

PERSPECTIVE DUAL-PURPOSE AND BEEF BREEDS ASSOCIATED WITH INCREASED BEEF PRODUCTIVITY IN CATTLE

Diyan Georgiev^{ID}, Nikolay Markov^{ID}, Miroslav Hristov^{ID}, Tsvetan Markov^{ID}

Research Institute of Mountain Stockbreeding and Agriculture Troyan - Agricultural Academy – Sofia

Corresponding author: Diyan Georgiev, d.georgiev.slujeben@gmail.com

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Abstract: A large part of the beef in Bulgaria comes from dairy breeds – about 40% of the total amount. Industrial crossbreeding is also used, with different bloodlines and types of crossbreeds being sold on the market. The main patterns in beef production have been identified, and the biological characteristics of cattle as meat producers have been analyzed. Some perspective, combined, and beef breeds are examined that can contribute to increasing beef productivity in the species and categories of cattle and solving the problem with beef in Bulgaria as a whole. A review of the technologies for breeding three dual-purpose and three beef cattle breeds in this regard is provided. Historical background, distribution, morphological and breed characteristics, productive types, weight development and growth, exterior, milk and meat productivity are described. Emphasis is placed on problems in the development of modern beef cattle breeding.

Key words: breeds, meat, combined direction, exterior

Introduction

Meat, mainly muscle mass, is used for food. Most of the meat consumed by humans is produced from farm animals, poultry, fish, game, and shellfish, which are specially raised for this purpose on farms and slaughtered, cut up, and processed in slaughterhouses and slaughtering centers. Different cuisines around the world use meat from different animals. There are significant cultural, religious, and social differences that determine attitudes toward the consumption of different types of meat. Some people do not eat meat at all. Artificial meat also exists and is produced.

A large part of the beef in Bulgaria comes from dairy and dual-purpose breeds – about 40% of the total amount. Industrial crossbreeding is also used, with various types of crossbreeds being sold on the market. There are about 280 beef farms and holdings in Bulgaria, raising 116,196 beef heifers and cows, or 34.8% of the total number of cows in the country.

The inclusion of beef and veal in our diet is primarily related to natural and economic factors and the utilization of feed resources—bulky, coarse, waste feed, and highly productive pastures (Darzhonov, 1987).

Exposition

Breeds are a source of labor in agricultural production. Improving them increases and reduces the cost of cattle production and increases labor productivity in animal husbandry, thereby creating added value. Individual types of farm animals involve a significant number of breeds. For a long time, cattle breeding worldwide was dominated by dual-purpose breeds. These breeds of cattle for milk and meat are specialized in terms of the time it takes to realize their genetic potential. Such breeds are:

Simmental

The breed was developed in the Sime River valley, Bernese Oberland region, Switzerland—a country with wide mountain pastures and rugged terrain. Cattle there are taken out in mid-spring and remain outside until late autumn. They make very good use of pasture and roughage. Cattle of this breed are calm and easy to raise. Between 46 and 60 million Simmental cattle are bred on six continents around the world. The breed is dominant in Austria, Serbia, Croatia, the Czech Republic, Slovenia, Slovakia, Romania, and others. In Austria alone, 1.6 million Simmental cattle are raised. The breed belongs to the red-and-white, broad-headed breeds. The color is red and white with shades ranging from dark red and brown to light beige. The head is always white, which is inherited when crossed with other breeds (Holstein, Black Pied, Brown Cattle, Grey Cattle) (Markov et al., 2021). The nose mirror and mucous membranes are bright pink. The horns are large, lyre-shaped, yellow, and with dark tips. The hooves are yellow and healthy. There are two productive types that are selected: meat-milk and milk-meat. In Europe, the milk-meat type is more popular (Markov et al., 2024).



Figure 1. Simmental cow owned by Rimsa-Troyan (picture by Rimsa – Troyan)

The Simmental breed belongs to the large cattle breeds. Cows have a height at the withers of 138-140 cm, and bulls have a height at the withers of 142-146 cm. Cows weigh 650-700 kg, and bulls weigh 1000-1100 kg. Calves are born with a live weight of 40-45 kg. At 6 months, they reach 180-195 kg. At 12 months, the live weight achieved is 300-340 kg for females and 400-450 kg for males. At 18 months, bulls weigh 480-520 kg. The average daily weight gain is 1380-1420 g, and the slaughter yield is 58-62%.

