International Journal of Biological, Life and Agricultural Sciences
ISSN: 2415-6612
Vol:11, No:7, 2017

Nutritional Value of Rabbit Meat after Contamination with 1,1-Dimethylhydrazine

Balgabay Sadepovich Maikanov, Laura Tyulegenovna Auteleyeva, Seidenova Simbat Polatbekovna

Abstract**—**In this article reduced nutritional value of the rabbits' meat at 1, 1 dimethylhydrazine experimental toxicosis is shown. The assay was performed on liquid chromatograph SHIMADZU LC-20 Prominence (Japan) with fluorometric and spectrophotometric detector. This research has revealed that samples of rabbit meat of the experimental group had significant differences from the control group:in amino acids concentration from 1.2% to 9.1%; vitamin concentration from 11.2% to 60.5%, macro – minerals concentration from 17.4% to 78.1% and saturated fatty acids concentration from 17,1% to 34.5%, respectively. The decrease in the chemical composition of rabbits' meat at 1,1 dimethylhydrazine toxicosis may be due to changes in the internal processes associated with impaired metabolic homeostasis of animals.

Keywords**—**1,1-dimethylhydrazine, metabolic homeostasis, nutritional value, rabbit meat.

I. Introduction

THE carrier rocket of the heavy class "Proton" has been in operation since 1965, and from 1967 and 2001 «Proton-K» and «Proton-M» were launched respectively. The «Proton-M» carrier rocket brings to Earth orbit up to 20 tons of payload and about 4 tons to the geostationary orbit. Both stages of takeoff of carrier rockets use fuel consisting of combustible UDMH and oxidizer of nitrogen tetraoxide (OT). The usage of hydrazine as a fuel for jet engines began in the twentieth century. During the Second World War, it was first used in Germany on the «Messerschmitt «ME-163»» fighter aircrafts and the piloted buzz bomb «Nutter». The latter one is used to combat bomber aviation [1].

According to the report of the company "Space Foundation" (USA) in 2009, the total volume of the world space market in the last five years increased by 40% and amounted to 261.6 billion US dollars. The number of launches increased by 42% and amounted to 78 launches, including 46% with payloads. Of 78 launches: 37% was made by Russia, 31% by the USA, 9% by Europe, 8% by China, 5% by «Sea Launch», «Land Launch» involving the USA, Russia, Ukraine, Norway and less than 4% by Japan, India, North Korea, South Korea and Iran. According to the 2009 data of the company "Euro consult" the number of national agencies increased up to 55 organizations. The growth of government spending on civilian space projects increased by 9%, which is 36 billion US dollars; The increase in expenditures for the military space sector accounts to 12%, which is 32 billion US dollars. Country spendings increase on space programs ranged from US $ 48.8 billion in the United States (almost 72% of total world government spending) to US $ 900 million in India.

In recent years intense rocket and space activities came up with a huge number of problems and began to attract the attention not only of specialists, but also of the general population. These problems include pollution of the environment because of separation of parts of carrier rockets and because of toxic components of rocket fuel (heptyl and its derivatives, nitrogen tetraoxide, etc.) [2].

The most significant environmental consequences of emergency and supernumerary situations with the RST (Rocket and Space Technology) are associated with the impact on the surface of the earth and are characterized by long-term contamination of soils, surface and groundwater, vegetation, and exposure to living organisms and humans [3].

The danger of 1,1 dimethylhydrazine during the interaction with the environment is determined by high volatility, water solubility, ability to migrate and accumulate, stability in deep layers of soil and plants. Any intake into the human body and animals is dangerous because it affects the central nervous system, liver and kidneys, changes the composition of blood [4]-[7].

The areas of fall of the first stages of launch vehicles represent a real threat to the environment because of the residues of toxic rocket fuel (RF) that remain and settle on the ground. As an example fuel-super-toxicant-asymmetric dimethylhydrazine (heptyl) could be accounted. Generally, heptyl enters the environment when it is dispersed in the atmosphere and spills fuel when the stages of carrier rockets fall. The areas of dispersion are usually called "zones of environmental problems", the total area of which is 77.09 million hectares. [8]. There is a systematic increase in the disease level of the population in those areas. To the pathologies caused by the influence of the residues of RF the violation of bilirubin metabolism in the human body, anemia of pregnant women and the development of immunodeficiency should be included. It has been experimentally proved that the development of diseases is connected with the effect of heptyl on the territory of residential areas near the RP [9].

