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Authors' contributions Please specify the authors' role using this form.	Conceptualization: Park CK. Data curation: Lee SH. Formal analysis: Lee SH. Methodology: Lee SH, Park CK Software: Lee SH. Validation: Lee SH. Investigation: Lee SH, Park CK. Writing - original draft: Lee SH, Park CK. Writing - review & editing: Park CK.
Ethics approval and consent to participate	All procedures that involved the use of animals were approved by the Kangwon National University Institutional Animal Care and Use Committee (KW-210112-1).
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8 Abstract

9 Brine mineral water (BMW) is groundwater near the deep sea, and the mineral component of the BMW is different 10 from the water of the deep sea because the components of BMW are derived from the unique geographical features 11 surrounding it. Recently, BMW has attracted attention due to the unique health-related minerals it possesses; 12 however, the influence of BMW on physiological function has not yet been determined in domestic animals. 13 Therefore, this experiment investigated the influence of BMW on the growth performance, water intake, blood 14 properties, and immunoglobulin levels of serum in growing-finishing pigs. A total of 64 pig barrows (Landrace \times 15 Yorkshire \times Duroc) with an average initial weight of 40.56 \pm 0.17 kg were used in the experiment, and 0%, 2%, 3%, 16 and 5% samples of BMW diluted with freshwater were provided to experimental animals during the 56 days. We 17 found that the gain/feed ratio in the 3% BMW group was significantly higher than that in the 5% BMW group of 18 growing-finishing pigs (p < 0.05). The water intake was significantly increased in the 5% BMW group compared 19 with the other groups (p < 0.05) of growing-finishing pigs. Additionally, the concentrations of red blood cells, 20 hemoglobin, and hematocrit were significantly higher in the 3% BMW group than in the control group. The level of 21 high-density lipoprotein cholesterol was higher in the 3% BMW group than in the 5% BMW group (p < 0.05). 22 Furthermore, immunoglobulin (Ig) G and IgM levels in the serum were significantly higher in the 2% and 3% BMW 23 groups than in the control group (p < 0.05). These results suggest that a dilution of 3% BMW in the intake water 24 could improve the levels of red blood cells and serum immunoglobulins in growing-finishing pigs.

25

Keywords: Brine mineral water, Growth performance, Red blood cells, Immunoglobulin, Growing-finishing pigs

28

Introduction

Deep ocean water below 200 meters has characteristics such as lower temperature, higher mineral nutrient content, and more microelements compared to other seawater [1]. Brine mineral water (BMW), which is derived from deep ocean water and has recently attracted attention due to ionized unique minerals, differs from general deep seawater because its contents depend on the surrounding geographical features [1, 2]. For this reason, BMW contains several unique minerals, such as natural selenium (Se), germanium (Ge), molybdenum (Mo), and vanadium (V); furthermore, it has a beneficial influence in terms of animal physiology because its ratio of calcium ions (Ca) to magnesium (Mg) is optimal for absorption in mammals [3, 4].

36 Pigs have a dietary requirement for certain minerals, including macro- and microminerals [5]. The functions of 37 these minerals range from structural components in some tissues and enzymes to the regulation of metabolism in 38 growing pigs [5]. In particular, BMW contains calcium, chlorine, magnesium, and potassium, which are classified as 39 macrominerals in terms of dietetics for growing pigs [3, 4]. These macrominerals play a role in the development and 40 maintenance of the skeletal system, components of extracellular anions, regulation of enzymatic metabolism, and 41 cofactors of many enzyme systems [5]. Furthermore, microminerals, which include cobalt, copper, and selenium of 42 the BMW, are components of vitamin B_{12} and the enzyme glutathione peroxidase and are involved in the synthesis 43 of hemoglobin [3-5]. Therefore, from the swine dietetics perspective, BMW has the potential to regulate enzymatic 44 metabolism and provide components for the development of tissues, skeletal systems, and enzymes. In a previous 45 study, we determined that the growth performances and factors regarding red blood cells of weaning pigs were 46 improved by intake of diluted BMW, which contains macro- and microminerals [3]. However, the influence of 47 BMW on growth performance and blood characteristics has not yet been studied in growing pigs.

