

Methods of examination and assessment of the safety of goat meat of the Zaanen breed

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Abstract. The purpose of the study was to develop a comprehensive system of veterinary and sanitary examination of the safety and quality of slaughter products of Zaanen goats. The studies were conducted on goats at the age of 36 months. According to the results of veterinary and sanitary examination of organs and carcasses, all experimental animals were found to be healthy. Five muscles served as the material for studying the chemical composition: the semi-webbed muscle, the biceps femur, the longest back, the biceps shoulder and intercostal muscles were studied. Organoleptic studies of meat and internal organs were carried out in accordance with the requirements of GOST 7269-79, physico-chemical studies of meat were carried out in accordance with GOST 23392-78, the mineral composition of tissues was studied on an atomic absorption spectrophotometer. The biological value of Zaanen goat meat was determined according to the "Methodological recommendations for the use of the express method of biological evaluation of products and feeds". Studies have shown that to assess the safety and quality of goat cuts and carcasses as meat raw materials, anatomical characteristics and morphometric parameters of regional lymph nodes should be used: heads - mandibular, parotid and pharyngeal lateral and medial; necks - superficial and deep cervical; thoracic limbs - axillary, axillary of the first rib and superficial cervical; sternum - axillary; chest wall - superficial cervical and intercostal; lower back - lumbar; pelvic extremity - popliteal, superficial and deep inguinal; the mammary glands are suprarenal.

1 Introduction

The supply of high-quality food products to the population is the primary task of agricultural production. At the same time, the dependence of the domestic market on imports poses a great threat not only to the food market, but also to other aspects of Russia's national security [1]. Significant differences in the criteria for assessing the safety of raw materials obtained in Russian regions from the USA and EU countries make it difficult for Russian agricultural

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producers to compete at the proper level, thereby disrupting the balance of the country's domestic food market in favor of cheaper and less safe imported raw materials [2,3].

In this regard, special attention is currently being paid to the tasks of obtaining safe and high-quality domestic livestock products. Goat breeding should play a certain and not the least role in this process. In Russia, goat breeding in large farms and private farmsteads is a dynamically developing and promising industry in the structure of animal husbandry. The wide distribution of goats is determined by the variety of high-quality products and raw materials obtained from them - milk, meat, down, wool, leather raw materials [4,5].

Currently, more than 370 breeds of goats are bred in the world. In Russia, a Zaanen goat is most often used for breeding. She is one of the largest: height at the withers is 75-90 cm, weight of queens is 50-55 kg. Dairy productivity in farm conditions is high: after lambing, milk yield reaches 4.5 -6.0 kg and stays at this level for up to four (five) months. The annual milk yield is 600-700 liters of milk [6].

In farms, animals are often slaughtered in private mini factories. It also evaluates the safety and quality of raw materials. In all manuals, it is recommended to carry out this process according to morphological and morphometric indicators of cattle or sheep. This is fundamentally wrong, since the ontogeny and phylogeny of these ruminants are different. It is believed that the ancestors of domestic sheep are European and Asian mouflons. These include the urial - steppe sheep. The ancestors of domestic goats are saber-horned (bezoar) and screw-horned goats. The third ancestor of domestic goats is considered to be the "primeval goat prisca". The European bison and the American bison are recognized as the ancestors of cattle. In this regard, we believe that it is long overdue to develop a scientifically sound system of veterinary and sanitary examination of goat slaughter products [7,8].

The purpose of the study is to develop a scientifically based comprehensive system of veterinary and sanitary examination of the safety and quality of slaughter products of Zaanen goats.

2 Materials and methods

Goats and adult goats of the Zaanen breed at the age of 36 months were taken for the study. The material for the study (carcasses of slaughtered animals and meat) was obtained in goat farms in the North-Western region of Russia. A total of 75 animals were studied.