The meat is lean and crispy and is highly valued by consumers. The fertility of the breed is 92-95%. Milk productivity is 5500-6600 kg of milk, with 3.9-4.4% fat and 3.4-3.9% protein. Some herds achieve 10,000-12,000 kg of milk. The recommended technology is free-range grazing. The breed record holder is the cow GS VOLT, which in 2016 achieved 18,808 kg of milk, with 5.58% milk fat and 3.31% protein. Simmental has long been introduced in Bulgaria and is successfully bred at the Experimental Base of RIMSA– Troyan, producing boutique dairy and meat products with good added value, which are sold locally.

Norman cattle

The Normandy cattle came about in Normandy in the early 19th century as a result of systematic crossbreeding of local dairy breeds: Ogeron, Cotentin, and Caouchoise (now extinct) with the Shorthorn breed (dairy type), which began to be imported from the United Kingdom in 1836. The aim was to improve physique and early maturity. The breed's stud book was established in 1880, and breeding stock

testing began in 1932. The breed was almost wiped out as a result of large-scale military operations in the area where it was distributed and during World War II.

In the 1960s, the breed began to slowly come back and reached 4.5 million. Right now, there are about 3 million Normandy cattle in France. Normandy cattle have been exported to many countries around the world for a long time, and the breed is present on all continents. There are large populations of Normans in Colombia, Brazil, Ecuador, Paraguay, Uruguay, Venezuela, etc. In Brazil, it is successfully used for hybridization with Zebu, and the resulting hybrid is called Normanzu. It is found in the USA, Australia, and Japan. In Europe, it breeds well and has been acclimatized and approved in Belgium, Switzerland, Great Britain, Ireland, Germany, the Czech Republic, Slovakia, Romania, Bosnia, and Herzegovina. Purebred Normans are also found in Senegal, Mali, and Madagascar.

Table 1. Milk yield, milk fat and protein content in milk from Normande cows for 100 and 305 days of lactation

Indicator	Norman cattle	
	Katarino Farm (I group) n=10	Farm ZP V. Vasilev (II group) n=10
For the first 100 days of lactation		
Dairy, kg	2876.48 ± 212.95	2468.92 ± 121.21
Dairy fat, %	4.88 ± 0.21	4.49 ± 0.16*
Dairy butter, kg	140.37±0.09	112.01±0.12*
Dairy protein, %	3.68 ± 0.11*	3.51 ± 0.9
Dairy protein, kg	105.85	-
305 days lactation		
Dairy, kg	5994.16 ± 187.23	5797.25 ± 191.46
Dairy fat, %	4.53 ± 0.12**	4.21 ± 0.10**
Dairy protein, %	3.57 ± 0.10*	3,49 ± 0.11

P<0.05*, P<0.01**

Table 1 shows the results for Normandy cows raised and acclimatized on two farms in the foothills of Bulgaria. The representatives of the Katarino farm showed better results in eight parameters studied.



Figure 2. Norman cattle (picture by Rimsa – Troyan)

Norman cattle are large animals with good musculature. The height at the withers of cows is 140–144 cm, and that of bulls is 150–155 cm. The chest circumference varies from 209 to 245 cm. Cows usually weigh 700–800 kg, and bulls 1000–1100 kg. Calves are born easily, with males weighing 40–45 kg and females 35–40 kg. The head is white, almost always with dark, spotted eyes. The mucoid membranes are dark, gray-black.

The neck has no dewlap. The back is broad and straight, the pelvis is broad and deep, and the thighs are muscular and strong. The udder is voluminous, set high between the hind limbs. The teats are symmetrically positioned and of medium length. Their skin is white, and their coat is red-spotted or spotted (patches), which can be black, gray, or brown (tiger stripes). Sixty-nine coat color variations have been described.