48 Because the usage of antibiotics causes bacterial antibiotic resistance in domestic animals, the addition of 49 antibiotics to feed has become illegal; consequently, disease has become more prevalent in domestic animals. 50 Therefore, more studies on antibiotic substitution [6], enzyme supplements [7], minerals [8], and probiotics [9] have 51 been conducted to enhance the immunity and growth of domestic animals. Furthermore, interest in environmentally 52 friendly farming has been rapidly increasing, with a focus on the effect of natural substances on the growth and 53 immunity of livestock [10, 11]. In this context, BMW can be a valuable source of additive feeding for livestock in 54 terms of environmental friendliness and the intake of natural minerals. In practice, some studies have reported that 55 BMW suppresses cancer cells [4], may be useful for recovering from physical fatigue [2], and may increase the 56 viability of reproductive cells [12].

57 BMW is groundwater that is geographical near the sea, and the concentration of sodium chloride (NaCl) is 58 higher than that of freshwater since BMW is generated from the ocean [3]. From the animal nutrition perspective, 59 salty water and growth performances are negatively correlated for domestic animals, so scientific experiments on 60 diluted BMW intake should be conducted regarding the usage of the feeding system in domestic animals. To solve 61 this task, we investigated the osmotic pressure of diluted BMW with freshwater, and the optimal dilution 62 concentration of BMW for the animal experiment was determined using porcine reproductive cells in a previous 63 study [12]. However, the physiological functions of BMW have not yet been investigated in growing-finishing pigs; 64 therefore, we investigated the effect of BMW on the growth performance, water intake, blood cell composition,65 serum cholesterol, and immunoglobulin of growing-finishing pigs.

66

67

Materials and Methods

68 **Preparation of the BMW**

The BMW was collected from approximately 1,100 meters underground around a coastal peninsula at 500 meters near the coast (37.65541534867342, 129.0508611658692; Geumjin-ri, Okgye-myun, Gangneung-si, Gangwon-do, Republic of Korea) using a water pump system (HA-1688, Han-il, Seoul, Republic of Korea). The collected BMW was laid to sink colloid particles for 48 hours at room temperature, the supernatant was filtered through a 1.0 μm pore size membrane filter (Advantec, Tokyo, Japan). The mineral composition analysis and information were referred to in the previous study [13] and the mineral composition of the BMW is shown in Table 1.

75

76 Animals and experimental design

77 All procedures that involved the use of animals were followed by the Kangwon National University Institutional 78 Animal Care and Use Committee (KW-210112-1). The BMW was diluted with freshwater until 0, 2, 3, and 5 % in 79 300 liters water tanks (Nwel, Seoul, South Korea) before intake by experimental animals through a water supply 80 pipe [3]. A total of 64 castrated pigs (Landrace \times Yorkshire \times Duroc) with initial body weight (BW) of 40.56 \pm 0.17 81 kg were randomly divided into four groups (n = 4 per group, 4 replicates per group) based on their BW. The 82 treatment groups were divided into four as 0% BMW (freshwater), 2% BMW, 3% BMW, and 5% BMW which were 83 utilized in the experiment. The experiment was conducted during the 56 days and was divided into the growing 84 phase (0 to 27 days) and the finishing phase (28 to 56 days). Animals were provided free access to BMW through 85 nipple waterers from water tanks throughout the experiment. All diets were provided in meal form during the 86 experiment. Table 2 lists the ingredient composition of the basal diets. The diets were formulated to meet or exceed 87 the requirements for all nutrients for the growing-finishing pigs [5]. At the beginning and the end of the experiment, 88 body weight and feed intake were measured to determine the average daily gain (ADG), average daily feed intake 89 (ADFI), and gain/feed ratio (G/F). The average daily water intake (L/days) of the pigs is strongly related to ADFI, 90 and it was calculated as (3.053×ADFI, kg) + 0.149 according to the previous study [14]. The average daily intake of 91 the minerals from BMW was calculated based on Table 1.

93 Complete blood corpuscle count

At the end of the experiment, blood from two pigs in each pen was collected from the cervical vein using 18gauge needle syringes (Hwagin, Seoul, Republic of Korea). The blood samples were stored in K₂EDTA micro trainer tubes (Becton–Dickson, NJ, USA) for complete blood corpuscle count (CBC) analysis. Anti-coagulated blood samples in K₂EDTA vacuum tubes were used to measure total red blood cell (RBC), hemoglobin (HGB), hematocrit (HCT), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), white blood cell (WBC) count, and platelet (PLT) levels; all blood cell parameters were assessed using an automatic CBC analyzer (ForCyte; Oxford Science Inc., CA, USA).