The slaughter of animals was carried out in the conditions of a farmer's private processing meat mini-plant. According to the results of veterinary and sanitary examination of organs and carcasses, all experimental animals were found to be healthy. After the commodity evaluation, the carcasses were sent to the cooling chamber, where they were kept for 24-72 hours at a temperature of 0.0 ... +4.0 °C. Then, after weighing, one carcass of each age group was selected for dissection. When starting the preparation of muscles, subcutaneous fat and fascia were previously removed from the half-carcass. Subsequently, all muscles were identified and classified in accordance with the International Veterinary Anatomical Nomenclature. Muscles and bones were weighed on a VLTK-500 scale. The mass of subcutaneous fat was added to the mass of intermuscular fat, and fascia, ligaments, large vessels and nerves, lymph nodes and kidneys were weighed together and grouped into other tissues. The total mass of muscle, bone, fat and other tissues was determined.

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The selection of material for histological examination and pouring it into paraffin blocks was carried out according to the generally accepted method: muscles with a volume of 1 cm were fixed in 10% formalin, washed, carried out through alcohols of increasing

concentration, carried out through xylene, xylene-paraffin and paraffin. Sections 5-7 microns thick were stained with hematoxylin and eosin.

Immediately after preparation and selection of material for histological examination, the muscles were placed in sealed bags and transferred to a refrigerator, where the air temperature was maintained within 0.0 ...+4.0 ° C. After 1-2 days, the muscles were thoroughly cleaned of fascia and fat and passed through a meat grinder twice. In the average sample of minced meat, the water content was determined by drying samples in a drying chamber at a temperature of 105 ° C until a constant mass was obtained (GOST 9793-74), fat was extracted with ether in a Soxlet apparatus (GOST 23042-86), total nitrogen was determined by the Kjeldahl method (GOST 29128-91). The amount of water, fat and protein was calculated as a percentage of the raw sample weight (L.V. Antipova et al., 2001).

Organoleptic studies of meat and internal organs were carried out in accordance with the requirements of GOST 7269-79 "Meat. Sampling methods and organoleptic methods for determining freshness" and according to the "Rules of veterinary inspection of slaughter animals and veterinary and sanitary examination of meat and meat products".

The physico-chemical study of meat was carried out according to GOST 23392-78, 23042-86. When determining the chemical composition (moisture, protein, fat, ash and other substances of muscle tissue), the methods set out in GOST 9793-74 "Meat products. Methods for determining the moisture content", GOST 25011-81 "Meat and meat products. Methods of protein determination", GOST 23042-86 "Meat and meat products. Methods for determining fat",

The mineral composition of the tissues was studied using an atomic absorption spectrophotometer (Perkin Elmer device, USA). The content of micro-macroelements in meat was determined according to the generally accepted method, according to GOST 17681-82.

The amino acid composition of the muscles was determined by ion exchange chromatography using an amino acid analyzer from Hitachi. The biological value of Zaanen goat meat was determined according to the "Methodological recommendations for the use of the express method of biological evaluation of products and feeds".

The manufacture of bone preparations of the axial and peripheral skeleton was carried out by maceration and (or) cooking. The organs of the oral cavity and neck were studied on sagittal incisions. Identification signs and organ lymph nodes were studied on the extracted organs of the thoracic and abdominal cavities. Their linear parameters were determined by an electronic caliper (the division price is 0.01 mm), and the mass parameters were determined on the scales of VLTK-500.

Results and Discussion. The object of the study was 75 goats of the Zaanen breed aged from 1-10 days to three years of postnatal life. Research material: bones of the axial and peripheral skeleton; regional and organ lymph nodes; internal organs and muscle tissue. The age of the animals for the study was not chosen by chance. 1-10 days of postnatal life is one of the critical periods of any animal's life. It is at this time that the body is subject to the strongest stress during the transition from intrauterine to postnatal life. The morphology and function of all organs and systems change significantly. Embryonic digestion, characteristic of late prenatal development, is replaced by the consumption and digestion of colostrum and milk. In the system of respiratory organs, the functions of external respiration are switched on. Significant changes occur in the structure of the heart and blood vessels: the placental circulatory system is turned off (the umbilical arteries and vein become desolate and turn into ligaments); the right and left halves of the heart are completely separated (the oval hole is overgrown); the arterial (Batalov) duct becomes desolate and turns into an arterial ligament. Chest excursions, contraction of somatic and visceral muscles of the trunk and extremities significantly increases the intensity of lymph and venous blood outflow. The function of endo- and exocrine glands is enhanced, the formation of immune defense organs occurs.