The breed has a long life time, with a minimum of 5 lactations. It shows good adaptability to sunlight and extremely high temperatures. The cows adapt well to machine milking. The average milk yield of the Normandy breed is 6000–6500 kg with 4.25% fat and 3.54% protein. Under selection control in France, there are 210,050 cows with an average milk production of 7469 kg, 4.29% fat and 3.61% protein. The record holder for the breed is the cow Champion, which produced 12,619 kg of milk with 3.89% fat and 5.01% protein.

The milk of Normandy cattle is considered the best in Europe for cheese and butter production in terms of its physical and chemical composition, nutritional value, and anti-allergenic properties. It is used to produce famous cheese brands such as Camembert, Livaro, Pont l'Évêque, Neufchâtel, and others. The local

qualities of this promising French breed are also not to be overlooked. The meat of Normandy cattle is high-quality, crispy, and partially marbled, and is used to produce boutique meat products with good added value. The recommended technology is free-range grazing (Markov et al., 2022).

Normandy sheep are currently bred in two locations: at the Katarino company in the village of Slivovitsa, Kresna municipality, and at the farm of agricultural producer Vasil Vasilev in the town of Kaspichan.

Red cattle breeds

Red cattle breeds are concentrated and bred mainly in Scandinavia, the Baltic States, the steppe regions of Eastern Europe, and Central Asia, and are characterized by relatively good milk productivity. These breeds are specific in their genetic similarity, which is the result of heredity, mainly from the Angler breed. Over the years, there has been an opportunity for continuous genetic drift without changing the type of any of them.

These breeds combine high milk yield with high protein and fat content in milk. They are known for their good health, longevity, early maturity, fertility, efficient utilization of roughage, relatively good meat productivity, and high adaptability, which make them still effective in certain regions of Europe and the world.

Danish Red cattle

Danish Red cattle is the second most common breed in Denmark after Holstein. It was developed through complex three-way crossbreeding and intensive selection. It is a dual-purpose breed. Its milk has excellent taste and technological qualities. Due to inbreeding in the past, it was necessary to inject blood from the Brown Swiss breed years ago. The animals are compact with a strong physique. The head is elongated and delicate. The nose mirror is gray in color. The neck is elongated. The legs are of medium length. The back and chest are broad. The udder is cup-shaped with cylindrical teats.

The live weight of cows varies from 550 to 800 kg, and that of bulls from 950 to 1000 kg. In 1988, the average milk yield of the evaluated cows was 6752 kg, with 4.17% fat and 3.45% protein. Nowadays, the breed produces 9000 kg of milk, with 4.1–4.2% fat and 3.2–3.5% protein. The Red Danish breed was used in the formation of the Bulgarian Red cattle breed. The recommended technology is free-range grazing. About 120 animals of various categories are raised on the Argirovi farm in the town of Saedinenie, Plovdiv Province, and boutique dairy and meat products are sold on the market (Markov and Hristov, 2021).

Bulgarian red cattle

Bulgarian red cattle is a breed that was widely bred until 35 years ago in northeastern Bulgaria, in the former districts of Ruse, Targovishte, Shumen, Silistra, Dobrich, and Varna. Prominent Bulgarian scientists such as Prof. Petko Komitski, Prof. Nikola Palagachev, Prof. Ivan Balabanov, Prof. Emilia Ivanova, Prof. Stefan Kostov, and others have worked to consolidate the breed in our country. Prof. Petko Komitski, Prof. Nikola Palagachev, Prof. Ivan Balabanov, Prof. Emilia Ivanova, Prof. Stefan Kostov, and others. Currently, it is bred on a limited basis by enthusiasts who are committed to preserving the breed in the area around the towns of Aksakovo (Varna region) and Veliko Tarnovo.

The Bulgarian Red cattle is covered with a uniform reddish-brown coat with lighter or darker shades in individual hairs. The nose mirror, eyes, anus, and vulva are dark in color. Bulls have more intense coloring. The horns are light with dark tips. The udder is light red. The average height at the withers of cows is 128-130 cm, the live weight of cows is 520-530 kg, and that of bulls is 800-900 kg. Female calves weigh an average of 32-34 kg at birth, 160-170 kg at 6 months, 270-290 kg at 12 months, and 360-370 kg at 18 months. Bull calves subjected to intensive fattening at 12-15 months reach a live weight of 450-475 kg, depositing a lot of fat in the pelvic area and internal organs. Cattle of this breed are of the dairy type with the characteristic body shape and proportions. The head is narrow, long, lean, well-shaped, with skin folds on the forehead and around the eyes. The ears are large, the horns small.