Unsymmetrical dimethylhydrazine is a potentially dangerous carcinogenic chemical compound (according to the classification of the International Agency for Research on Cancer it belongs to the group of carcinogenic substances 2B), therefore it can be one of the risk factors for the growth of oncopathology in the population living near the areas where

Balgabay Sadepovich Maikanov, Laura Tyulegenovna Auteleyeva and Seidenova S. P. are with the Kazakh Agro Technical University, Kazakhstan.
Zhubatov Zhailaubai Kyzylbayevich is a Doctor of Technical Sciences, professor, Kazakhstan.
S.Seifullin, Master of Veterinary Sciences, Ph.D. candidate, Kazakhstan (email:laura_aut@list.ru).

the rocket stages fall. Hydrazine and its derivatives can penetrate body in various ways and their relative toxicity does not depend on the methods of penetration. They are equally well absorbed with subcutaneous, enteral, inhalation routes of injection, as well as with cutaneous application [10]. However, the most dangerous way is inhalation. Derivatives of hydrazine quickly enter the blood. For instance, hydrazine, applied to the skin of dogs, was detected in the plasma after 30 seconds. The maximum concentration after inhalation to the skin was achieved after 1-3 hours [11]. Under the impact of rocket and space activities on agriculture, there is an important aspect that agricultural products obtained from sites contaminated with rocket fuel components carry with them a real threat of transferring highly toxic components through the food chain to animals and humans [12].

II. Material and Methods

The experimental 1,1 dimethylhydrazine toxicosis was caused by distillation with distilled water of an impurity of 1,1 dimethylhydrazine. In the experiment, 1,1 dimethylhydrazine was used, 98% of SSS (state standard sample), manufactured by Sigma Aldrich, Germany (Fig. 1). To work with 1,1 dimethylhydrazine (SSS), special courses were passed: "Industrial safety at hazardous production facilities", with qualification: "Personnel admitted working with HTS (highly toxic substances) and hazardous substances" and “The person responsible for safe reception, storage and the release of HTS and hazardous substances”

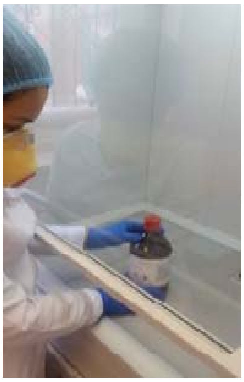

Fig. 1 1,1 dimethylhydrazine

Experimental and control groups of laboratory animals-rabbits were selected according to the system of analogues. The first group (n = 15) was rabbits and 98% 1.1 dimethylhydrazine was injected to this group orally together with distilled water at a dose of 0.075 mg / kg live weight, the second group (n = 15) was control animals. After the experiment, on the 6th day, decapitation of rabbits was carried out. The rabbit autopsy was carried out by the Shore method.

The chemical composition of the meat was determined by a set of methods: moisture was determined by drying it at 105 ° C, adipose by Soxhlet, total protein by modified Kjeldahl method, mineral substances by burning in a muffle furnace.Determination of the vitamin composition was carried out in accordance with GOST (National Standard) 32307-2013 "Meat and meat products. Determination of fat-soluble vitamins by HPLC method ", GOST 55482-2013 “Meat and meat products. Method for determining the content of water-soluble vitamins. " GOST 52147-2003 "Protein-vitamin-mineral and amido-vitamin-mineral supplements. Method for the determination of fat-soluble vitamins”.

The determination of vitamins in the samples was carried out on a liquid chromatograph SHIMADZU LC-20 Prominence with gradient elution. To separate the vitamins, a 25 cm * 4.6 mm chromatography column of SUPELCO C18 was used. In operation, the column was equipped with a precolumn to protect the main column from contamination. Samples were injected with an autosampler. The sample volume was 20 μl. During liquid chromatography standard solutions of vitamins (Sigma-Aldrich, USA), phosphoric acid 85% (Sigma-Aldrich, USA), highly pure acetonitrile («HLPC» of Germany) were used. The macro- and microelement composition was carried out according to GOST R 53150-2008 "Food products. Definition of trace elements. Preparation of samples by mineralization and under increased pressure”.