The age of young animals at 1-2 months is the period of the most intensive growth and development of individual organs and the body as a whole. 6-8 months is the period of puberty of Zaanen goats. The age of 12 months is characterized as the period of onset of economic maturity.

Slaughter of animals should be carried out with preliminary thermometry and clinical examination of animals. Only clinically healthy animals should be delivered to the conveyor. After slaughter and exsanguination, veterinary and sanitary analysis of internal organs, carcass and head is started.

We recommend starting the veterinary and sanitary examination of goat slaughter products of the Zaanenskaya breed from the head. We draw attention to the objective necessity of this event. Currently, veterinary and sanitary examination of the heads of small cattle (goats and rams) is not carried out at meat processing plants: with the conveyor method of cutting sheep carcasses, there is no special point for analyzing the organs of the heads of these animals. At the same time, in the ancient cuisine of a number of peoples of Russia (and currently in the menu of a number of public catering establishments), the dish "Lamb's head" is included. Sheep heads are imported into the country as a by-product. The possibility of supplying substandard raw materials or attempts at falsification is not excluded: instead of the declared product, goat heads are imported.

The solid palate can serve as an auxiliary organ for species identification of the goat's head. It is based on paired right and left palatine processes of the incisor bones, palatine processes of the upper jaws and horizontal plates of the palatine bones. In the embryonic period of ontogenesis, they coalesce in the median plane, forming the bone palate. The latter is covered with a mucous membrane lined with a multilayered flat slightly keratinizing epithelium. The epithelium and submucosal layer form palatine rollers. The number of complete palatal rollers in the Zaanen goat ranges from 12 to 14: they have a pyramidal shape and end in well-defined caudally directed papillae. Of these, only the first eight are divided by the median palatal suture into paired semicircles. A large oval incisor papilla is located on the palate immediately behind the plate of the same name, and on the sides of it there are slit-shaped arcuate openings of the naso-palatine canal.

Veterinary and sanitary examination of the head is continued by the study of regional lymph nodes. The established patterns of lymph outflow from the organs of the head of the Zaanen goat breed do not contradict the general scheme of the structure of the lymphatic bed of this area in other mammals. The first-order lymphatic center for lymph flowing from the organs of the interdigital space (tongue, mandible, lower lip, ventral parts of the large masticatory and pterygoid muscles, sublingual and mandibular glands) are the rostral, middle and caudal mandibular lymph nodes. They are elongated oval in shape and are located from the medial surface of the body and the branches of the lower jaw, caudally from the vascular facial tenderloin. After passing all (or some of them), the lymph is directed to the nodes of the pharyngeal lymph center and (or) to the cranial deep neck lymph node.

The pharyngeal lymphocenter of the Zaanen goat is represented by the lateral and medial pharyngeal lymph nodes. For a veterinary and sanitary expert, they are as interesting as possible, since almost all the lymph flowing from the organs of the head passes through them.

The pharyngeal lateral lymph node lies under the Atlas in its wing fossa and is laterally covered by the brachial and brachial muscles. It is a third-order node for the flowing lymph from the dorsal part of the goat's head. From the pharyngeal lateral lymph nodes of the Zaanen goat, lymph is directed to the pharyngeal medial, cranial deep cervical lymph nodes and (or) to the corresponding right and left tracheal trunks. The pharyngeal medial lymph node lies between the dorsal wall of the pharynx and the ventral arch of the atlas.

Nodes of the pharyngeal lymphocenter are mandatory for examination and can be detected between the dorsal wall of the pharynx and the ventral muscles of the occipital-atlas and axis-atlas joints.

Then proceed to the veterinary and sanitary examination of the carcass. We propose to carry out species identification based on the morphology of the kidneys and liver, and in complex cases - on the bones of the axial skeleton.

Morphological features of the lungs of the Zaanen goat breed may well play the role of species identification features. On the right and left lung, the cranial and caudal interstitial slits are deep: they almost reach the surface of the corresponding main bronchus.

Three lobes are well expressed on the left lung: the cranial one is almost quadrangular, the middle one is cone-shaped, and the caudal one is in the form of a truncated pyramid. On the right lung of the Zaanen goat, five lobes are clearly distinguishable. The caudal lobe is in the form of a truncated cone, with a rounded additional lobe attached to it from the medial surface. The middle lobe of the right lung (as on the left lung) is cone-shaped.