The neck is medium long and narrow. The dewlap is small. The withers are sharp, poorly muscled, and slightly exceed the back line. The back and loins are long, medium wide. The back line is level or slightly arched. The chest is medium deep, flat with sloping ribs and wide intercostal spaces. The belly is voluminous but not pendulous. The croup is well developed, long, and level. The tail is long, thin, ending in a long tuft of black hair. The legs are well placed, with delicate bones, well-formed joints, and healthy hooves. The skin is delicate, mobile, and elastic. It forms numerous delicate folds on the neck. The musculature is poorly developed. The body is dry, angular, with empty thighs, and a clearly defined skeleton. About 25 animals are monitored. The monitored animals show a milk production of 6500 kg and 3.4% fat and 3.3% protein. The recommended technology is free-range grazing. The breed is threatened with extinction (Markov and Hristov, 2021).



Figure 3. Bulgarian red cattle (picture by Rimsa – Troyan)

Specialized beef breeds offer higher meat content per kilogram of live weight and high slaughter yield of around 69-72%. Beef cattle farming requires less initial investment compared to dairy farming. The rise of culinary culture, the popularization of foreign national cuisines, and increased interest in gourmet food have led to growing interest in high-quality beef. For the Eastern European region, a choice must be made between breeds that have already proven themselves worldwide. Numerous experiments show that high-intensity meat breeds have higher daily weight gain and greater slaughter weight. At the same time, medium-intensity breeds are characterized by higher reproduction rates. These are the breeds we present to you (Markov and Hristov, 2021).

Hereford

The Hereford cattle breed was developed in a hilly region with rich vegetation and long periods of grazing. This has contributed to the development of a healthy constitution, excellent adaptability to breeding conditions, disease resistance, high maturity, very good meat qualities, good maternal qualities, and high reproductive capacity. Hereford is a typical representative of the English early maturing specialized beef breeds.

The coat is red, with a white head, neck, throat, and lower chest, lower limbs, and tail tip. This colouring of the Hereford is dominantly inherited in offspring, even when crossed with other breeds.



Figure 4. Hereford cattle (picture by Rimsa – Trojan)

The head is broad, with medium-length, thick horns. A hornless Hereford breed was developed in Canada, from which around 2,000 animals were imported to Bulgaria in the 1980s and acclimatized, including at RIMSA-Troyan. The neck is short, well muscled, and the chest is deep, broad, and barrel-shaped, with a well-developed sternum. The limbs are short, widely spaced, and strong. The skin is thick and loose, covered with long, coarse, sometimes curly hair. The average live weight of cows is 600–750 kg, and that of bulls is 800–1000 kg. The weight of calves at birth is 30–32 kg, and at weaning at 7–8 months of age – 170–200 kg. Young animals have high growth and fattening capacity. At 18 months of age, heifers reach 430–450 kg.

The slaughter profitability is relatively high – 60–65% when fattened to 500 kg live weight. Young animals accumulate a lot of fat, which impairs the quality of the meat. Hereford beef is high quality, pink in color, well marbled with fat, tender, juicy, and tasty. When animals are fattened on pasture, the meat is produced without excessive fat deposition (Markov and Hristov, 2021).

