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Evaluation of the growing performance of rare breed sheep

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1. Introduction

Sheep (*Ovis aries*) are quadrupedal, ruminant mammals that are kept as livestock all over the world. Sheep are thought to be one of the first animals domesticated by humans. These sheep were primarily raised for meat, milk, and skins. Woolly sheep began to be developed around 6000 BC in Iran, cultures such as the Persians became dependent on sheep's wool for trading. They were then imported to Africa and Europe via trading.

A well known hypothesis states that *Ovis aries* are descendants from the European *Ovis musimon* and Asiatic *Ovis orientalis* species of moufflon.

Domestication of sheep is thought to have occurred between 8-10,000 B.C, and were among the first to be domesticated but now, however *Ovis aries* are dependent on man to survive and are fully domesticated, with only a few feral breeds which are mostly free from predation in areas or places such as islands (Zöldág, 2008).

Sheep are now kept for their meat, milk and wool. Profits from wool vary depending on breed, for e.g a merino sheep is highly valued and renowned for its wool, while more traditional breeds such as Textle or Scottish blackface, the cost of removing the fleece could cost the value of the wool or more.

Milk from sheep is used predominately in cheese and yogurt production. Sheep produce a considerable amount less milk than cows and only have two teats, but on the positive there milk contains higher fat, solids, minerals and lactose (4.8%).

Sheep Meat (mutton) however was once the stable source of protein to humans at the transition into agriculture, but sheep reproduce too slowly to be a main competitor in todays meat production and have given way to chicken and pork.

In this study we investigated two native, old historical breed, which are used not for their huge production capability but for gene preservation.

The Hungarian native Tsigai breed is an old, independent long-tailed sheep breed originating in Asia Minor. The breed appeared in Hungary at the end of 18th century. After the end of 19th century, significant breeding programs diminished, and the breed lost its growing ascendancy. The breed origin of the Scottish blackface has been lost in time, but most likely have originated from the horned hill sheep breed. Over the years the farmers recognised the breeds ability to survive the rough environment imposed on them.

Interactions between the environment and genotype are important in sheep farming when it comes to selection and breeding. Careful analysis of these details are required to maximise output by increasing the growing performance of these sheep.

Ways to increase meat production in sheep, in any system, is to produce more lambs per ewe and increasing growth performance of the lambs. The first objective can be achieved by increasing ewe productivity, including lambing rate or frequency, whereas the second objective requires enhancement of the growth potential and survival of lambs. Improvement of body weight and growth performances of Sangsari sheep seems feasible in selection programs, as some of the related traits are moderately heritable, the weaning weight and the weight at six months are well correlated to other traits of concern, which could suggest that these traits are useful in selection programs. The traits of concern are very dependent on the production system, and when the ranges are poor providing feed resources is not often economically feasible (Miraei-Ashtiani, 2007).

2. Aims

Aim of study is to evaluate the weaning weight and yearly weight in a Hungarian native sheep breed, in order to reveal any changes, in the course of the conservation work.

The main objective of this study is to evaluate and analyse the weaning weight and its changes over time of these two traditional sheep breeds. We want to compare the groups of Tsigai from the different locations and also compare them to the performance results of the Scottish blackface lambs in Ireland.

We want to carry out data analysis of the weight at the weaning in an up-to-date processing and on the other hand to give a general overview about the live weight of the Tsigai breed from its documented history.

The study has looked at the ability of the Tsigai and the Scottish blackface breed to generate liveweight from pastures that may well have been left ungrazed and un-utilized due to poor quality. Our intention is to show that these breeds deserve consideration based on their performances on pasture.

3. Literary survey

Scottish blackface sheep

The breed origin of the Scottish blackface has been lost in time, but most likely have originated from the horned hill sheep breed, mentioned in the old monasteries records from the 12th century. Over the years the farmers recognised the breeds ability to survive the rough mountainous terrain and the harsh weather environment imposed on them and a suitable breed was founded. Several types of Scottish Blackface have evolved i.e the popular Perth variety, having large frame, longer coat and are mostly found in the north-east of Scotland, Cornwall, Devon and Northern Ireland. The second type are a medium-framed called lanark, with shorter wool, commonly found in Ireland and Scotland (Mills, 1996).

The Scottish blackface can also be called Scotties, Blackies, Highland Sheep, Blackface Sheep, are a medium size, white woolled breed of sheep, black marked faces and legs and occasionally some white patches. Both sexes have horns. Their wool is strongly double coated, long and thin usually used in the carpet industry.

All Blackfaces are horned, with completely black or black and white face and legs (Figure 1). The fleece should be free of black fibre and can vary from short, fine wool used for carpets and tweeds to strong coarse wool, which is sold mainly for the Italian mattress trade.

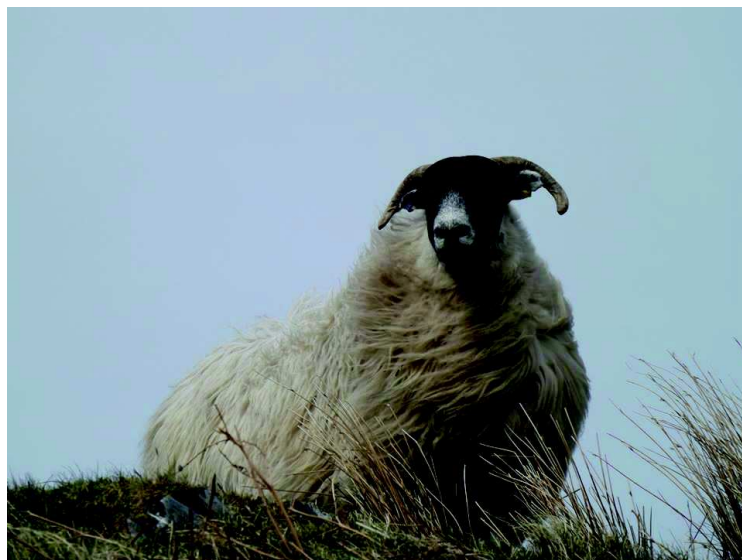


Figure 1. A young scottish blackface ewe (Scottish blackface breeders union, <http://www.sbbu.org>)

There are several distinct types within the breed. These have evolved over the years, influenced by climate, environment and grazing quality. This gives the breed the advantage of being able to produce species to suit every climatic condition. The Scottish Blackface, which are the most numerous, are sub-divided into three types.

The Perth type, a large-framed sheep with a medium to heavy wool, is found mainly in north-east Scotland, south-west England and Northern Ireland. The larger frame produces lambs ideal for long keep on winter forage, or indoors to finish in the spring when hogget prices tend to be on the rise. With hoggets reaching a finishing weight of 40 kg plus. A Perth ram can bring size, strength and vigour to a hill flock.

The Lanark type, which is dominant in much of Scotland and some areas of Ireland, is of medium size, with shorter wool than the Perth type. Over the past thirty years, a strong influence of Newton Stewart type has been introduced, the integration of Lanark and Newton Stewart bloodlines, as well as benefiting both milking ability and hardiness, has helped create a more uniform and identifiable breed.

In the north of England, the large-framed, soft woolled Northumberland Blackface is popular and influential in breeding the North of England Mule.

The principal function of the breed is to utilise the hill and mountain grazing of the British Isles to best advantage, producing store lambs which are suitable for short or long keep, finishing off grass, rape, turnips or in-shed.