The right cranial lobe of the lung is divided into two parts by a deep wide slit reaching the trachea. The cranial one is the apex and the eparterialic (tracheal) bronchus penetrates into it. It departs from the trachea between its fifth and sixth rings (counting the rings from the bifurcation). The caudal part is called the tongue and has the shape of a triangular pyramid. In length, it is 2.0-2.2 times shorter than the previous one.

The outflow of lymph from the heart and lungs occurs in the right and left tracheobronchial and bifurcation nodes. Their number ranges from three to seven, and they are located at the base of the main bronchi and tracheal bifurcation. Their average value is $12.83 \pm 1.85 \times 10.81 \pm 1.05 \times 7.32 \pm 0.92$ mm. The average volume of each node in newborn baby goats is on average 17.33 mm³. By six months of postnatal life, this indicator increases 30.51 times.

The liver of a Zaanen goat is a massive parenchymal organ with visible microscopic lobules surrounded by connective tissue. With deep cuts, it is divided into five lobes - right, left and middle. By the gate of the organ, the last one indicated in turn is divided into a tailed and a square one. From the visceral surface in the ventral part of the organ, the square lobe is separated from the right by the gallbladder and the cystic duct. The gallbladder is voluminous and from the side of the diaphragmatic surface significantly protrudes beyond the ventral edge of the organ. There is an extensive renal indentation on the caudal lobe. Two to four hepatic (portal) lymph nodes lie next to the liver gate. Lymph flows through them, flowing from the liver parenchyma, and is directed to the abdominal trunk.

The volume of hepatic lymph nodes of the Zaanen goat breed increases unevenly during postnatal life. Thus, it was found that in newborn goats this indicator is 4.46 mm³, by six months of life the volume of each node increases by 33.77 times, and by the end of the observation period - by 72.05 times.

The pre-ventricles, true stomach (rennet) and intestines are opened only if necessary, if there are suspected lesions and signs of diseases. For veterinary and sanitary examination of these organs, we analyze the abdominal, cranial and caudal mesenteric lymph nodes.

We have convincingly proved that the goat of the Zaanen breed has smooth multi-suckled kidneys (before our study, it was claimed that the goat and sheep have the same type of kidneys - smooth single-suckled). This feature of the morphology of the kidney of a goat is a species identification feature.

Morphological analysis of the regional lymph nodes of the carcass begins with a deep cervical lymphocenter. In the Zaanen goat breed, it is represented by a chain of three nodes - cranial, middle and caudal deep cervical. They are located parallel to the common carotid artery in a shallow trough formed by the esophagus and trachea. During nutrovki and butchering of carcasses, they are often removed along with the trachea and esophagus. However, during veterinary and sanitary examination, the nodes must be examined, since lymph flows through them from the organs of the head, muscles and skin of the neck.

The axillary lymph node and the axillary lymph node of the first rib lie on the medial head of the triceps muscle of the shoulder (or on the distal tendon of the large round muscle)

at the level of the shoulder joint, between the thoracic limb and the rib wall. They are important during examination, since lymph flows through them, flowing from almost the entire thoracic limb (excluding the scapula and the dorsal shoulder girdle muscles). They are accessed from the caudal surface of the triceps muscle of the shoulder, making an incision along the inner surface of its medial head.

The cranial sternal lymph node is well accessible to the eye from the side of the half-carcass cut surface. It is found in the bend of the handle of the thoracic bone, slightly below the internal thoracic arteries and veins. The lymph node is covered with pleura and fatty tissue, it can be destroyed when sawing (cutting) the breast bone. Lymph flows through the nodes from the muscles of the shoulder girdle of ventral fixation, thymus, caudal parts of the esophagus and larynx. In an adult goat, its volume is on average 168.84 mm³, which is 61.17 times more than the same indicator of newborn goats. It is important to note that already in six-month-old animals its volume is 95.88 mm³, which is 34.74 times more than this indicator of newborn animals.

Intercostal lymph nodes are located under the spine near the junction of the rib head with the spine. They are small, covered with pleura and adipose tissue. Lymph flows through them from the dorsal muscles of the withers and back, as well as the corresponding skin areas.

