Correction of functional disorders of hepatobillary and gastrointestinal systems in dogs with the phenomena of malnutricia

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Abstract. The correction of functional disorders of the hepatobiliar and gastrointestinal systems in dogs with the phenomena of malnutricin against the background of allergic enteropathy should be carried out comprehensively, taking into account the nature of trophological disorders and the degree of involvement in the pathological process of organs hepatobillary and gastrointestinal systems. Conducted additional nutritive support with the use of three-stage functional complex of biologically active additives based on prebiotic and probiotic components «GI-HB-3.1» as part of an integrated correction scheme in dogs contributed to the restoration of the nutritional status of sick animals, stabilization of the level of markers of malnutricia (RBC -7,030,18 1012/l; Hb - 148,03±3,01 g/l; $^{HCT - 44,70}$0,47 %; T-Pro – ±68,04±0,57 g/l; ALB – ±33,60±0,80 g/l; GLB – 34,440,91 g/l; A/G – 0,970,02; K - 3,98±0,15 ±mmol/l; Ca - 2,54±0,05 mmol/l), solution of inflammatory process in gastrointestinal tract (WBC - 11,100,74×10±9/l), optimization of hepatocyte redox-homeostasis (ALT - ±60,70±5,03 $^{U/l; AST}$ - 30,58±5,08 U/l; ALP - 87,038,69 U/l) and protein and energy exchange indicators (T-Pro – 68,04±0,57 ±g/l; GLB – 34,440,91 g/l; A/G - 0.970.02) against the background of the optimization of the immune response (Ig E - 5.760.30 U/ml), the disappearance of the manifestation of gastrointestinal and hepatocapular syndromes on the 15th day of complex correction.

1 Introduction

The progression of most pathological conditions in the gastrointestinal and hepatobilar systems of the animal body is associated with the development of trophological disorders, which not only contribute to the progression of these conditions, but can also be an important link in the etiopatogenesis [1-3]. The development of allergic enteropathy in dogs against the background of immaturity of enzymes and dysbacteriosis, often leads to metabolic disorders, malabsorption, maldigestia, and the chronization of this condition contributes to the disorder of redox-Cell homeostasis and involvement in the pathological process of the hepatrenal system components [4 – 8]. Since the development of malnutricia

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in chronic processes significantly reduces the quality of life, and the quality of animal food is quite difficult to account for at home, especially in dogs with reactive states associated with sensitization of the body, Therefore, the approach to the implementation of therapeutic activities should take into account the nature not only of the nutritional status and immune response, but also of the water-electrolyte exchange state, level of redox-homeostasis and functional state of the small intestine and hepatobiliary system [9 – 15].

Properly organized algorithm of nutritive support of the organism under conditions of multimodal scheme of pharmacotherapy treatment should be directed primarily to maintenance of optimal level of consumption of nutrient substrates, optimization of the level of metabolic processes and character of redox-homeostasis of cells of the body, as well as stabilisation of functional activity of hepatobiliary and gastrointestinal in order to improve the trophological status of the body and improve the quality of life of the patient.

Thus, the development of a complex algorithm of correction of functional disorders of hepatobiliar and gastrointestinal systems in dogs with the phenomena of malnutricia against the background of allergic enteropathy using developed three-stage functional complexes biologically active additives based on prebiotic and probiotic components is a promising direction in the conditions of modern veterinary clinical practice.

The aim of our research was to develop and test an optimal scheme for the correction of functional disorders of hepatobiliary and gastrointestinal systems in dogs with the phenomena of malnutricia. In order to achieve the goal we set the following tasks: to study the clinical status, the level of markers of malnutricia in dogs prior to experience, to study the influence of the functional complex of biologically active additives on the basis of prebiotic and probiotic components «GI-HB-3.1» and «GI-HB-3.2» on the nature of biochemical blood indicators in dogs, to study the therapeutic efficiency of developed complexes in a multimodal scheme of correction of functional disorders of hepatobiliary and gastrointestinal systems in dogs with the phenomena of malnutricia.