Grazed on better hills, many lambs are sold prime direct off their mothers at carcass weights of 15-19 kgs. The smaller hill lambs are ideal for the markets of Italy and Spain, which require carcass weights of 8-12 kgs. Blackface lamb are naturally reared, symbolising the purity and goodness of the land and has a reputation for its unrivalled sweet flavour and tenderness. Available from September onwards, it is without doubt 'naturally good'.

Of equal importance, the Blackface is at the summit of the pyramid of stratification of the British sheep industry. The hills produce a reservoir of females, which are drafted to marginal or upland farms either as ewe lambs or five or six year old ewes, where they are crossed with a Bluefaced Leicester to produce the ever popular Scotch Mule Ewe, or a Border Leicester to produce the Greyface Ewe. Crossed with a terminal sire, the blackface ewe produces a quality prime lamb, or a store lamb for finishing (description of the Blackface Sheep Breeders Association, www.scottish-blackface.co.uk).

The breed itself is an easy care breed, lambs are born with a good coating of wool which is essential for the first few days of life, the mothering, attentive and defensive ability of the ewe is excellent leading to a strong bond between lamb and ewe.

Scottish blackface ewes usually mother a single lamb on these marginal pastures. Twins are not uncommon in ewes experiencing better conditions. The ewes are aggressive, milky, devoted mothers whose lambs are vigorous and extremely attractive. The lambs are naturally reared, symbolizing the purity and goodness of the land and has a reputation for its unrivaled sweet flavor and tenderness (Scottish Blackface Breeders Union, www.sbbu.org).

The Scottish blackface has a key role in the sheep industry in Scotland and England. A common practice is crossing the ewe (scottish blackface) with a Blue faced leicester to produce the ever popular Scotch mule ewe, or the greyface ewe if crossing with the Border leicester. If the Scottish blackface is crossed with a terminal sire, a quality lamb is produced that can be used as a good finisher type lamb in the feedlot.

Hungarian native Tsigai

During the last 200 years, the Tsigai were continuously present in Hungary but in varying proportion (1% – 10%) to other breeds. They never became dominant because their expansion was limited by the presence of the Hungarian Zackel (Racka) and the appearance of the Merino. The ancient Tsigai were not a primitive breed, but a highly developed multipurpose one. During the 18th and 19th centuries, the golden age of the breed, it was unrivalled that the three primary uses of these sheep: as a source of wool, milk and mutton. After the end of 19th century, significant breeding programs diminished, and the breed lost its growing ascendancy. It should also be kept in mind that the industry focused on the specialisation of productivity, and breeding for multipurpose use, therefore this single breed lost popularity.

At the end of the World War II, a small number of native animals that had been maintained made it possible to establish a gathered flock of 200 ewes in Karcag in 1950. This limited stock can be considered as a base and starting point of the national gene conservation program in the Tsigai breed (Gáspárdy, 2004).



Figure 2. Tsigai lamb in Kunfehértó (Photo by Annus, 2014)

These days, two different variants of the Tsigai are distinguished. One of them is the original (native), being the gene reserve, while the other is selected for milking. The latter variety came from the Southland, and these ewes have been mated continuously to breeding rams from this region (Zombor/Sombor and Plivniča) ever since. It is believed that the milking Tsigai has some blood from other breeds: this is the reason that it is officially registered by the Hungarian Association of Sheep Breeders as a new breed. Table 1 shows the differences between the two types.

The Transylvanian Tsigai, considered to be the ancient type of Hungarian Tsigai, are wide in the chest, with short legs and a long trunk, similar to the proportions of the original mountain sheep. On the Hungarian Great Plain, the animals grew taller, their rumps became wider, and their bellies better filled out, as seen in the side view. Different colour variants of the Tsigai have existed in the past and continue to be bred that way.

According to the current Hungarian breed-standard, the Tsigai is black or coffee-coloured on the head and on the extremities (Figure 2). The fleece of the lambs are sandy-grey, which turns after a few months to white. Some of the rams carry dark horns with 1.5 volutes. Ewes are polled or rarely, carry rudimentary sickle-like "goat-horns." The skin, gums, tongue and palate are slate-grey, as is the corneous matter. The skin is thin and elastic. The head is dry (lean or finely chiselled) and less convex from side view. The mouth is medium delicate; the eyes are large and vivid. The auricles are generally thick, short and horizontal. The top of the head

follows a gradual transition from the front to the nape. The neck is medium muscled and free of folds. The shoulders are firm; the withers are medium wide (Table 1). The back and loin are straight, relatively long, and medium muscled. The loin is slightly slanting, medium long and wide, and can sometimes be short and sloped. Limbs are relatively long and medium muscled. The udder is well developed. The skeleton is strong. The native Tsigai is extremely strong, hardy and resistant (description from the Association for Hungarian Sheep and Goat Breeders).

Table 1: Body measurements of adult ewes in Hungarian native and milking Tsigai

Parameter	Native Tsigai	Milking Tsigai
Live weight, kg	53.4	76.0
Height at wither, cm (1)	67.5	73.8
Body length, cm (1)	75.0	79.6
Chest depth, cm (1)	35.1	34.8
Chest width, cm (1)	24.3	25.0
Heart girth, cm (2)	91.4	104.6
Rump width, cm (1)	24.4	28.7
Cannon girth, cm (2)	8.5	10.1
Head length, cm (2)	22.1	25.6
Ear length, cm (2)	13.9	20.4

(1) – measured by stick

(2) – measured by tape

The wool is white with a little greyish tinge, which is due to dispersed black fibres. The overwhelming majority of the fleece is down, having very low pith content. The wool of the Tsigai was qualified in the past as a third-class (C/D) wool. The relatively tick downs are covered by 2-3 epithelium cells. Pliant wool covers the body everywhere, except the face and the extremities. The grease is yellowish, oily, easy cleaned by washing, and medium abundant. Newborn lambs are relatively large and develop quickly. The castration of male lambs for extensive fattening has been practised in the past. The mutton is fine, soft, and does not smell like sheep-suet.

Mating is restricted to the period August – November. The frequency of twins is low.

Around the year 2000, the registered seed-stock population of the Hungarian native Tsigai was about 50 rams and 1000 ewes, managed by the National Parks; some of these are maintained by farming societies and private farmers also. This population is maintained as closely to its original environmental conditions as possible in order to maintain the character of the breed. In addition to these animals, approximately another 3000 animals are scattered over the country.

Impacts on the growing performances

Several studies have shown that growth traits of sheep are affected not only by the animals genetic potential for growth but also by maternal effects including maternal genetic and permanent environmental effects (Jafaroghli, 2010).

Body weight of lambs at different ages can be considered as selection criteria in breeding programs (Ozcan et al., 2005).

In a number of studies, the placentas function play a key role on the development of the fetus. Fetal growth can be limited by placenta size. Fetal hypoxaemia and hypoglycaemia accompany fetal growth retardation which is achieved by carunclectomy this is suggestion of the impaired oxygen and glucose by the umbilical supply. The fact that growth retardation does occur in fetus with small placentae but not to the extent that is estimated by diminution of placental function, this is a strong suggestion that a compromise is met in the fetal growth potential and the and the constraints caused by reduced glucose and oxygen. Birth weight and lifelong growth retardation has been attributed to fetal undernutrition i.e placental insufficiency in delivery of nutrients (Gill, 1998).