101

102 Analysis of biochemical factors and immunoglobulins in the serum

103 The blood was also collected from two pigs in each group and collected blood samples for analysis of 104 biochemical factors, immunoglobulin G (IgG), and IgM were stored in vacutainer serum tubes (Becton–Dickinson). 105 Then, the samples were centrifuged at 4°C and 1,000g for 20 min, the serum was derived from the supernatant of 106 centrifuged blood. The glucose (GLU), total cholesterol (CHOL), high-density lipoprotein (HDL), low-density 107 lipoprotein (LDL), and triglyceride (TG) were analyzed using each parameter strips (Arkray, Kyoto, Japan) and the 108 level of the parameter strip were measured by an automated chemistry analyzer (Spotchem EZ SP-4430, Arkray). 109 Also, the level of IgG and IgM were detected using the IgG (CSB-E06804p, CUSABIO, Wuhan, China) and IgM 110 (CSB-E06805p, CUSABIO) ELISA kit, and all process were followed the manufacturer's instructions. The IgG and 111 IgM density values were read at 450 nm using spectrophotometry.

112

113 Statistical analysis

114 The average of each group (cage) was used for each experiment unit when the ADG, ADFI, G/F, and BW, and 115 intake of minerals from the BMW during water intake were analyzed. Also, the average of the two pigs in each 116 group was used for each experiment unit when the CBC analysis, biochemical analysis, and immunoglobulin levels 117 were analyzed. The BMW level was considered as fixed effect to used to do statistical analysis in various parameters 118 such as growth performance, mineral intake, and blood characteristics. Then, the collected data were analyzed 119 through general linear mean (GLM) by statistical analysis system software (SAS version 9.2; SAS Institute, Cary, 120 NC, USA). Differences were considered to be significant when their probability of occurring by chance was less 121 than 5% (p < 0.05).

122	
123	Results
124	Growth performance
125	The influence of BMW on pig growth during the 56-day experiment is shown in Table 3. The ADG, ADFI, and
126	G/F levels did not significantly differ among the treatment groups, whereas the final BW was lower in the 5% BMW
127	group than in the other treatment groups at the growing phase ($p < 0.05$). Of these results, the G/F was higher in the
128	3% BMW group ($p = 0.391$) than in the other treatment groups at the growing phase. The G/F was also higher in the
129	3% BMW group than in the other BMW groups ($p = 0.067$) at the finishing phase. The final BW was significantly
130	higher in the 3% BMW group than in the 5% BMW group ($p < 0.05$). In particular, the ADG had significantly
131	decreased in the 5% BMW group compared to the other treatment groups during the growing-finishing phase ($p < p$
132	0.05). There was no significant difference between the ADFI and G/F among the treatment groups in the growing-
133	finishing phase.
134	
135	Intake of water and additional minerals from BMW
136	The average daily water and mineral intake from the BMW are shown in Table 4. The water intake was not
137	different among the groups at the growing phase but it significantly increased in the 5% BMW group at the finishing
138	phase ($p < 0.05$). The quantities of ingested Na, Cl, Ca, Mg, and Se from BMW were significantly higher in all the
139	BMW groups than in the control group ($p < 0.05$).
140	
141	Complete blood corpuscle count
142	The RBC, HGB, and HCT levels were significantly higher in the 3% BMW group than in the control group ($p < p$
143	0.05) in growing-finishing pigs (Table 5). However, the MCV, MCH, and MCHC levels did not significantly differ
144	among the groups. Substances in the red blood cells without MCV increased in the BMW groups compared with the
145	control group, but there was no significant difference in WBC and PLT among the treatment groups (Table 5). None
146	of the complete blood corpuscle count levels exceeded the normal range in growing-finishing pigs.
147	
148	Biochemical factors, IgG, and IgM
149	Table 5 shows the effects of BMW on the GLU, CHOL, HDL, LDL, and TG levels during the 56-day
150	experiment. The GLU, CHOL, LDL, and TG levels in the porcine serum did not significantly differ among the

151 groups for up to 56 days; however, the HDL levels were significantly lower in the 5% BMW group than in the 152 control group (p < 0.05). The IgG levels were also higher in the BMW groups than in the control group, particularly 153 in the 2% and 3% BMW groups (Table 5). The IgM levels were also significantly higher in the BMW groups than in 154 the control group, and the level in the 2% BMW group was significantly (p < 0.01) higher than those in the 3% and 155 5% BMW groups in growing-finishing pigs (Table 5).