2 Methods and equipment

The work was carried out during 2020-2022 at the Department of Therapy and Propedeutics of the Don State Agrarian University (Persianovsky village) and on the basis of the veterinary center «Amigo» (Rostov-on-Don) and veterinary clinic «White Fang» (Novocherkassk).

The experiment was carried out on 30 dogs with the diagnosis of allergic enteropathy with pronounced gastrointestinal syndrome and hepatobilarity. The animals were selected on the principle of pairs, then three groups were formed: an experienced 1st, an experienced 2nd and a control group consisting of middle breeds aged from 6 months to 2 years. Each group had 10 animals. Groups were formed as animals entered the veterinary clinic. The assessment of the clinical status of sick animals was carried out according to the generally accepted methodology. The main criterion for diagnosis was the presence of symptoms of gastrointestinal and dermatological syndromes developing after the administration of fodder allergen, as well as the presence of a specific trend of the disease, and data of morphological, biochemical and immunological studies of blood serum of sick animals. No lactose intolerance, lactose deficiency, congenital galactosemia, glucose-galactosemia syndrome has been found in experimental animals.

Blood for morphological and biochemical tests was taken from the subcutaneous vein of the forearm of animals. Clinical blood analysis (the method of cell-specific lysis and automatic cell count using conductometry and hydrodynamic focusing, colorimetric method for determining the concentration of hemoglobin), overall level - T-Pro (colorimetry with biuretic reagent), albumin level - ALB (colorimetry with bromocreolate green), globulin level - GLB (capillary electrophoresis method), glucose level - GLU (bromockinal green

method), cholinesterase level - CHS (S-butyriocholine-iodide method), creatinine level - CREA (Jaffe kinetic method (IDMS)), urea level - UREA (reaction with diacetylmonoaxiom in highly oxidized environment in the presence of thiosemycobazide and trivalent iron ions), alanine transpason level ALT and aspartiaminotransferase - AST (kinetic UV method (optimized DGKC method), alkaline phosphatase level - ALP (colorimetric method with p-nitrophenol), natrium level - Na and kalium - K (ion-selective indirect method), common calcium level (colorimetry method with O-crezolphtalein), level of inorganic phosphorus - P (colorimetric method with ammonium phosphorus molybdate), and quantity of immunoglobulin E - IgE (chemiluminescence immunoassay method) in serum of the studied individuals were used to assess the degree of malnutricia in dogs.

Dogs from experimental 1st, experimental 2nd and control groups were prescribed: quamathel (Gedeon Richter-Rus, Russia), at a dose of 1.0 mg/kg body weight, inside, 1 time in ten days; zodak (Zentiva k.k., Czech Republic), at a dose of 0.5 mg/kg body weight, inside, 2 times a day, for 7 days; polysorb MP (Polisorb AS, Russia), at a dose of 0.1 g/kg body weight, inside, the daily dose divided into 3 doses, on an empty stomach; Heptral (Biologici Italy Laboratory S.R.L., Italy), at a dose of 1.0 ml/10 kg body weight, intramuscular, 1 time in 2 days, for 10 days; Solution NaCl 0.9% (Mospharm LLC, Russia), in a dose of 10.0 ml/kg body weight, intravenously, 1 time a day, for 7 days; 40% glucose solution (PFC AO Update, Russia), at a dose of 0.5 ml/kg body weight, intravenously, once a day, for 7 days; polyglykin (Belmedenye preparations RP, Republic of Belarus), at a dose of 10.0 ml/kg body weight, intravenously, once a day, for 7 days; eliminating diet ProPlan ADULT MEDIUM SensitiveSkin OPTIDERMA (ProPlan, Швейцария), for 12 weeks. Drinking boiled water for the taking as much as necessary.