The sensitivity of lamb birth weight, particularly in twins, to the ewes plane of nutrition in late pregnancy is well known. Severe undernutrition during early and mid pregnancy causes at day 90 a reduced foetal weight. This can be reversed considerably by adequate feeding towards the end of gestation. Almost complete compensation in birth weights of lambs from ewes which were severely underfed until 90 days of gestation then re-fed to term (Everitt, 1977).

Cold stress in the last few weeks (5-6) of gestation can cause an increase in the birth weight of lambs independent of feed intake (Thompson, 1982). This has been given an explanation that elevated foetal plasma insulin levels associated with modern maternal and foetal hyperglycaemia. This is good indication for the shearing late gestation ewes in winter.

Early postnatal growth is clearly related to lamb birth weight. Thus in single lambs with a birth weight reduction of 30% due to severe maternal under nutrition throughout pregnancy, weaning weights were reduced by 25% (Schinckel and Short, 1961) This reason can be hard to differentiate due to the reduced milk production due to poor prenatal nutrition, although when lambs were offered ad libitum feed the positive correlation between birth weight and pre-weaning growth rates persists (Penning et al 1980).

Lighter lambs are born to young primiparous dams and are lighter up to one year old but in a study of two year old ewes the progeny showed no difference in live weight and body condition at 18 months whether it was their first or second time to lamb (Kenyon, 2008). Kenyon et al. (2014) have also stated, that post weaning, multiple born lambs in comparison to their singleton born counterparts are often lighter in their first year of life, although this difference tends to reduce with age.

Daily weight gain/intensity/speed/economics

Lambs depend on mothers colostrum and milk in the first weeks of life, but after the 2-3rd week they begin to test alternatives too i.e grass or grain. Daily weight gain is dependent on numerous factors, breed, genetics, sex, weather, quantity and quality of milk the lamb is receiving. As the lamb gets older parasite burden, quality and quantity of forage and the addition of concentrates can all alter the daily weight gain, the intensity and speed of the maturation and development of the lamb (Bösing, 2014).

The addition of concentrate feeds to grazing lambs may compensate for a low availability or poor quality forage, i.e. in times of low rainfall or in densely populated farms. It may thereby maintain nutrient and energy intakes therefore performance of animals.

Capabilities of the animal under environmental influences

Early growth traits are important in sheep production. So it is vital to choose the best animals for breeding the next generation. The birth rate and early growth rate of animals are not only by genetic potential but also by maternal and environmental factors (Mandal, 2012). A few studies carried out by Mandal et al in traits have shown that at an early age direct and maternal factors are important in growth and all growth related performances. They found that the lambs born in 2-3 parities of dams had a significantly ($p < 0.05$) higher daily weight gains than lambs

of younger or older ewes at pre-weaning. Also significant results $P < 0.01$ were found when the time of birth was taken into consideration. The Average daily weight gain (ADG) of lambs born in the months of March-April were showing higher ADG than lambs born in the months of October-November. In the same study the male lambs and single lambs had higher rate of gain than their counterparts. Environmental issues can be the reason if very low to moderate heritability estimates for ADG in preweaning lambs is observed, reflecting on poor nutritional level of ewes creating a large environmental variation.

It was also observed that permanent environment effect consistently decreased in importance as lambs became increasingly independent of the ewe, but a reduction in the ADG in days after weaning was reported in a study by (Jafaroghli, 2010): a high coefficient of variation was found for ADG₂ which can be explained by stresses arising from termination of suckling and changes in nutritional and environmental conditions due to grazing on pastures. It has also been stated that the birth weight is an economical important trait due to its effect on pre-weaning growth of lambs and accordingly on economic success of lamb production. The study also showed that lambs with higher ADG in the preweaning period showed higher post weaning gains on phenotypic levels.

It should be mentioned that when ewes are brought from poor pastures or are grazing poorer pastures before mating, they should be flushed for two to three weeks. Flushing may increase lambing percentage by increasing the number of eggs ovulated. Flushing has more effect early in the breeding season, but may improve embryo survival late in the breeding season (Susan Schoenian, sheep and goat specialist, www.sheepandgoat.com)

Influence of the ewe on performance of the lambs

In the study by Corner-Thomas (2014) a number of interesting results were stated. Based upon the multiple regression analysis live weight of ewes at breeding had a positive impact on both the live weight of lambs at approximately 18 days of age, at weaning and he also stated that younger ewes live weights and survival rates of lambs born to ewes bred at 7 month of age are often lower than those born to mature ewes.

Only a minimal influence was observed due to the ewe live weight and body condition at breeding and in pregnancy on lamb live weight to weaning. This shows us that these parameters are not essential for farmers to use to alter lamb live weights (Corner-Thomas; 2014).

Preservation of genetics

Rare breeds are results of human creation therefore they are worth preserving and conservation as any other work of art, like monuments or buildings. The two chosen breeds, the Tsigai and the Scottish Blackface have similarities as both breeds are not bred for the intensive production. They are rare endangered breeds, and they need to be preserved. There are a few arguments to maintain the genetic variability and preserve the old breeds. Current endangered breeds may possess appreciated genetic characters, which can be desired and could well be our advantage in future market circumstances. Endangered domestic animal breeds are reserve populations, for when the useable genetic variation in presently dominating populations highly declines. Some domestic animal breeds are historically closely linked to different farming cultures, environment traditions and regions which are unique and worth preserving. Their adaptation ability, and resistance to diseases are higher than some modern sheep breeds'. Under unfavourable, harsh conditions they can be bred with minimum input. These breeds are useful for demonstration and showing of historical development of animal husbandry, attractions for tourism. They are of great value for physiological and genetic comparative studies. In the breed maintenance it should be preserved not only the name of a breed but all its characteristics and attributes. This maintenance requires very special selection of the future breeding animals. However in integrated crossing programs with high yielding breeds may be economical to utilize them.

With the increase of corporate agribusiness and the declined interest in small family holdings, many breeds of sheep are in danger of extinction, these include the rare or native breeds, in the case of the breed for my thesis the Tsigai. The reason being is the preference for breeds of uniform characteristics and fast growth have pushed heritage breeds to the edge of farming and the sheep industry. Those that remain are maintained through the efforts of conservation organisations like the one saving the Tsigai breed here in Hungary as well as farmers who believe that keeping the traditional breeds alive.

Genetic control and development

Genetics in sheep breeding are viewed in the eyes of the farmer as essential. The body shape, form, conformation or phenotype show a wide range in terms of weights and heights in accordance with breed. The growth rate and mature weight is a heritable trait that is often the basis of selection (Zöldág, 2008).

It has also been reported that there is a low heritability (<0.10) of visual carcass conformation in sheep. Minor differences were seen in British sheep breeds in carcass conformation at equal fatness i.e. same maturity stage (Taylor, 1985) despite selection of these animals over long periods of time for different conformation types.

Purchas and Wilkin (1995) in their study concluded “that higher muscularity led to only a slightly higher meat yield. This is also in consistence with some New Zealand meat plants. Level of muscularity increase with carcass weight which implies that muscularity increases with age (Abdullah et al 1998). This would imply lambs grazed on pasture and slaughtered at an older age compared to a shorter more intense system, would have higher muscularity.

Study performed by Hopkins (1996) assessed muscularity in lambs, and it has been stated, that there were no effect of sex on muscularity, which was consistent with the results of Purchas and Wilkin (1995). Also the overall yield from hindquarters were the same in both sexes in the study.