- 156
- 157

Discussion

158 Natural substances are typically more physically and chemically stable than artificial mixtures, such as chemical 159 products and high molecular substances [15]. In this context, BMW is useful for the addition of multiple complexes 160 to feed because it is composed of valuable minerals that are advantageous for mammalian growth. In practice, BMW 161 has antidiabetic influences in mice [16]; moreover, a study of weaning pigs also found that using BMW improved 162 the feed efficiency and hematological values in weaning pigs [3]. Our study also showed that supplementation with 163 BMW improved the growth performance and red blood cell levels in growing-finishing pigs, but over 5% BMW in 164 the intake water negatively affected growth performance in growing-finishing pigs. Thus, we suggest that diluting 165 intake water with two to three percent of BMW is optimal for the growth performance in growing-finishing pigs. 166 Eventually, we determined that BMW was beneficial for the growth performance of growing-finishing pigs, but we 167 confirmed that supplementation with BMW in the form of water was inefficient from an animal management 168 perspective. Therefore, we strongly suggest that further studies should be conducted on the effect of extracted BMW 169 powder in feed additives on the growth performance of pigs.

170 An appropriate level of sodium and chloride is essential for growth performance and feed efficiency, but 171 excessive amounts cause sodium toxicity and side effects such as nervousness, weakness, and epilepsy, which can 172 cause death [17, 18]. Some studies report that deep-ocean seas and mineral-rich deep-ocean seas contain various 173 beneficial minerals [19, 20]; however, the sodium and chloride concentrations of seawater should be considered 174 when being used by animals and humans because excessive sodium chloride causes dehydration and sodium toxicity 175 [21]. With intake of over 5% BMW, the viability of male reproductive cells decreased and the abnormal morphology 176 increased; in particular, most cells shrank in cell culture medium containing 10% BMW [12]. In our study, the water 177 intake was increased in the BMW groups compared to the control group in finishing pigs; however, there were no 178 differences among the 0, 2, and 3% BMW groups in growing-finishing pigs. We suggest that 2 to 3% BMW may be

the optimal concentration for the intake of beneficial minerals from BMW for the management of growing-finishingpigs.

181 Dehydration and acute contraction of the spleen occur when the red blood cell concentrations are increased, 182 whereas low red blood cell levels cause hemorrhagic anemia, hemolytic anemia, and oligemia in mammals [21]. 183 Furthermore, high levels of hemoglobin cause hemolytic anemia, hemoglobin-free disease, and lipidemia, whereas 184 microcytosis is caused by low hemoglobin. In this study, all BMW groups showed increased red blood cell levels, 185 but none of the parameter levels exceeded the normal range in growing-finishing pigs. These results indicate that 186 BMW is a stable feed additive in growing-finishing pigs. Additionally, selenium is an essential mineral in mammals 187 that protects the membrane of red blood cells from peroxides and supports oxygen transport in blood vessels [22]. 188 Thus, we suggest that the total red blood cell, hemoglobin, and hematocrit levels of the treatment groups were 189 increased due to selenium in the BMW. Based on these results, we will conduct a future study on the effects of the 190 extracted mineral powder derived from BMW on the growth performance, blood characteristics, and immune 191 response in pigs and apply it to study reproductive performance in sows.

White blood cells are classified as granulocytes and agranulocytes; granulocytes are composed of neutrophils, eosinophils, and basophils for the performance phagocytosis, neutralization of poison, transportation of heparin, and storage of peroxidase. Lymphocytes and monocytes in agranulocytes play roles in the production of antibodies, the differentiation of T and B cells, and phagocytosis. In this study, there were no significant differences in white blood cell parameters between the control and BMW groups; however, the white blood cell parameters did not exceed the normal range in growing-finishing pigs. Based on this result, we suggest that BMW does not influence the immune system of pigs through granulocytes and agranulocytes.