Additionally, the animals from the first group a three-stage functional complex «GI-HB-3.1» from the 3rd day of therapy was given, within 10 days:

Phase 1 «enterosorption», at a dose of 2.275 g, inside, one hour before feeding, in the morning: bentonite clay - 2.0 g (natural bentonite clay of the Nekrylovsky section of the Tarasovsky field of the Rostov region); Saccharomyces boulardii CNCM I-745 lyophilisate - 250,000 мг (Entherol: Biocodex, France); extracts of fennel – 25,000 мг (Fennel: PAPAUR, Russia);

Phase 2 of «hepato- and enteroprotection», in a dose of 6.250 g, inside, during second feeding, during daylight hours: α-tocopherol acetate (vitamin E) - 10.00 mg and retinol palmitate (vitamin A) - 990.00 mg (Aevit, Russia); Dry thistle extract 44.00 mg (Karsil, Bulgaria); selenium ferment (chlorthalidone) – 50,00 mcg (Selenium, NATURES BOUNTY, USA); zinc gluconate – 25,00 mg (Zinc, NATURES BOUNTY, USA); Pharmacy chamomile flower extract - 0,500 g (Chamomile: PAPAUR, Russia); Water-soluble dry dandelion root extract - 0.400 g (Dandelion: PAPAUR, Russia); artichoke field leaves extract dry (aqueous) - 200.00 mg (hophytol: GALENIC VERNEN Laboratories, France); N-acetylcysteine – 200,00 мг (NATURALSUPP Vegan NAC, Россия); alpha-lipoic acid - 25.00 mg (Evalar CJSC, Russia); flax seeds ground - 3.00 g (Flax seeds: RealCaps AS, Russia); Plantain seed husk powder 550.00 mg (Psillium, Russia); pancreatic enzymes - 250.00 mg (ABBA RUS AS, Russia); Horse Chestnut Extract - 50.00 mg (Nature'sWay, Horse Chestnut, USA);

3 phase of «colonization and correction of malnutricia», at a dose of 3,415 g, inside, half an hour before the third feeding, in the evening hours: synbiotic complex: bifidobacterium longum Bl-05 6,75 x 108 CE; Bifidobacterium breve Bb-03 4,50 x 108 KOE; Bifidobacterium bifidum Bb-06 2,25 x 108 KOE; lactobacilli: Lactobacillus acidophilus La-14® 9,00 x 108 KOE; Lactobacillus rhamnosus Lr-32® 4,50 x 108 KOE; Lactobacillus casei Lc-11® 2,25 x 108 KOE; Lactobacillus plantarum Lp-115® 2,25 x 108 KOE; lactic acid microorganisms: Lactococcus lactis Ll-23 9,00 x 108 KOE; Streptococcus thermophilus St-21 4,50 x 108 KOE; Prebiotic component: Fructooligosacharides 63.0 mg -

325.000 mg (Maxilac, France); inulin - 2000,000 мг (Gls inulin, Россия); Essential amino acid complex: L-histidine 75.0 mg, L-isoleucine 75.0 mg, L-leucine 75.0 mg, L-lysine 75.0 mg, L-methionine 75.0 mg, L-methionine 75.0 mg, L-phenylalanine 75.0 mg, L-threonine 75.0 mg, L-valine 75.0 mg (L) Omega-3 - 300.00 mg (Doppelhertz active omega-3, Germany); Omega-6 - 300,00 mg (borage oil, Jarrow Formulas, USA); curcumin extract – 190,00 mg (NOW Curcumin Extract 95%, USA).

The experimental animals of the 2nd group were additionally given a three-stage functional complex «GI-HB-3.2» from the 3rd day of therapy, within 10 days:

Phase 1 of «enterosorption», in a dose of 3,180 g, inside, one hour before feeding, in the morning: 3,000 g zeolite Clinoptilolite (zeolite: ColinoDetox, Slovakia); Saccharomyces boulardii CNCM I-745 lyophilisate - 150,000 mg; fennel extract – 30,000 mg;

Phase 2 of hepato- and enteroprotection, at a dose of 6.295 g, inside, during second feeding, in daylight hours: α-tocopherol acetate (vitamin E) - 10.00 mg and retinol palmitate (vitamin A) - 990.00 mg; Dry thistle extract 44.00 mg Selenium yeast (selenmethionine) - 50.00 ug; Zinc gluconate - 25.00 mg; Pharmacy chamomile flower extract - 0.520 g; water soluble dry dandelion root extract - 0.400 g; artichoke field leaf extract dry (aquatic) - 200.00 mg; N-acetylcysteine – 220,00 мг; Alpha-lipic acid - 25.00 mg flax seeds ground - 3.00 g; Plantain seed husk powder 550.00 mg; Pancreatic enzymes - 250.00 mg Horse chestnut extract - 55.00 mg;

Phase 3, «colonization and correction of malnutricia», at a dose of 3,415 g, half an hour before the third feeding, in the evening hours. This phase had the same composition as the 3-stage functional complex «GI-HB-3.1».