4. Materials and methods

We received the Tsigai data from the Hungarian Association of Sheep and Goat Breeders (2000-2013, n=2809). This herdbook contains the pedigree data from about 28000 animals from 1995, but in our investigation we only analysed the lambs born after 2000. The Scottish blackface data was received from farms in the West of Ireland (2010-2013, n=747; Table 2). From the lambs 2982 were female, and 574 male.

Table 2: Number of lambs by year of birth in the total database

year of birth	number of lambs
2000	1
2001	7
2002	8
2003	32
2004	92
2005	269
2006	273
2007	203
2008	309
2009	213
2010	527
2011	748
2012	874

On the course of statistical analysis we took into consideration the animals' gender, birth type, and keeping niche (geographical and environmental locations) as well.

We made 4 groups of the animals by keeping place and breed. The first group consists the Scottish Blackface sheep, kept in Ireland (Figure 3).

These sheep are kept on the mountains for almost 10 months of the year. They are brought down to the lowland areas at spring when the ewes are coming close to parturation and returned back again after they lamb. They are also brought down for shearing, drenching for liver fluke up to 4 times per year depending on the weather conditions, dipping against flystrike, lice and keds and lastly at weaning

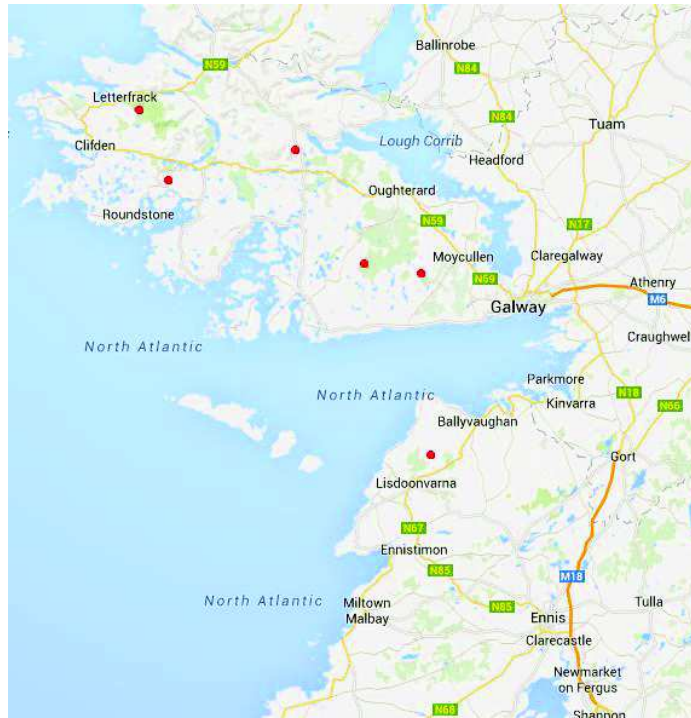


Figure 3: Scottish Blackface farms in Galway, Ireland

They are also brought down from the hills in November for mating for four or five weeks as the rams are expected to travel less to seek ewes that are in estrus. They are brought down not only for the rams benefit but also for flushing in an attempt to increase egg survival and lamb numbers (Figure 4).



Figure 4. The original scottish blackface sheep (scottish blackface breeders union, <http://www.sbbu.org>)

The other three groups contain the Tsigai sheep, from different keeping niche (Figure 5). The second group of sheep was kept either on poorer salty or sandy lowland pastures (Akasztó, Kunszentmárton, Debrecen, Kardoskút, Nagyiván, Jánoshalma, Kunfehértó, Pátroha). The third group was kept on richer lowland meadows (Csanádpalota, Szentes, Gyula, Mezőhegyes, Hódmezővásárhely, Szeged). The fourth group was the mountain Tsigai

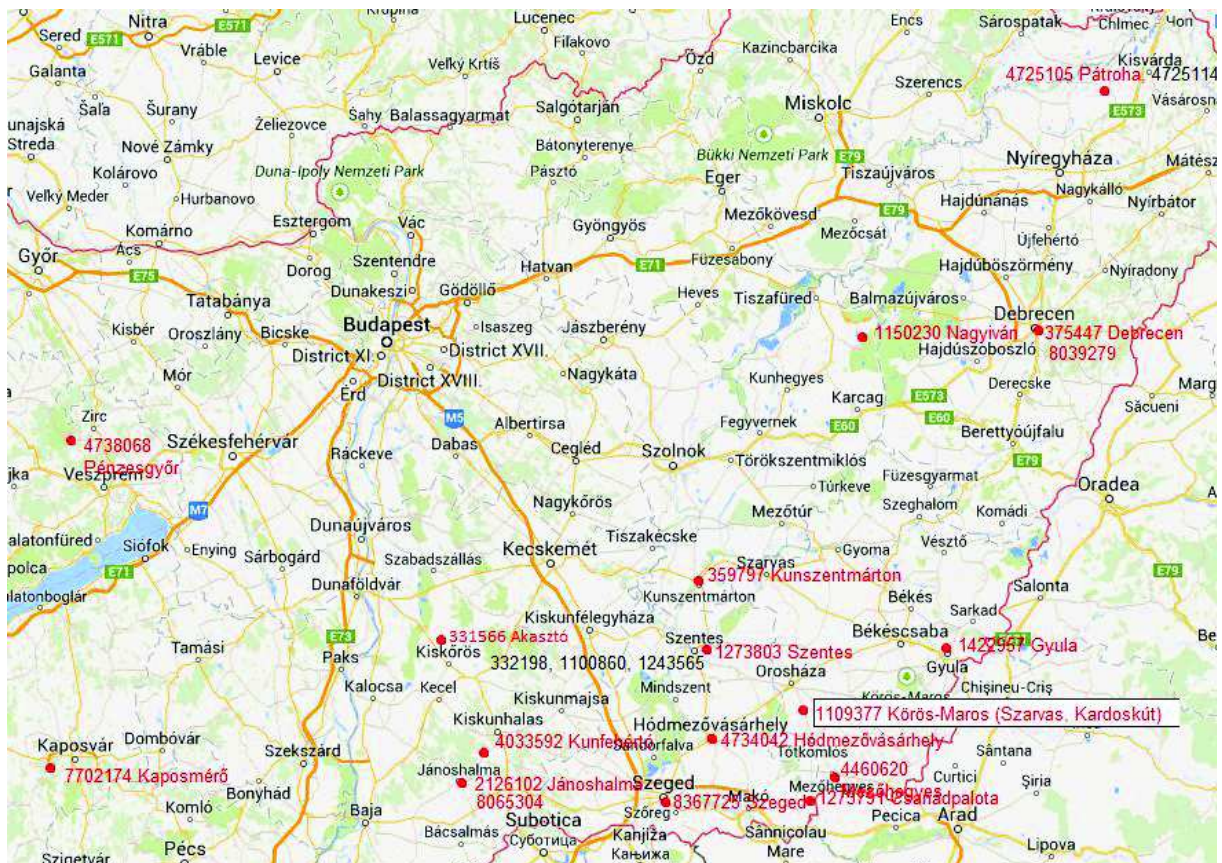


Figure 5: Farm locations in Hungary

Both lowland places are located on the Hungarian Great Plain. The Great Plain contains the basin of the Tisza River and its branches. Bordered by mountains on all sides, it has a variety of terrains, including regions of fertile soil, sandy areas, wastelands, and swampy areas. Hungarians have inhabited the Great Plain for at least a millennium. Found here is the place of the puszta (Figure 6), a long, and uncultivated expanse (the most famous such area that is still in existence is the Hortobágy National Park), with which, much Hungarian folklore is associated. In earlier centuries, the Great Plain was unsuitable for farming because of frequent flooding. Instead, it was the home of massive herds of cattle and horses. In the last half of the 19th century, the government sponsored programs to control the riverways and expedite inland drainage in the Great Plain. With the danger of recurrent flooding largely eliminated, much of

the land was placed under cultivation, and herding ceased to be a major contributor to the area's economy. Weather conditions in the Great Plain can be especially harsh, with hot summers, cold winters, and scant rainfall.