199 Cholesterol metabolism is directly related to internal lipids, which influence the growth performance of pigs [5]. 200 LDL and HDL are types of cholesterol; HDL plays an anti-inflammatory and antioxidant role in mammals [23]. 201 HDL is increased by selenium, which has been shown to reduce total cholesterol in rats [24]. Furthermore, copper 202 and selenium supplementation depletes lipid contents in rats [25]. In this study, although the concentration of HDL 203 in porcine serum was significantly lower in the 5% BMW group than in the control group, the HDL levels of the 2% 204 and 3% BMW groups did not significantly differ from that of the control group. We suggest that the selenium of 205 BMW positively regulates the HDL levels of growing-finishing pigs.

When white blood cells are exposed to antigens from external materials, such as microorganisms and viruses, IgM forms pentomic molecule chains, which produce many antibodies [26]. A diet of fermented liquid feed increased

208	IgG concentrations in weaning pigs [27], and the IgG and IgM levels were higher in the BMW groups of this study.
209	Supplementation with BMW increased immunoglobulin, which is directly related to the immune system and may
210	protect growing-finishing pigs from diseases; these results indicate that the addition of BMW diluted with water is
211	beneficial to the growth, red blood cell activity, cholesterol metabolism, and immunity of growing-finishing pigs.
212	Previous studies have reported that supplementation with BMW could improve the growth performance and red
213	blood cell levels of weaning pigs [3]; thus, the continuous intake of BMW could increase growth performance and
214	immunity.
215	
216	Conclusion
217	The addition of BMW improved the feed efficiency and total red blood cell, hemoglobin and hematocrit, HDL
218	cholesterol, IgG, and IgM levels during the growth phase in pigs. The results of this experiment suggest that the
219	addition of 2 to 3% BMW to water improved the growth and immunity of growing-finishing pigs. In conclusion,
220	BMW has the potential to be used as a feed additive for enhancing the immunity and feed efficiency of growing-
221	finishing pig diets.
222	
223	Competing Interests
224	No potential conflict of interest relevant to this article was reported.
225	
226	
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231	Author's Contributions
232	Conceptualization: Park CK.; Data curation: Lee SH.; Formal analysis: Lee SH.; Methodology: Lee SH, Park CK;
233	Software: Lee SH.; Validation: Lee SH.; Investigation: Lee SH, Park CK.; Writing - original draft: Lee SH, Park
234 235	CK.; Writing - review & editing: Park CK.
236	Ethics approval and consent to participate
237	All procedures that involved the use of animals were approved by the Kangwon National University Institutional
238	Animal Care and Use Committee (KW-210112-1).
239	

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298

299

Tables

		Components	Concentration	
	Ca (mg/L)		1,657	
	Mg (mg/L)		995	
	K (mg/L)		205	
	Cl (mg/L)		19,393	
	Na (mg/L)		9,092	
	SO ₄ (mg/L)		4,402	
	Sr (mg/L)		30.40	
	SiO ₂ (mg/L)		13.10	
	Zn (mg/L)		8.46	
	F (mg/L)		2.60	
	I (mg/L)		0.11	
	Ti (mg/L)		0.62	
	Se (µg/L)		480.00	
	V (μg/L)		305.00	
	Mn (µg/L)		16.00	
	Cu (µg/L)		12.00	
	Co (µg/L)		2.80	
	Ge (µg/L)		1.40	
301				
202				
302				
			7	

300 Table 1. Components of the brine mineral water

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304	Table 2	Formulae a	nd chamical	compositio	n of ovr	parimontal	diate for	the growing	r finiching	nine
JU T	1 auto 2.	ronnulae a	ind chemical	compositio	n or eap	Jermentai	ulcus 101	the growing	g-misining	s pigs

Ingredients (%)	Growing phase (0 to 27 days)	Finishing phase (28 to 56 days)
Ingredients (%)		
Corn	46.26	67.86
Soybean meal	34.00	18.76
Animal fat	4.50	3.50
Wheat	11.00	3.69
DCP	0.80	0.80
Limestone	0.60	0.85
Salt	0.30	0.30
DL-Methionine	0.32	0.21
L-Lysine	0.90	1.71
Mineral premix	0.15	0.15
Vitamin premix	0.15	0.15
Choline chloride	0.02	0.02
Total	100.00	100.00
Calculated values		
ME (Kcal/kg)	3,300	3,300
Crude protein (%)	20.00	18.00
Calcium (%)	0.30	0.25
Lysine (%)	1.00	1.00
Methionine and cysteine (%)	0.59	0.48