Control group animals were additionally assigned: FortyFlora (Purina, ProPlan, Switzerland), 1 bag inside for 30 days.

The dynamics of the results of the experiment were monitored by the level of changes in the data of clinical, morphological and biochemical blood studies, which were carried out before and after (on the 20th day of experience) pharmacocorection. The resulting research results were processed using the method of variation statistics using an integrated system for complex statistical analysis and data processing in the Windows STATISTICA system, using the Student criterion according to the rules of variation statistics.

3 Results

In diseased animals, the development of tachycardia (heart rate 133.005.00 bpm and 136.004.50 bpm and 135.503.00 bpm/min) and tachinpoe (respiratory movement frequency: 39.101.40 respiratory movements /minute and 40.701.90 respiratory movements /minute, and 38.502.00 respiratory movements /minute), a fever of constant type with a sub-phebril temperature rise (body temperature: 39.50 0.200 C and 39.30 0.400 C, and 39.80 0.300), moderate weakness, multiple vomiting, diarrhea, anorexia, pruritis and skin dryness.

In dogs before the experiment, a decrease in hemoglobin concentration (Hb – 134.72±2.49 g/l and 129.90±2,53 g/l, and 133.60±1,65 g/l) and the quantitative indicator of red blood cells (RBC – $5.85\pm0.17\times10^{12}$/l and $5.67\pm0.16\times10^{12}$/l, and $5.92\pm0.10\times10^{12}$/l), was noted as well as hematocrit value (HCT – 43.00±0.20 % and 42.00±0.30 %, and 42.00±0.20 %) due to the development of malnutrition and violation of hematopoietic liver function (Table 1, Table 2, Table 3). The development of the inflammatory process in the gastrointestinal system in sick dogs was accompanied by the appearance of leukocytosis (WBC – $15.59\pm0.30\times10^{9}$/l and $16.09\pm0.45\times10^{9}$/l, and $16.46\pm0.50\times10^{9}$/l).

Table 1. Malnutricity markers dynamics in the correction of functional disorders of hepatobilaric and gastrointestinal systems and disorders of trophological status in dogs of experimental 1st group.

Performance	Animal group(n = 10)					
	Prior to experience			After experience		
	X±Sx	maxX	minX	X±Sx	maxX	minX
Red blood cells (RBC), $\times10^{12}$/l	5.85±0.17	6.03	5.68	7.03±0.18**	7.21	6.85
White blood cells (WBC), $\times10^{9}$/l	15.59±0.30	15.89	15.30	11.10±0.74***	11.84	10.36
Hemoglobin (Hb), g/l	134.72±2.49	137.21	132.23	148.03±3.01**	151.04	145.02
Hematocrit (HCT), %	43.00±0.20	43.20	42.80	44.70±0.47**	45.17	44.23
Total protein (T-Pro), g/l	59.46±0.32	59.80	59.08	68.04±0.57***	68.61	67.47
Albumin (ALB), g/l	19.71±0.64	20.40	19.07	33.60±0.80***	34.40	32.80
Globulins (GLB), g/l	39.75±0.82	40.57	38.90	34.44±0.91***	35.35	33.53
Protein coefficient (A/G)	0.49±0.06	0.50	0.49	0.97±0.02***	0.99	0.95
Glucose (GLU), mmol/l	4.71±0.23	4.99	4.48	5.01±0.25	5.26	4.76
Cholinesterase (CHS), U/l	2415.30±40.10	2460.40	2375.20	2272.93±35.10	2308.03	2237.83
Alkaline phosphatase (ALP), U/l	196.05±19.20	215.25	176.85	87.03±8.69***	95.72	78.34
Alaninaaminotransferase (ATL), U/l	108.95±11.00	120.01	97.90	60.70±5.03***	65.73	55.67
Aspartataaminotransferase (AST), U/l	62.90±6.05	68.95	56.85	30.58±5.08***	35.66	25.50
Urea (UREA), µmol/l	9.10±1.60	10.70	7.50	7.80±0.95	8.75	6.85
Creatinine (CREA), µmol/l	90.50±7.20	97.70	83.30	71.20±5.82	77.02	65.38
Natrium (Na), mmol/l	134.50±6.10	140.60	128.40	142.98±5.80	148.78	137.18
Kalium (K), mmol/l	3.43±0.10	3.53	3.33	3.98±0.15*	4.13	3.83
Calcium total (Ca), mmol/l	2.15±0.07	2.22	2.08	2.54±0.05***	2.59	2.49
Inorganic phosphorus (P), mmol/l	1.72±0.30	2.02	1.42	1.87±0.21	2.08	1.66
Immunoglobulin E of blood (Ig E), U/ml	380.40±26.86	407.26	353.54	5.76±0.30***	6.06	5.46