Galloway

The breed originates from Scotland. Selection methods and conditions – natural selection. Breeding status since 2017. The Galloway breed is one of the oldest beef cattle breeds. They are known for their resilience and can live on the most nutritionally poor land and soil. The breed is characterized by high absorption

of grass feed. They have an extremely calm temperament and high resistance to disease and climate change. The animals are relatively small, compact and sturdy, with a harmoniously developed constitution. The body is cylindrical, with rounded shapes. The head is short and broad with a straight profile line, large eyes, and broad noses turned forward and upward, with strongly hairy ears. Galloways are naturally hornless. The neck is of medium length and well muscled. The withers are short, muscular, and slightly distinguishable. The croup is moderately broad, muscular, and straight. The backline is straight. The animals have a strong bone structure, well-developed musculature, strong legs, and hooves. The most visible characteristic of Galloway cattle is their long fur, consisting of two layers. The outer layer has longer and coarser hairs designed to protect the animal from wind and rain, while the second layer provides good thermal and waterproofing. The color of the coat is unusual, uniform—from white, light brown, brown to brown-black, to black. There are three main varieties of Galloway cattle according to colouring (Yarkov, 2022). Bulls weigh 800–950 kg and cows weigh 450–550 kg. Calves are born weighing 27–29 kg. At 7–8 months, they weigh 180–205 kg, and at 15–18 months, 350–400 kg. The average daily weight gain ranges from 850 to 1200 g. Fertility is high at 96.4%. The intercalving period varies from 340 to 390 days. Calving is easy and does not require medical assistance. The slaughter efficiency is 60–65%. The meat is marbled with pronounced fat layers.

Meat quality is one of the most important characteristics of the Galloway breed. Studies show that beef from the Galloway breed is low in total and saturated fat. It has a high content of beneficial Omega 3 and Omega 6 fatty acids, making it significantly healthier than pork and as good as chicken and salmon. Veal is lean but well marbled. The recommended technology is free-range, pasture-raised. Gaul cattle are raised on several farms in Bulgaria, with the largest herd being at the Training Center of Trakia University in Stara Zagora, numbering around 120 animals. Since 2024, six heifers and one bull have been available to scientists from RIMSA-Troyan for scientific experiments related to industrial crossbreeding.

Wagyu

Wagyu means Japanese cattle in Japanese. ("wa" means Japanese and "gyu" means cattle). They are mainly bred in the Kobe area of Hyogo Prefecture. In practice, the breed is often incorrectly referred to as Kobe. For centuries, this breed has been used for pulling power (harness). During the period 1635–1868, the population was practically "closed," with export and import prohibited by order of the shogun.

It is only after 1868 that the Japanese, under foreign influence and despite their Shinto traditions, began to consume beef. At that time, Brown Swiss,

Shorthorn, Devon, Simmental, Ayrshire, Angus, and Korean cattle were imported into the country, which had an impact on the consolidation of the breed. In 1910, crossbreeding was discontinued and purebred breeding was adopted. The breed was recognized in 1944. In 2017, 1.6 million Wagyu cattle were raised in Japan by 5,010 farmers. Since 1997, the breed has been considered a national treasure of Japan. Zenva is a government organization in Japan that strictly monitors the breed registry. The animals are extremely gentle, with a calm (peaceful) temperament and are suitable for pasture breeding (Markov et al., 2022; Markov et al., 2024; Hristov et al., 2024).

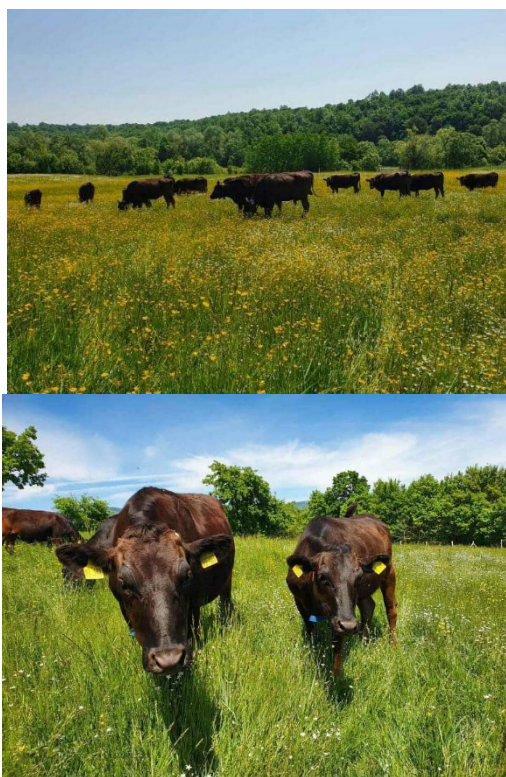


Figure 5. Wagyu cattle (picture by Rimsa – Troyan)

Wagyu show good adaptability. The cattle are medium-sized, well-muscled, with a fine bone structure and a well-developed constitution.