Figure 6: Great Hungarian Plain (Photo made by Gáspárdy, 2014)

The last group of Tsigai animals were kept in the Transdanubian region. (Pénzesgyőr, Kaposmérő) The terrain is very varied with gentle hills, valleys, basins, mountains and plains. Transdanubia is primarily an agricultural area, with flourishing crops, livestock, and viticulture. The western part of the country usually receives more rain than the eastern part, where severe droughts may occur in summertime.

The keeping and the feeding of the flocks in this investigation were based on almost year-round outside keeping. The flocks were driven into stables for a short winter keeping mostly just before the starting of the lambing season. The flock in Pénzesgyőr had a regular winter keeping in a paddock without roofing.

It can be stated, that the lambing regularly happened under well-managed condition by use of mothering on pen and with careful control. The raising of the progenies were based on the maternal milk, and lasted for approximately 2-3 months. Additional feeding of the lambs on concentrate is less typical in rare breeds. If it happens, it is not intense.

The lambs were weaned at different ages on the different keeping systems. We choose the 60 days of age to calculate an *adjusted weaning weight* (WW60), so we could compare the weight of the lambs from the different weaning systems on this basis.

Next to it we calculated *the average daily gain during the suckling period*. We used general linear model (GLM, weaning age as a covariant) to compare the results according to the birth type, the gender, and the keeping place, including the breed impact.

The trends in the weaning weight and in the daily gain during suckling period was performed by use of the *year of birth*. Because of the low number of lambs in years 2000-2005, these years were merged in the data analysis. Linear regression of the year was fit on the traits to receive the regression coefficient (b, and its p-value).

The statistical analysis were performed by using Statistica program (StatSoft, 2013).

5. Results and discussion

Weaning weight

Our animals in the investigation reached on average 20 kgs in WW60.

The adjusted weaning weight (WW60) was 21.6 kg in male lambs (n=545), and 20.0 kg in female lambs (n=2856).

This adjusted weaning weight was 21.7 kg by the single lambs (n=1670), and 19.8 kg in the multiple births (n=1731). These results were statistically significant ($p<0.001$).

According to the expectations the male lambs were heavier than the females. Single lambs reached greater weaning weight than lambs from multiple birth.

During the evaluation of the weaning weight according to the keeping environment we also found differences. The lambs in the Hungarian mountainous keeping place were 19.2 kg, while in Ireland the average weaning weight was 19.8 kg, significantly differing from the previous one ($p<0.001$). The value of the Scottish Blackface appeared at the average level of the Hungarian Tsigai. The Scottish Blackface could reach greater performances.

The two Hungarian lowland niches showed greater weaning performances (under poorer and richer meadow conditions 21.9 kg and 22.1 kg, respectively; $p<0.001$). However, no differences were found between these two latest niches ($p=0.887$).

Previous studies about the Tsigai sheep described that in the 1960s evolved the intensive broiler lamb production (Kukovics, 2002). These lambs were kept inside intensively, and reached 30-35 kg weight for 4-5 months of age.

Póczos et al (1934) investigated the weaning weight in Merino and Tsigai breeds. They found, that the Tsigai broiler lambs were 10-12 kg at 4 weeks of age before the fattening. The Merino lambs started the fattening with 20 kg, and reached 32-36 kg at 60 days of age, whereas in our investigation the Tsigai lambs are smaller and are reared in a less intensive system.

A Hungarian Racka trial (Töröcsik, 2013) produced 17.92 kg adjusted weaning weight for 70 days.

From a study by Zishiri (2014) it is known, that the WW (age around 80-120 days) was in Dorner 33.06 kg, in Ile de France was 28.47 kg, and in Merino Landsheep 29.91 kg. These meaty type lambs were older at the measuring but also heavier, than the native breeds.

In Uruguay most of Merino Stud Breeders have as their principal selection objectives decreasing Fibre Diameter, maintaining or increasing Clean Fleece Weight and increasing Yearling Body Weight. The WW was measured at 120 days of age (Ciappesoni, 2013), it was on average 22.91 kg.

Dual-purpose sheep breeds constitute the major part of the total sheep population in the Czech Republic. Wolfová et al (2011) investigated the most common breeds of this type: Romney, Merinolandschaf, Romanov and Sumavska. Historically, they were raised primarily for mutton and wool, but more recently lambmeat production has become the main function of these breeds. The average weaning age for all breeds is 130 days. At that age the WW was 33.55 kg by Merinolandschaf, 39.4 kg by Romney, 30.35 kg by Sumavska and 28.7 kg by Romanov.

Daily weight gain

We found that the DWG was higher by the male lambs (285 g) than by the females (263 g).

The same difference was found in singles (285 g) and multiple (263 g) birth.

The average daily weight gain (DWG) at the Irish keeping place was 261 g. At the poorer lowland place the DWG was 293 g, while at the richer lowland keeping place was 295 g. These two values was not significantly differing ($p=0.845$). At the mountainous keeping place the DWG was 246 g, it was significantly different from the places ($p<0.001$; Table 3).

Table 3: Daily weight gain by location (in grams)

location	daily weight gain	number
Scottish Blackface, West of Ireland 1	261 ^b	747
Tsigai, poor lowland 2	293 ^c	1715
Tsigai, rich lowland 3	295 ^c	767
Tsigai, mountain 4	246 ^a	172

a,b and c – different superscript letters show significant differences

Our results complied on all philosophical levels regarding the weaning weight of the lambs. Male lambs being heavier than females and also singletons being heavier than lambs from

multiple births Post weaning, multiple born lambs in comparison to their singleton born counterparts are often lighter in their first year of life, although this difference tends to reduce with age (Hopkins et al 2007; Kenyon 2008) this statement is also correct regarding our results when 19.8kgs were recorded in the multiple births compared to 21.7kgs in the singletons. The male lambs excelled in daily weight gains than their counterparts at pre-weaning. Lambs from single births also exhibited higher average daily weight gains at pre-weaning than twin born lambs (Mandal, 2012). In our study our results yielded a 21.6kgs in males and 20kgs in females which is also in compliance with Mandal (2012).

In a previous study (Töröcsik, 2013) it became known that the native breeds do not respond well to the more generous feeding conditions. In this investigation the average daily gain during the suckling period was 192 g.

Mandal et al (2012) examined the daily weight gain in Muzaffarnagari sheep and found that in the pre-weaning period the DWG was 136.9 g. The Muzaffarnagari sheep, an important mutton breeds of India, has better potential for meat and carpet wool production than other Indian sheep breeds. Both the Tsigai and the Scottish Blackface lambs showed better daily gain, we can explain it with the better grazing places and conditions.