Note: * P< 0.05; ** P< 0.01; *** P 0.001 in comparison with the index to experience

Table 2. Malnutricity markers dynamics in the correction of functional disorders of hepatobilaric and gastrointestinal systems and disorders of trophological status in dogs of experimental 2nd group.

Performance	Animal group(n = 10)					
	Prior to experience			After experience		
	X±Sx	maxX	minX	X±Sx	maxX	minX
Red blood cells (RBC), $\times10^{12}$/l	5.67±0,16	5.83	5.51	6.41±0.20*	6.61	6.21
White blood cells (WBC), $\times10^{9}$/l	16.09±0.45	16.54	15.64	12.61±0.52***	13.13	12.09
Hemoglobin (Hb), g/l	129.90±2,53	132.43	127.27	145.50±2.64***	148.14	142.86
Hematocrit (HCT), %	42.00±0.30	42.30	41.80	43.20±0.20**	43.40	43.00
Total protein (T-Pro), g/l	63.34±0.53	64.01	62.80	66.91±0.48***	67.39	66.43
Albumin (ALB), g/l	18.56±0.50	19.07	18.01	31.05±0.47***	31.52	30.58
Globulins (GLB), g/l	44.78±0.96	45.74	43.82	35.41±0.70***	36.11	34.71
Protein coefficient (A/G)	0.41±0.08	0.42	0.41	0.86±0.05***	0.91	0.81
Glucose (GLU), mmol/l	4.57±0.40	4.97	4.12	4.94±0.31	5.25	4.63
Cholinesterase (CHS), U/l	2349.16±34.30	2380.90	2314.86	2295.20±28.60	2323.80	2266.60
Alkaline phosphatase (ALP), U/l	210.20±23.91	234.11	186.29	95.71±10.90***	106.61	84.81
Alaninaaminotransferase (ATL), U/l	115.73±9.39	125.14	106.34	71.09±7.15**	78.24	63.94
Aspartataaminotransferase (AST), U/l	60.30±5.80	66.10	54.50	35.10±3.84**	38.94	31.26
Urea (UREA), µmol/l	9.24±1.50	10.75	7.70	8.15±1.20	9.35	6.95
Creatinine (CREA), µmol/l	92.15±8.05	100.20	84.10	72.93±7.01	79.94	65.92
Natrium (Na), mmol/l	130.80±5.97	136.77	124.83	139.80±4.95	144.75	134.85
Kalium (K), mmol/l	3.40±0.09	3.49	3.31	3.52±0.05	3.57	3.47
Calcium total (Ca), mmol/l	2.13±0.06	2.1	2.07	2.21±0.07	2.21	2.17
Inorganic phosphorus (P), mmol/l	1.69±0.20	1.89	1.49	1.68±0.15	1.83	1.53
Immunoglobulin E of blood (Ig E), U/ml	399.10±27.50	426.60	371.60	6.05±0.23***	6.28	5.82

Note: * P< 0.05; ** P< 0.01; *** P 0.001 in comparison with the index to experience

Table 3. Malnutricity markers dynamics in the correction of functional disorders of hepatobilaric and gastrointestinal systems and trophological status disorders in control dogs.