Determination of fatty acid composition. Determination of fatty acid composition was carried out in accordance with GOST 32915-2014 "Milk and dairy products. Determination of the fatty acid composition of the fat phase by gas chromatography”. Determination of the fatty acid composition was carried out on a gas chromatograph. The experiment was considered at the meeting of the Ethical Commission of the Faculty of "Veterinary and Livestock Technologies" of the Kazakh Agrotechnical University named after S. Seifullina.

Statistical processing of the results was carried out according to M-EXCEL. The validity of the differences in the chemical values of each sample was determined from the analysis of variations (ANOVA). Differences were considered to be valid at an exponent $p < 0.05$.

III. Results and Discussion

As a result, the study found that the moisture content in the muscle tissue of rabbits in the experimental group of rabbits is higher than in the control group and is 69.9 ± 0.15 and 64.8 ± 0.13 g / 100 g, respectively. This demonstrates an increase in muscle hydremia. The concentration of proteins in the control group was 4.1% greater than in the experimental group. The fat content in the muscles of the test group was 23.9%.

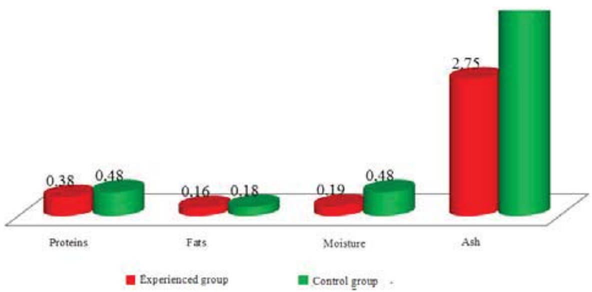

Fig. 2 Nutritional value of meat in groups

The toxin has a significant effect on the quantitative indicators of the vitamin composition of the muscle tissue of rabbits. The content of all water- and fat-soluble vitamins in meat of infected animals was lower than in healthy animals (Fig. 3).

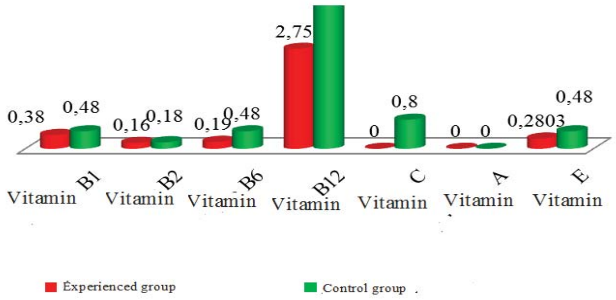

Fig. 3 Vitamin content of meat in groups, mg / 100g

In particular, the concentrations of vitamins A, C are not detected. The B vitamins were within the following limits: vitamin B1-0.38 ± 0.04 mg / 100 g and 20.9% less than in the control group; Vitamin B2-0.16 ± 0.07 mg / 100 g and 11.2%; Vitamin B6-0.19 ± 0.08 mg / 100g and 60.5%; Vitamin B12 - 2.75 ± 0.04 mg / 100g and 34.6%.

There are also changes in the mineral metabolism. In the experimental group, the sodium concentration was 12.53 ± 0.05 mg / 100 g and was 78.1% less than in the control group; Calcium-10.6 ± 0.14 mg / 100 g and 45.7%; Phosphorus-104.9 ± 0.11 mg / 100g and 44.8%; Magnesium-14.78 ± 0.03 mg / 100g and 40.8%; Potassium-266 ± 0.09 mg / 100g and 20.6%, respectively. A similar picture was observed with regard to trace elements: iron was 73.5% less than in the control group; Molybdenum by 74.5%; Manganese by 30.8%; Zinc by 17.4% and copper by 9.4%, respectively.