A study revealed (Maxa, 2007) the average daily gain results in mutton type lambs. The weaning age was 60 days, the DWG in Texel was 318 g, in Shropshire 281 g, in Oxford Down 333 g and in Suffolk 324 g. These results are remarkable higher than the native breeds' DWG values, this shows the difference between the single purpose mutton type breeds and the traditional gene reserve breeds.

Tendency in the weaning performances

Regarding the alteration of the live weight over a period of time it became obvious that the Tsigai sheep kept in lowland condition showed a significant increase in the WW60. The Scottish blackface in the past 3 years are showing the traditional performance, due to harsh conditions. Our study revealed a slight decrease in the weaning weight of the Tsigai lambs in the mountain niche which indicates the decision of the breeders to conserve the original traits of this breed.

Regarding the alteration of the live weight by time (Figure 7) it became obvious that in Tsigai sheep kept in lowland conditions shown a significant increase in the WW60.

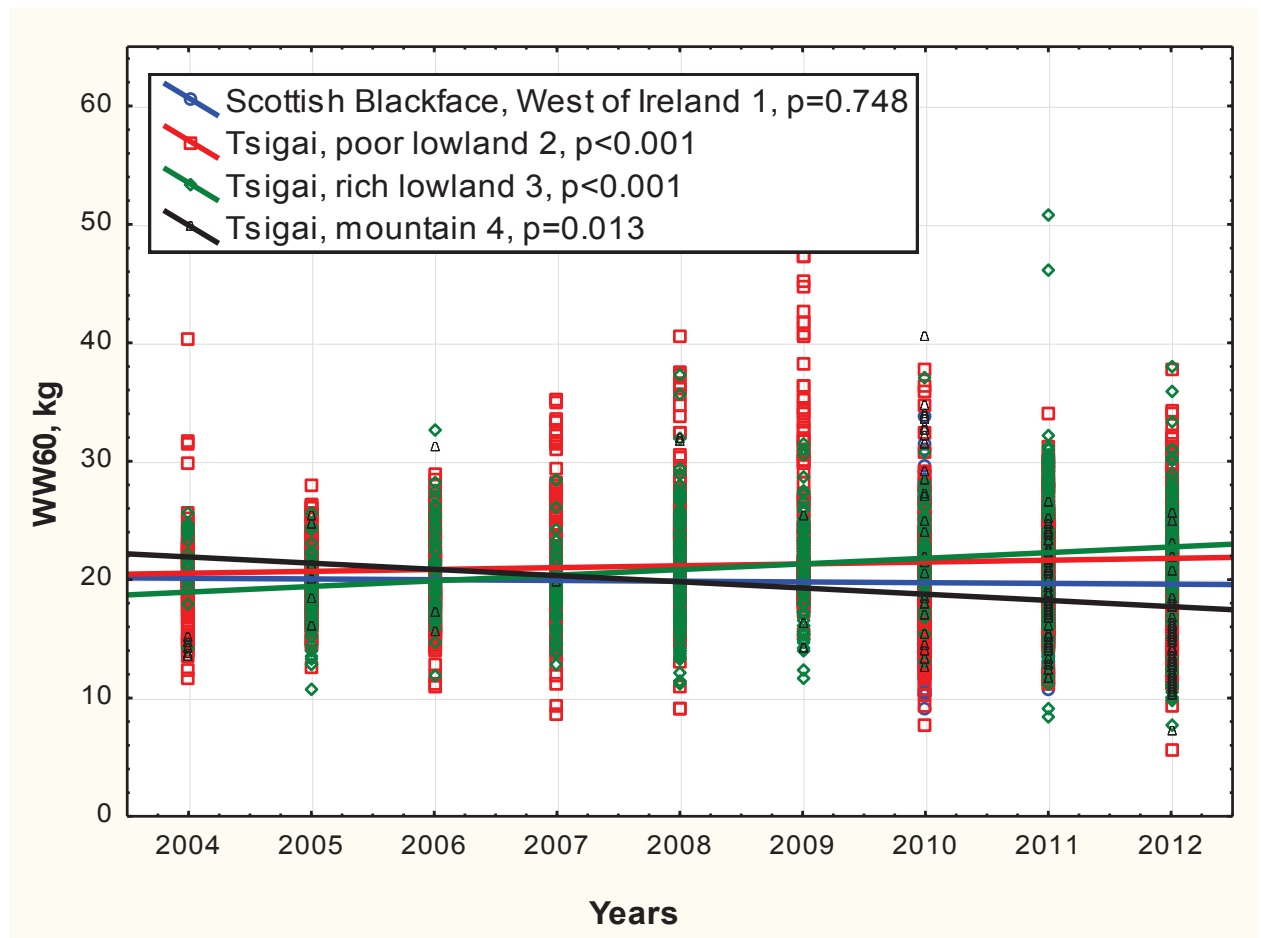


Figure 7: WW60 by year of birth

The average daily weight gain above Scottish Blackface (Figure 8) is showing a significantly nonchanging relationship on a yearly basis due to the limitations of the landscape. The animals on both rich and poor lowland have a slight increase in the daily weight gain. Finally the mountain group have a decrease in the daily weight gain, due to the conservation work.

