful to quantify the potential of this indigenous and valuable farm animal to maintain their genetic resources for the unknown feature. This should be more emphasized in the developing countries since the awareness of the problem is lower than in developed countries. Also, indigenous breeds are more desirable for developing countries since these breeds have all qualities that form the basis for low-input systems and sustainable agriculture.

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