TABLE I
MINERAL COMPOSITION OF RABBIT MEAT IN GROUPS, IN MG/G

Fatty acids	Groups, M±m	
	Experimental (n=15)	Control (n=15)
	Macro	
Magnesium	14,78±0,03	25±0,0,12
Sodium	12,53±0,05	57±0,03
Phosphorus	104,9±0,11	190±0,12
Potassium	266±0,09	335±0,06
Calcium	10,6±0,14	19,5±0,04
	Micro	
Iron	0,85±0,04	3,2±0,11
Manganese	0,09±0,03	0,013±0,02
Copper	0,116±0,01	0,128±0,11
Molybdenum	0,0011±0,06	0,0043±0,03
Zinc	1,9±0,05	2,3±0,03
	p<0,05-0,01	

Amino acid composition in the experimental group showed significant changes. We detected a change in the qualitative and quantitative structure of the amino acid composition of the meat of the experimental group. Compared with the control group, a decrease in the total number of amino acids was observed in the muscles. So, in the protein of rabbit meat of the experimental group there were significant differences in irreplaceable amino acids from 1.2 to 9.1%; Replaceable amino acids from 1.2 to 7%.

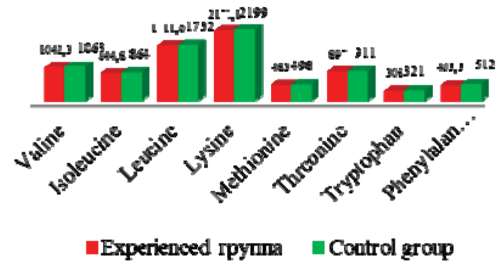

Fig. 4 Irreplaceable amino acids in groups, in mg / 100 g

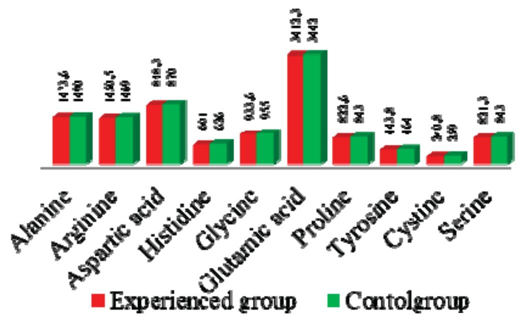

Fig. 5 Replaceable amino acids in groups, in mg / 100 g

The ratio of the sum of irreplaceable to replaceable amino acids in the experimental group was 0.65 less than in the control group. The sum of the amino acids of the muscle protein in the test group was lower by 2% compared to the control group (Fig. 5).

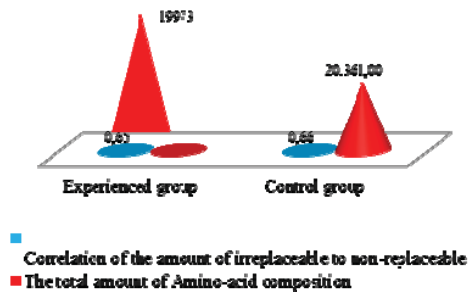

Fig. 6 Amino acid indicators of meat protein in groups

Fig. 7 shows that the limiting amino acids in the meat protein of the experimental group are valine-SCOR 98.6%, methionine-SCOR 65.4%, phenylalanine-SCOR 39%. The results obtained allow to summarize that under experimental 1,1 dimethylhydrazine toxicosis essential amino acids decrease of irreplaceable amino acids from 1.2 to 9.1%; Replaceable amino acids from 1.2 to 7%. It is known that irreplaceable amino acids determine the nutritional and biological value of meat and this makes it necessary to take into account the revealed fact in the veterinary and sanitary assessment of meat production when 1.1 dimethylhydrazine is affected. The fatty acid composition of the experimental group of animals had significant deviations.

A decrease in the concentration of saturated acids was found, of which stearin by 25.6%; myristic by 21.5%, palmitic by 17.1%; polyunsaturated acids of which linoleic by 22.3% and linolenic by 34.5% (Table II).