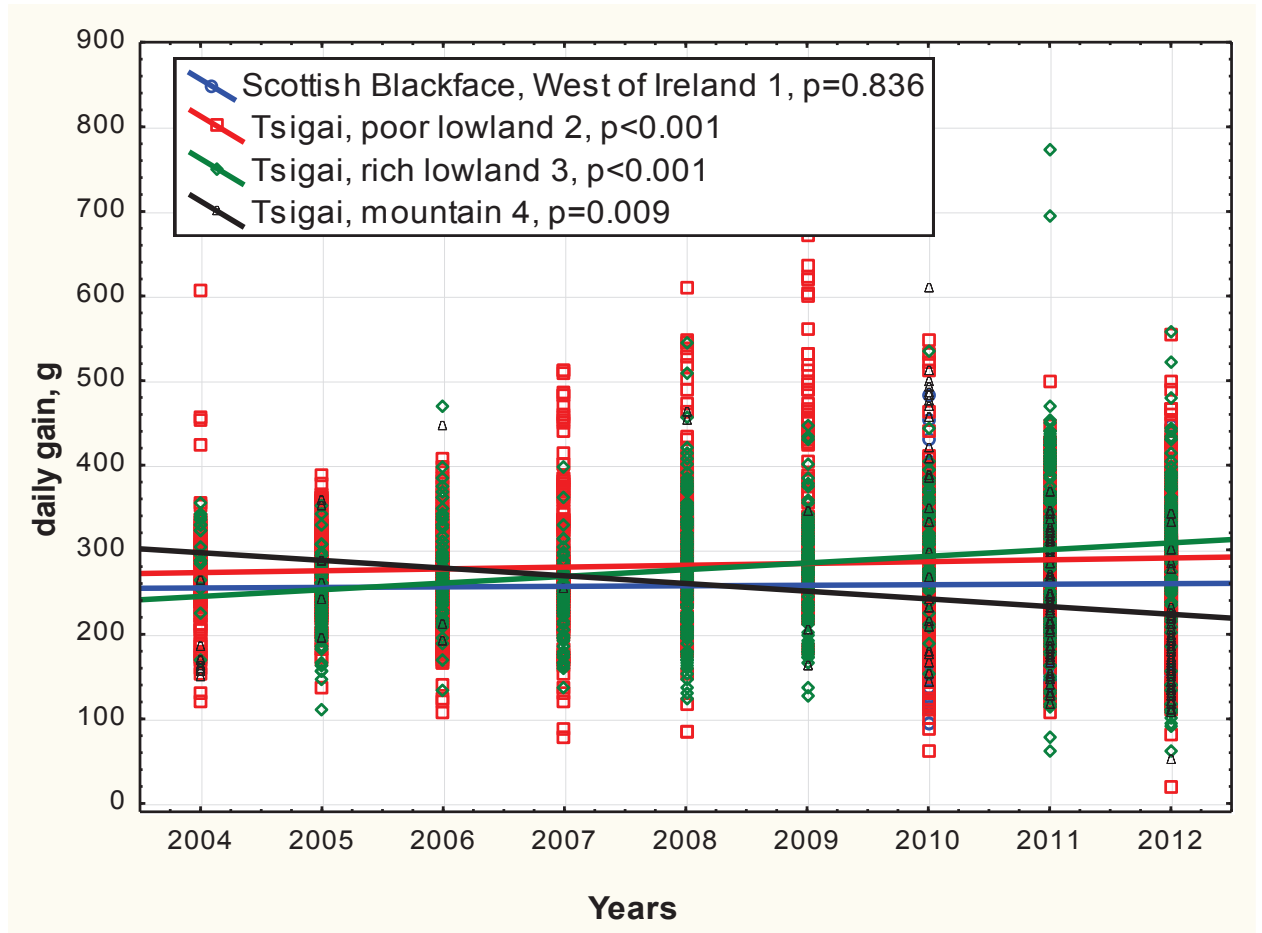


Figure 8: Daily weight gain by years

We calculated the adjusted yearling weight (Figure 9) so that we could compare the individual groups accurately. The animals kept on the poor lowland showed no significant changes by years. The second group of the Tsigai (rich lowland) had a significant ($p < 0.001$) increase in the yearling weight. The mountain type Tsigai were showing a decrease year by year, explained due to genetic conservation work.

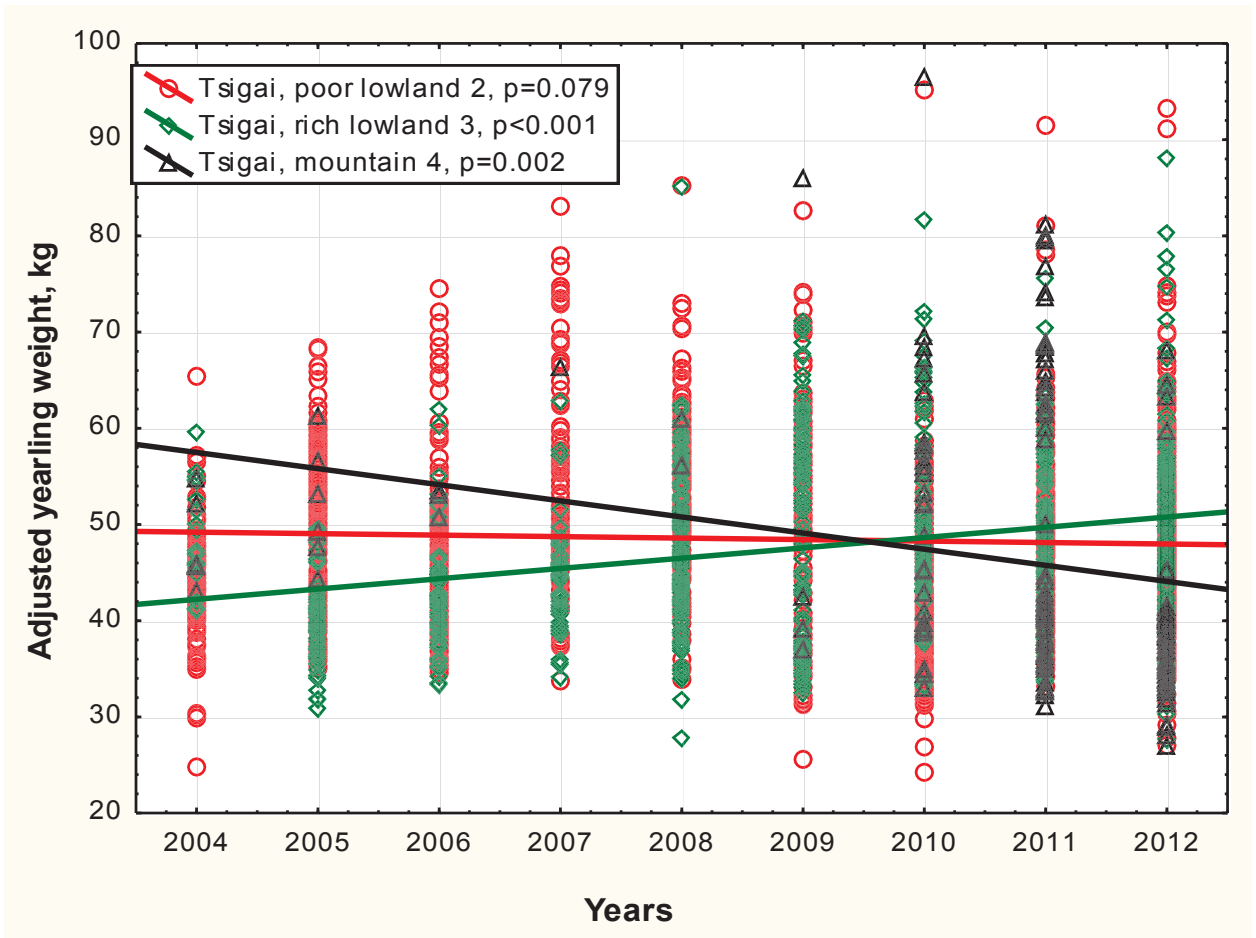


Figure 9. Adjusted yearling weight, Tsigai

According to the Hungarian standards in 1953 the average live weight of a Tsigai ewe was 40 kg. Therefore the Tsigai belongs to the medium-sized sheep breeds (Schandl, 1941). At that time the average weight of the Tsigai ewes was changed by the seasons. Before the winter time it could reach 45 kg, but after a harsh winter it was around 30 kg.

Gáspárdy et al. (2001) stated, that nowadays the live weight of the Tsigai ewes is round 50-55 kg. It can be clearly seen, that the live weight of the breed was increasing by the years.

Our results were slightly greater than these historic values recorded by Schandl (1941). Explained mainly due to conservation work leading to better care and attention of this endangered native breed.

Table 4: Yearling weight and daily gain of one year old Tsigai sheep

location	number of animals	adjusted yearling weight, mean (kg)	standard deviation of yearling weight	daily gain till 1 year of age (g)	standard deviation of daily gain
2	1513	48.45	9.43	121.03	25.78
3	775	47.48	9.24	118.41	25.21
4	174	46.57	13.88	115.95	38.06

The pedigree contained data about the Tsigai sheep's yearling weight. We calculated the average daily gain till 1 year of age, and compare the values from the different keeping places. Apparently the sheep from the mountainous keeping place reached the smallest measurements (Table 4).

6. Conclusions and Recommendations

In our investigation we received significantly differing results, which can be professionally accepted. Interesting that the live weight in the mountainous keeping place was slightly decreased, while it showed in the lowland keeping places increasing tendency.