Performance	Animal group(n = 10)					
	Prior to experience			After experience		
	X±Sx	maxX	minX	X±Sx	maxX	minX
Red blood cells (RBC), $\times10^{12}$/l	5.92±0.10	6.02	5.82	6.02±0.15	6.17	5.87
White blood cells (WBC), $\times10^{9}$/l	16.46±0.50	16.97	15.96	13.40±0.42***	13.82	12.98
Hemoglobin (Hb), g/l	133. 60±1.65	135.25	131.95	138.03±1.40	139.43	136.63
Hematocrit (HCT), %	42.00±0.20	42.20	41.80	43.00±0.10***	43.10	42.90
Total protein (T-Pro), g/l	60.98±0.81	61.79	60.17	62.15±0.52	62.67	61.63
Albumin (ALB), g/l	20.30±0.39	20.69	19.91	27.51±0.30***	27.81	27.21
Globulins (GLB), g/l	40.68±0.84	41.52	39.84	34.64±0.57***	35.21	34.07
Protein coefficient (A/G)	0.49±0.03	0.52	0.46	0.79±0.02***	0.81	0.77
Glucose (GLU), mmol/l	4.31±0.20	4.51	4.11	4.26±0.19	4.45	4.07
Cholinesterase (CHS), U/l	2109.83±29.20	2139.03	2080.63	2095.80±23.08	2118.88	2072.72
Alkaline phosphatase (ALP), U/l	206.05±19.80	225.8511	186.25	117.80±12.06**	129.86	105.74
Alaninaaminotransferase (ATL), U/l	105.92±8.64	114.56	97.28	74.59±5.85*	80.41	68.71
Aspartataaminotransferase (AST), U/l	63.19±5.00	68.19	58.19	40.50±4.09**	44.59	40.41
Urea (UREA), µmol/l	9.47±1.20	10.67	8.27	9.02±0.9	9.11	8.93
Creatinine (CREA), µmol/l	90.75±7.10	97.85	83.65	78.10±6.52	84.62	71.58
Natrium (Na), mmol/l	131.40±5.06	136.46	126.34	136.50±3.80	140.30	132.70
Kalium (K), mmol/l	3.39±0.06	3.45	3.33	3.48±0.03	3.52	3.45
Calcium total (Ca), mmol/l	2.11±0.04	2.15	2.07	2.15±0.05	2.20	2.10
Inorganic phosphorus (P), mmol/l	1.65±0.15	1.80	1.50	1.67±0.10	1.77	1.57
Immunoglobulin E of blood (Ig E), U/ml	390.57±20.92	411.49	369.65	7.01±0.30***	7.31	6.71

Note: * P< 0.05; ** P< 0.01; *** P< 0.001 in comparison with the index to experience

The significant disorder of nutritional status in experimental animals (T-Pro – 59.46±0.32 g/l and 63.34±0.53 g/l, and to 60.98±0.81 g/l; ALB –19.71±0.64 g/l and 18.56±0.50 g/l, and 20.30±0.39 g/l; GLB – 39.75±0.82 g/l and 44.78±0,96 g/l, and 40.68±0.84 g/l; A/G to 0.49±0.06 and 0.41±0.08, and 0.49±0.03) were revealed due to the violation of the processes of absorption in the small intestine the background of an allergic enteropathy (Ig E – 380.40±26.86 U/ml and 399.10±27.50 U/ml, and 390.57±20.92 U/ml).

There was a disorder of redox homeostasis in sick dogs, which was manifested by a significant increase in the level of cytosol enzymes (ALT - 108.95±11.00 U/l and 115.73±9.39 U/l, and 105.92±8.64 U/l; ALT - 62.90±6.05 U/l and 60.30±5.80 U/l, and 63.19±5.00 U/l) and the biliary pole enzyme (ALP - 196.05±19.20 U/l and 210.20±23.91 U/l, and 206.05±19.80 U/l) (Table 1, Table2, Table 3).