Lumbar lymph nodes are numerous. They are located in the abdominal cavity under the spine and ventral muscles of the lower back: on the left - between the aorta and the small lumbar muscle, on the right - between the caudal vena cava and the small lumbar muscle. When removing the amniotic fat, these nodes are often removed along with it. Lymph flows through these nodes from the organs of the pelvic cavity, pelvic limb, dorsal and ventral muscles of the lower back, abdominal wall and corresponding skin areas. The volume of each lumbar lymph node in an adult goat is on average 59.99 mm³. From the lumbar nodes, the lymph is directed to the lumbar cistern.

Iliac lymph nodes are found during the transition of the abdominal cavity to the pelvic and are divided into three groups (medial, lateral, external). Medial iliac lymph nodes lie to the side of the cranial pelvic and near the caudal package of lumbar lymph nodes at the level of the last lumbar vertebra. The lateral iliac are located in the iliac fossa near the branching of the circumferential deep iliac artery. The external iliac lymph nodes lie on the medial surface of the iliac muscle at the entrance to the pelvic cavity. Nodes are large, well detected. The iliac group of lymph nodes is often separated from the carcass along with the amniotic fat. Lymph flows through them from the organs of the pelvic cavity and pelvic limb.

Sacral lymph nodes lie behind the medial iliac in the pelvic cavity. They are covered with adipose tissue and peritoneum, and therefore are not easily accessible for examination.

The popliteal lymph node in a Zaanen goat is found in the adipose tissue between the biceps femoris muscle and the semi-tendon muscle slightly above the level of the knee joint.

The superficial inguinal nodes are located paramedially under the pubic bones. In goats, they are called suprarenal (there may be one or two), and they lie at the base of the udder. When the udder is separated, these lymph nodes remain with it. It is important to analyze the morphological state of these nodes: the presence of pathological changes in them requires a thorough examination of udder tissues. The node has an oval shape: in an adult goat, its length is on average 28.73 ± 2.94 mm, the width reaches 13.07 ± 1.31 mm, and the thickness does not exceed 8.84 ± 0.7 mm. In an adult goat, the volume of the suprarenal lymph node is on average 3447.95 mm³, which is 82.31 times more than the same indicator of newborn goats.

In males, the superficial inguinal lymph node is found laterally from the white line of the abdomen, near the pubic crest, behind the inguinal ring, in adipose tissue laterally from the body of the penis. In males, they do not require the close attention of a veterinary expert.

In controversial cases, it is necessary to carry out species identification of the carcass or cut. It is advisable to carry it out on the bones of the axial skeleton, since many of them have pronounced species identification features of anatomy. The axial skeleton includes the bones

of the head, cervical, thoracic, lumbar, sacral and caudal vertebrae, as well as ribs and chest bone. The bones of the peripheral skeleton of a goat do not have pronounced specific structural features and cannot be used for error-free species identification.

In a goat, the specific feature of the first cervical vertebra (Atlas) is the presence of a well-developed caudo-lateral process of its wing. There is no similar structure on the first cervical vertebra in other agricultural and domestic animals. In dogs, a wing tenderloin is located on the Atlanta wing instead of the wing opening that the goat has. In addition, carnivores have a transverse opening on the wing of the first cervical vertebra, which is absent in the goat.

The second cervical vertebra (epistropheus, axial) of the goat has a pronounced dorsal ridge. Cranially, it forms an arcuate process slightly protruding above the axis tooth. Caudally, the crest ends with a vertically positioned bone plate (which neither sheep nor dog have). The heights of the body of the second vertebra and the crest are almost equal. Note at the same time that in sheep, the height of the crest of the epistropheus is two times less than the height of the vertebral body. In a dog, the crest of the epistropheus is elongated craniocaudally. Its anterior end in the form of a process significantly overhangs the tooth-like process, reaching the plane of the apex of the latter. In addition, the dog has a deep cranial vertebral notch instead of the intervertebral opening of the axial vertebra.

The sacral bone of a goat is formed by five fused vertebrae. The spinous processes are interconnected along the entire length, and dorsally end in a longitudinally located roller-shaped thickening. There are no interstitial openings. In sheep, the sacrum is a fusion of the bodies of four vertebrae. The spinous processes of the vertebrae do not coalesce into a single ridge, and between them there are interstitial openings.