Table 2. Measured exterior body measurements of first-calf heifers, Wagyu in cm, ($X \pm s$) at the farm in the village of Palitsi, Elena municipality

Measurement	n=20	Standard (according Motojama et al.,2016) MAAF,2015, National Beef cattle Advancement Fuund Assotiation
	X $\pm$ s	Standard
Height at withers, cm	128.25 $\pm$ 1.34*	127-129
Height at the crotch, cm	129.6 $\pm$ 0.72**	128-131
Chest depth, cm	66.9 $\pm$ 1.72	65-69
Chest width, cm	45.9 $\pm$ 0.41***	44-47
Chest size, cm	188.1 $\pm$ 1.56	185-192
Athwart body length cm	158.4 $\pm$ 0.52*	155-160
Range of the whistle, cm	14.83 $\pm$ 0.28***	14-16
Width of the croup in the hindquarters,cm	41.5 $\pm$ 0.62*	40-42
Width of the tubercle in the ischial tuberosities, cm	39.8 $\pm$ 0.22***	40-42
Head length, cm	31.5 $\pm$ 0.31*	30-32
Head width, cm	17.6 $\pm$ 0.28	16,5-18
Half-range of the piston, cm	27.4 $\pm$ 1.12	27-28
Live weight, kg	574.8 $\pm$ 3.57	520-600

P<0.05*, P<0.001**, P<0.0001**

The height at the withers of cows is 100–129 cm, and that of bulls is 135–140 cm. The horns are straight, slightly curved forward, and end with a white tip. They have black, red, and brown skin and coat colors and shiny black nostrils. There are four black breeds, which make up 90% of the population. These are the Totori, Tajima, Shimane, and Okaima breeds. There are two red breeds—the Koma and Kumamoto—and one brown breed, which is genetically related to Korean cattle and the Simmental breed. The live weight of cows is 700 kg, and that of bulls is 950 kg. The low birth weight of calves (30 kg for females and 40 kg for males) allows for relatively easy calving. Bulls cover up to 50% more females compared to other breeds. Heifers are inseminated at 12 months. During the period from 11

months to 29–30 months, their diet includes highly concentrated feed, roughage, and beer. Individual massages are also performed to relieve stress and muscle stiffness. They are fattened until 28–30 months of age. At 29.2 months, the fattened male calves reach 576-756 kg, with an average daily weight gain of 0.770 g. Kobe beef is meat produced from male cattle, while Matsuzaka beef is meat produced from female cattle. The slaughter profit is 65%. The carcass of a male Wagyu consists of 47.7% muscle, 41.7% fat, and 10.6% bone. The meat is juicy, tender, marbled, and layered with specific fat. This fat runs through the muscles in thin lines (stripes) and gives the meat its characteristic taste and aroma. The recommended technology is free-range, pasture-raised (Markov et al., 2022).

Wagyu of different categories are raised on a farm in the village of Palitsi, Elena municipality, with about 100 animals, and on a farm in the village of Dalbok Dol, Troyan municipality, with 25 animals.

Conclusion

A significant part of the beef in Bulgaria comes from breeds with a combined purpose – about 40% of the total quantity. Industrial crossbreeding is also used, with various types of crossbreeds being sold on the market.

Currently, there are about 280 beef farms and holdings in Bulgaria, raising 133,100 beef heifers and cows, or 24.05% of the total number of cows in the country. The majority (around 85,000) are purebred cows with pedigrees from beef breeds, mainly English and French, while the rest are high-blooded crossbreeds.

Approximately 80% of farmers engaged in beef cattle farming are members of the two officially registered beef cattle associations. The average area used per beef farm in the country is approximately 2,500 decares.

The essence of the problem is the establishment of beef cattle farms with precisely defined breed zoning, territory, and number of animals, which are able to provide both grazing and forage and succulent fodder during the winter.

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