According to the Scottish Blackface results we can observe a nonchanging performance in the weaning weight and daily weight gain.

We couldn't use all of the data from the pedigree, because we wasn't convinced about the accurate measuring practice. We would suggest the farmers to measure the weight of their animals precisely, especially in older age, so the change of the breed can be followed.

Really important to mention the breeds' historical changes. Our results show the impact of the keeping place to the performances, but supposedly the genetic changes also take part in the alteration of the native breeds. The biochemical and DNA polymorphism was studied by Gáspárdy et al. (2014) in different Tsigai flocks. They stated, that the flocks generally are not endangered by inbreeding, although there is genetic deviations among the populations. This study calls the attention to the importance of the environmental impacts on the animals.

In the future to strengthen the economic relevance of the rare breeds, it could be profitable to produce region-specific, high quality lamb products.

7. Acknowledgement

Firstly I would like to thank my supervisor Dr. Annus Kata for her help and support throughout my thesis work. Dr. Gáspárdy András for his valued contribution and his knowledge of the Hungarian Tsigai. I would also like to thank both the Hungarian Association Of Sheep And Goat Breeders and the Irish farmers who kept records of the weights which contributed to my thesis. Finally I would like to thank you for taking the time to read it.

8. Summary

Evaluation of the growing performance of rare breed sheep

by Ciaran Marley

The Hungarian native Tsigai breed is an old, independent long-tailed sheep breed originating in Asia Minor. The breed appeared in Hungary at the end of 18th century. After the end of 19th century, significant breeding programs diminished, and the breed lost its growing ascendancy.

The breed origin of the Scottish blackface has been lost in time, but most likely have originated from the horned hill breed sheep. Over the years the farmers recognised the breeds ability to survive the rough environment.

The main objective of this study is to evaluate and analyse the weaning weight and its changes over time of these two traditional sheep breeds.

We received the Tsigai data from the Hungarian Association of Sheep and Goat Breeders (2000-2013, n=2809) and Scottish blackface data from farms in the West of Ireland (2010-2013, n=747). We took into consideration the animals keeping niche, geographical and environmental locations as well.

At first we adjusted the weaning weight to 60 days (WW60), so we could compare the lambs from the different weaning systems. We calculated the average daily gain during the suckling period. We used general linear model (GLM, weaning age as a covariant) to compare the results according to the birth type, the gender, and the keeping place, including the breed impact.

The WW60 was 21.6 kg in male lambs (n=545), and 20.0 kg in female lambs (n=2856). This trait was 21.7 kg by the single lambs (n=1670), and 19.8 kg in the multiple births (n=1731). These results were statistically significant ($p < 0.001$). During the evaluation of the weaning weight according to the keeping environment we also found differences. The two Hungarian lowland niche showed similarity ($p = 0.886$): the animals kept in poorer meadow were 21.9 kg, while on the richer meadow they were 22.1 kg. In Ireland the average weaning weight was 19.8 kg, while the lambs in the Hungarian mountainous keeping place were 19.2 kg, both significantly differing from the previous results ($p < 0.001$). From the daily gain results we found quite similar tendencies.

Regarding the alteration of the live weight over a period of time it became obvious that the Tsigai sheep kept in lowland condition showed a significant increase in the WW60. A true maintenance was observed in the Scottish blackface in the past 3 years showing the breeders intention to maintain the breed in its traditional performance. Our study revealed a slight decrease in the weaning weight of the Tsigai lambs in the mountain niche which indicates the decision of the breeders to conserve the original traits of this breed.

The study has looked at the ability of the Tsigai and the Scottish blackface breed to generate liveweight from pastures that may well have been left ungrazed and un-utilized due to poor quality. Our intention is to show that these breeds deserve consideration based on their performances on pasture.

9. Összefoglalás

A növekedési teljesítmény értékelése ritka juhajtásban

Ciaran Marley

Az őshonos cigája Kis-Ázsiából származó, önálló régi hosszúfarkú juhajt. A 18. század végén jelent meg Magyarországon. A 19. század végével a jeletősebb tenyészprogramok megszűntek, és a fajta elvesztette növekvő jelentőségét.

A skót feketefejú juhajt eredete a múlt homályába vész, de valószínűleg a helyi szarvált dombvidéki juhtól származhat. Az évek során a gazdák felismerték a fajta kiváló túlélőképességét a sivár hegyi tartási körülmények között.

Jelen dolgozat célja ennek a két őshonos juhajtának vizsgálata a választási súly és ennek évenkénti változásának tekintetében.

A Magyar Juh-és Kecsketenyésztő Szövetségtől kaptuk a cigája fajta törzskönyvi adatait (2000-2013, n=2809), a skót feketefejú adatokat pedig Nyugat-Írországi farmoktól gyűjtöttük (2010-2013, n=747). Az állatoknál figyelembe vettük a tartási helyet, valamint a földrajzi és környezeti elhelyezkedést is.

A választási súlyt 60 napra korrigáltuk (WW60), az eltérő választási rendszerből származó bárányok összehasonlíthatósága érdekében. Kiszámoltuk a szoptatási időszakban az egy napra eső átlagos súlygyarapodást. General linear modell-t használtunk (GLM, kovariáns: választási kor) az eredmények összehasonlítására a születési típus, az ivar, a tartási hely és ezen belül a fajta hatásának tekintetében.

A WW60 21,6 kg volt kosbárányoknál (n=545), és 20,0 kg a jerkebárányoknál (n=2856). Ez a mutató 21,7 kg volt egyes ellésnél (n=1670), és 19,8 kg ikerelés esetében (n=1731). Ezek az eredmények statisztikailag szignifikánsak voltak ($p < 0,001$). A választási súly tartási körülmények szerinti vizsgálatánál szintén találtunk eltérést. A két magyar alföldi területen tartott állatok hasonlóságot mutattak ($p = 0,886$): a gyengébb legelőn tartott bárányok 21,9 kg-os súlyt értek el, míg a gazdagabb legelőn tartottak 22,1 kg-t. Az írországi juhoknál az átlagos választási súly 19,8 kg volt, míg a magyar dombvidéken tartott állatok 19,2 kg-t értek el, mindkét eredmény szignifikánsan eltér az előző eredményektől ($p < 0,001$). A napi súlygyarapodás eredményeinek tekintetében hasonló tendenciákat állapíthatunk meg.

Az élősúly időbeli változását tekintve egyértelművé vált, hogy az alföldi környezetben tartott cigája bárányok 60 napra korrigált választási súlya az évek során jelentősen növekedett. Viszont valódi fajtafenntartó munkát figyelhetünk meg a skót feketefejú juhok esetében az emült 3 évben, ez mutatja a gazdák abbéli szándékát, hogy a fajtát megtartsák eredeti állapotában. A vizsgálat során enyhe csökkenést tapasztaltunk a hegyi körülmények között tartott cigája bárányok választási súlyában, mely jól mutatja a tenyésztők azirányú döntését, hogy megőrizték a fajta eredeti tulajdonságait.

Jelen vizsgálat arra irányult, hogy megállapítsuk a cigája és a skót feketefejú juhok élősúly gyarapodását a kihasználatlan és silányabb minőségű legelőkön. Célunk, hogy felhívjuk a figyelmet ezeknek a fajtáknak legelői képességére.

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