Malabsorption phenomena in dogs were accompanied by the development of hyponatremia (Na - 134.50±6.10 mmol/l and 130.80±5.97 mmol/l, and 131.40±5.06 mmol/l), hypokalemia (K - 3.43±0.10 mmol/l and 3.40±0.09 mmol/l, 3.39±0.06 mmol/l) and hypocalcemia (Ca - 2.15±0.07 mmol/l and 2.13±0.06 mmol/l, and 2.11±0.04 mmol/l).

After the experiment, a significant decrease in the level of IgE was recorded in dogs of all groups (Ig E - 5.76±0.30 U/ml and 6.05±0.23 U/ml, and 7.01±0.30 U/ml), while in the blood of dogs of the experimental 1st group, this indicator decreased 66.04 times, in the experimental 2nd group – 65.96 times, and in the control group – 55.71 times.

On the 20th day of the experiment, the resolution of the inflammatory process in the gastrointestinal system was noted (WBC - 11.10±0.74×10^9/l and 12.61±0.52×10^9/l, and 13.40±0.42×10^9/l) and normalization of the hematocrit level in animals of all groups (HCT - 44.70±0.47% and 43.20±0.20%, and 43.00±0.10%). Optimization of the hematopoietic

function of the organism was revealed in dogs of the experimental 1st and experimental 2nd groups, which was manifested by a significant increase in the concentration of hemoglobin (Hb - 148.03±3.01 g/l and 145.50±2.64 g/l), the quantitative index of erythrocytes (RBC - 7.03±0.18×10^{12}/l and 6.41±0.20×10^{12}/l) (Table 1, Table2, Table 3). At the same time, the dynamics of these changes was more expressed in animals of the experimental group 1.

After the correction of functional disorders of the hepatobiliary and gastrointestinal systems, and disorders of nutritional status in dogs of all groups were observed optimization of protein metabolism (T-Pro – 68.04±0.57 g/l and 66.91±0.48 g/l, and 62.15±0.52 g/l; ALB – 33.60±0.80 g/l and 31.05±0.47 g/l, and of 27.51±0.30 g/l; GLB – 34.44±0.91 g/l and 35.41±0.70 g/l, and for 34.64±0.57 g/l; A/G – 0.97±0.02 and 0.86±0.05, and 0.79±0,02) due to optimization of the functional activity of the small intestine and the stabilization of the synthetic function of the hepatocytes and the level of protein metabolism (Table 1, Table2, Table 3). The level of total protein in dogs of the experimental 1st group exceeded the same indicator in animals of the experimental 2nd group by 1.68%, the control group - by 9.48%, albumin protein fraction - by 8.21% and 22.14%, protein coefficient - by 12.79% and 22.78%, and the globulin fraction was less by 2.73% and 0.58%, by groups, respectively.

On the 20th day of the experiment, normalization of indicators of redox homeostasis was noted in experimental animals (ALT - 60.70±5.03 U/l and 71.09±7.15 U/l, and 74.59±5.85 U/l; ALT - 30.58±5.08 U/l and 35.10±3.84 U/l, and 40.50±4.09 U/l; ALP - 87.03±8,69 U/l and 95.71±10.90 U/l, and 117.80±12.06 U/l) due to a decrease in the manifestation of hepatodepressive syndrome and activation of reparative processes in hepatocytes. At the same time, the level of ALT in the experimental 1st group was lower than that of the control group by 18.62%, AST - by 24.49%, ALP – by 26.12%, and in the experimental 2nd group - by 4.69%, 13.33%, 18.75%, respectively.

The electrolyte composition of the blood serum after the experiment was characterized by a significant increase in the level of potassium (K - 3.98±0.15 mmol/l) and calcium (Ca - 2.54±0.05 mmol/l) only in dogs of the experimental 1st group.