The sacral bone of a dog is formed by three sacral vertebrae, and their spinous processes form the so-called cock crest. Thus, the cervical, lumbar and sacral vertebrae of a goat have pronounced specific anatomical features that allow absolutely unmistakable identification of the carcass, half-carcass or any cut that includes sections of the vertebral column.

Meat is a combination of muscle, fat, nervous, connective, cartilaginous and bone tissues in their natural ratio and the residual amount of blood. The properties of meat tissues and their ratio determine its most important quality indicators, including nutritional value. They depend on the type of animals, gender, age, fatness, method of cutting. Muscle and adipose tissues have the highest nutritional value.

We have assessed the quality of five carcasses of Zaanen goats. Animal carcasses met the requirements of veterinary legislation, the rules of veterinary inspection of slaughter animals. According to their fatness, the goats were classified into the first category: the musculature is developed satisfactorily, the spinous processes of the dorsal and lumbar vertebrae, as well as the makloki and withers protrude, subcutaneous fat deposits are felt on the lower back and ribs.

The mass of the chilled carcass of animals of the Zaanen breed aged 12 months was 21.66 kg. The lethal yield was 41.05—43.21% (on average 41.56%). The organoleptic evaluation showed that the goat carcasses were fresh, odorless. The surface of the carcasses is pink with a reddish tinge, the fat is white.

According to the results of biochemical studies, the following biochemical parameters were determined in goat meat cuts: water 73.75%; fat 5.62%; protein 19.65%; ash 0.98%. The essential amino acids in meat proteins were: leucine — 1.04%, lysine — 1.93%, threonine — 1.03%. By absolute weight, the yield of first-class meat was 18.46 kg, which is 85.23%. The amount of protein in the meat of Zaanen goats was 19.65%. The content of essential amino acids reached 41.31%. Meat corresponds to the formula of a balanced diet.

Goat meat of the Zaanen breed is a dietary product containing a balanced amount of fats, proteins and carbohydrates. Already in 12-month-old animals, the muscles of the trunk, neck, head and limbs are well developed and chemically complete: it is advisable to use them for the manufacture of valuable types of meat products.

3 Conclusion

1. The specific identification of carcasses and organs of goats of the Zaanen breed can be carried out according to the specific morphological characteristics determined by originality and selectivity, severity, ease of detection and stability during reproduction.
2. To carry out reliable species identification, it is recommended to use: in the head area - the bones of the cerebral skull, in the neck area - the specific features of the morphology of the atlas and axial vertebra; in the back and lumbar region - the structural features of the lumbar vertebrae; in the croup area - the sacral bone and the topography of the hyaline cartilage of the articular surface of the hip joint. The features of the anatomy of the peripheral skeleton of the Zaanen goats are not species-specific and cannot be used for veterinary and sanitary identification of carcasses or cuts.
3. The formula of permanent teeth of the Zaanen breed goat specified by us is recorded: upper jaw - 10, CO, RZ, M2; lower jaw - 13, CO, RZ, M2. The type of kidneys of the Zaanen breed goat is smooth multi-lobed, which distinguishes them from ruminants (in cattle, the kidneys are furrowed multi-lobed, in sheep - smooth single-suckers). We recommend using the established morphological patterns as identification signs.
4. Additional features for species identification are the features of the hard palate (the presence of 11-13 complete palatal rolls), larynx (vocal processes are placed perpendicular to the longitudinal axis of the organ), lungs (the presence of the right cranial bronchus), liver (the presence of five lobes and renal indentation on the caudate lobe) and spleen (rectangular shape, elongated gate).
5. To use anatomical characteristics and morphometric parameters of regional lymph nodes for veterinary and sanitary examination and assessment of the safety and quality of goat cuts and carcasses as meat raw materials: heads - mandibular, parotid and pharyngeal lateral and medial; necks - superficial and deep cervical; thoracic limbs - axillary, axillary of the first rib and superficial cervical; sternum - axillary; chest wall - superficial cervical and intercostal; lumbar - lumbar; pelvic extremity - popliteal, superficial and deep inguinal; the mammary glands are suprarenal.

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