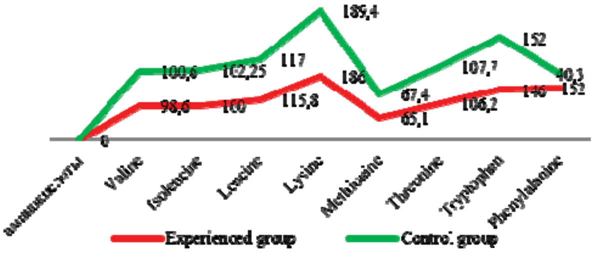

Fig. 7 Amino acid rate in groups %

TABLE II
FATTY ACID COMPOSITION OF RABBIT MEAT IN GROUPS, IN MG/G

Fatty Acids	Groups, M±м	
	Experimental (n=15)	Control (n=15)
Saturated		
C14: 0 (myristic)	0,22±0,02	0,28±0,11
C16: 0 (palmitic)	1,51±0,13	1,82±0,13
C18: 0 (stearic)	0,32±0,08	0,43 ±0,03
Monounsaturated		
C14: 1 (myristolein)	0,01±0,09	0,02±0,23
C16: 1 (palmitoleic)	0,21±0,15	0,29±0,13
C18: 1 (oleic)	1,0±0,09	1,20 ±0,18
Polyunsaturated		
C18: 2 (linoleum)	1,15±0,07	1,48±0,06
C18: 3 (linolenic)	0,19±0,13	0,29±0,09
Number of fatty acids	4,83	5,81
p<0,05-0,01		

IV. CONCLUSION

1,1 dimethylhydrazine, thus, results in a liver malfunctioning, including the synthesis of amino acids. In our opinion, the lowering of the level of many amino acids can be due to their detoxifying role in the body. Methionine refers to amino acids with detoxifying properties and cystine - to anticarcinogenic properties.

The toxin has a negative effect on the quantitative indicators of the vitamin composition of the rabbit muscular tissue, the content of all water- and fat-soluble vitamins, and on the mineral metabolism and fatty acid composition.

ACKNOWLEDGMENT

We express our gratitude to the Experimental regional laboratory of the engineering profile "Scientific Center of Radio Ecological Researches" of Governmental University of Shakarim,Semey- Duysembaev Sergazy Turlybekovich and collective analytical laboratory "Garysh-ecology" from Zhezkazgan for assistance in investigations.

REFERENCES

[1] Adushkin VV, Kozlov SI, Petrov A.V. Ecological problems and risks of impacts of rocket and space technology on a full-fledged environment: reference book. - M., 2000. -28 p.
[2] Development of a system of criteria for environmental sustainability of the territory of the Republic of Kazakhstan, environmental and hygienic standards and standards for the permissible impact of the operation of rocket and space equipment on environmental objects: Report on research (interim) / Subs. State. Pref. "Infrakos-Ecos"; Hand. Zhubatov Zh., Kozlovsky VA - Almaty, 2006. - 180 p. No. ГР 0105РК00170; Inv. No. 0206RK01094.
[3] Karimov M.Sh., Duisenbekov S.L., Mirzadunov R.A. Pollution and disturbance of soil and vegetation cover of areas of falling parts of missiles, / / Theses dokl. Conf. "Results of the implementation of programs to assess the impact of carrier rocket launches from the Baikonur cosmodrome on the environment and public health." - Almaty; Karaganda, 2006. - P. 48-55.Ponomarev A. / Facts Only / Beekeeping. - 2009.- № 4. - P.21.
[4] Kulmakhanov Sh.K. Kazakhstan's preparedness plan for natural disasters. - Almaty, 2002. - 256 p.
[5] Sakhno VI, Zakharov GI, Karlin NE, Pilnik NM Organization of medical care for the population in emergency situations: a training manual. - St. Petersburg: Publishing house "Publishing house FOLIO", 2003. - 248 p.
[6] Bochkov NP, Chebotarev AN Human heredity and mutagens of the environment. - Moscow: Medicine, 1989. - 272 p.
[7] Egorov N.S. Workshop on microbiology. - Moscow: Izd-vo MGU, 1976. - 307 p.
[8] Sergeeva A.V. Analysis of the impact of rocket and space activities on the environment // Service in Russia and abroad. - 2007. - №4. - P. 96-106.
[9] Panin LE Medico-social and ecological problems of using rockets on liquid fuel (heptile) // http://old.soramn.ru/Journal/2006/N1/124-131.pdf. 2.04.2015.
[10] Belov A. To the question of toxicity and danger of hydrazine and its derivatives // medved.kiev.na/arhiv_mg/.
[11] Smith E.B., Clark D.A. Absorption of hydrazine throygh canines kin // Toxicol. appl. Pharmacol. - 1972. - Vol. 21. - P. 186-193.
[12] Ardashov A.A. Dynamics of the Angara carrier rocket. - St. Petersburg: VIKA named after A.F. Mozhaiskogo, 1998. – 134 c.