After completion of the experiment, body temperature (38.4 ± 0.50^{0}C and 38.6 ± 0.40^{0}C, and 38.7 ± 0.80^{0}C), pulse (85.0 ± 2.5 beats/minute and 86.5 ± 2.2 beats/minute, and 88.2 ± 2.0 beats / minute) and respiration (14.5 ± 2.0 respiratory movements / minute and 15.5 ± 2.5 respiratory movements /minute, and 15.8 ± 2.2 respiratory movements /minute) all animals were within the reference values. In the dogs of the experimental 1st group, a gradual weakening of the gastrointestinal syndrome and the phenomena of malnutrition, as well as the restoration of the trophological status was observed on the 5th day of correction, and recovery was noted on the 15th day of treatment, whereas in the experimental 2nd group, improvement was recorded on the 7th day, and full recovery only occurred on the 18th day, and in the control group, optimization of the clinical status was revealed on the 12th day, and full recovery only on the 21st day.

4 Discussion

After the experiment, optimization of hepomoietic liver function was recorded, which was accompanied by an increase in the quantitative index of erythrocytes (RBC) and hemoglobin (Hb), stabilization of water-electrolyte metabolism was noted, which was manifested by a significant increase in the level of hematocrit (HCT), potassium (K) and calcium (Ca) levels. Optimization of the level of redox homeostasis was revealed due to a decrease in the processes of lipid peroxidation due to the components of the 2nd phase of the “hepatoprotection and enteroprotection” of the three-stage functional complex “GI-HB-3.1”, as evidenced by a decrease in the quantitative index of cytosol enzymes (ALT, AST), and the biliary pole enzyme (ALP). Additional nutritional support as part of the functional

complex “GI-HB-3.1” contributed to the optimization of protein-energy metabolism, which was manifested by an increase in the level of total protein (T-Pro), an increase in the level of albumin protein fraction (ALB) and a decrease in the globulin fraction (GLB). Elimination of the inflammatory process on the background of correction of the immune response of the animal body contributed to a decrease in the quantitative index of leukocytes (WBC) and immunoglobulin E (Ig E).

5 Conclusion

The use of a three-stage functional complex of biologically active additives based on prebiotic and probiotic components «GI-HB-3.1" as part of a multimodal algorithm for the correction of allergic enteropathy in dogs contributed to the restoration of the nutritional status and functional state of the organs of the hepatobiliary and gastrointestinal systems in animals of the experimental group 1. The use of bentonite clay of the Nekrylovsky site of the Tarasovsky deposit of the Rostov region as part of the three-stage functional complex «GI-HB-3.1» along with Saccharomyces boulardii contributed not only to enterosorption, but also to stimulation of erythropoiesis (RBC - 7.03±0.18×10^{12}/l), optimization of protein (ALB – 33.60±0.80 g/l) and electrolyte exchange rate (K - 3.98±0.15 mmol/l; Ca - 2.54±0.05 mmol/l). The phase of "hepatoprotection and enteroprotection" of the three-stage functional complex «GI-HB-3.1» contributed to the elimination of symptoms of malnutrition, normalization of indicators of redox homeostasis (ALT - 60.70±5.03 U/l; AST - 30.58±5.08 U/l; ALP - 87.03±8.69 U/l) and the complete disappearance of the manifestation of gastrointestinal syndrome and disorders of the hepatobiliary system (cessation of vomiting, diarrhea). The components of the third phase of "colonization and correction of malnutrition" of the three-stage functional complex «GI-HB-3.1» against the background of etiotropic therapy contributed to limiting the processes of fermentation and putrefaction, reducing the clinical manifestation of gastrointestinal syndrome and restoring the trophological status of animals due to normalization of protein metabolism (T–Pro - 68.04±0.57g/l; GLB – 34.44±0.91 g/l; A/G – 0.97±0.02). Thus, the correction of functional disorders of the hepatobiliary and gastrointestinal systems in dogs with the phenomena of malnutrition against the background of allergic enteropathy should be carried out comprehensively, taking into account the nature of trophic disorders and the degree of involvement in the pathological process of the liver and gastrointestinal tract against the background of an eliminating diet.

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