305 Mineral premix, supplied per kilogram of diet: 45 mg Fe, 0.25 mg Co, 50 mg Cu, 15 mg Mn, 25 mg Zn, 0.35 mg I,
306 0.13 mg Se; Vitamin premix, supplied per kilogram of diet: 16,000 IU vitamin A, 3,000 IU vitamin D₃, 40 IU

307 vitamin E, 5.0mg vitamin K₃, 5.0 mg vitamin B₁, 20 mg vitamin B₂, 4 mg vitamin B₆, 0.08 mg vitamin B₁₂, 40 mg

308 pantothenic acid, 45 mg niacin, 0.15 mg biotin, 0.65 mg folic acid, 12 mg antioxidant

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311 Table 3. Effects of brine mineral water (BMW) on the growth performance in the growing-finishing pigs

Iterree	D	iluted BMW in	CEM			
Items	0	2	3	5	- SEM	<i>p</i> -value
Growing phase						
Initial BW (kg)	40.55	40.98	40.59	40.12	1.499	0.989
ADG (g)	827	817	862	815	12.964	0.084
ADFI (g)	2,123	2,074	2,044	2,047	46.936	0.768
G/F	0.394	0.398	0.424	0.406	0.012	0.391
Final BW (kg)	70.50 ^a	70.83 ^a	69.67 ^a	65.86 ^b	0.996	0.026
Finishing phase						
ADG (g)	1,034	1,050	1,084	945	36.728	0.132
ADFI (g)	3,304 ^b	3,418 ^b	3,391 ^b	3,539ª	48.966	0.042
G/F	0.314	0.307	0.320	0.267	0.013	0.067
Final BW (kg)	99.39ª	99.61ª	99.78ª	92.77 ^b	1.092	0.002
Total phase						
ADG (g)	930 ^{ab}	934 ^{ab}	973ª	880 ^b	18.153	0.037
ADFI (g)	2,713	2,746	2,717	2,793	41.482	0.625
G/F	0.354	0.353	0.372	0.336	0.011	0.205

312 ^{a,b}Means in the same row with different superscripts differ (p < 0.05)

313 Growing phase, 0 to 27 days; Finishing phase, 28 to 56 days; Total phase, 0 to 56 days; BW, body weight; ADG,

314 average daily gain; ADFI, average daily feed intake; G/F, gain/feed ratio; SEM, standard error mean

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317 Table 4. Effect of brine mineral water (BMW) on the daily water intake and intake of minerals of the BMW in the

318 growing-finishing pigs

Itoms	Di	Diluted BMW in intake water (%)				
Items	0	2	3	5	SEM	<i>p</i> -value
Growing phase						
Water (L/day)	6.631	6.482	6.389	6.399	0.143	0.767
Na (g/day)	0.000^{d}	1.179 ^c	1.743 ^b	2.909 ^a	0.050	0.001
Cl (g/day)	0.000^{d}	2.514°	3.717 ^b	6.205 ^a	0.107	0.001
Ca (g/day)	0.000^{d}	0.215°	0.318 ^b	0.530 ^a	0.009	0.001
Mg (g/day)	0.000^{d}	0.129°	0.191 ^b	0.318 ^a	0.005	0.001
Se (mg/day)	0.000^{d}	0.062 ^c	0.092 ^b	0.154 ^a	0.003	0.001
Finishing phase				$\langle \rangle$		
Water (L/day)	10.235 ^b	10.585 ^{ab}	10.502 ^{ab}	10.953ª	0.149	0.042
Na (g/day)	0.000^{d}	1.925°	2.865 ^b	4.979ª	0.031	0.001
Cl (g/day)	0.000^{d}	4.106 ^c	6.110 ^b	10.621ª	0.065	0.001
Ca (g/day)	0.000^{d}	0.351°	0.522 ^b	0.907 ^a	0.006	0.001
Mg (g/day)	0.000^{d}	0.211°	0.313 ^b	0.545 ^a	0.003	0.001
Se (mg/day)	0.000^{d}	0.102 ^c	0.151 ^b	0.263 ^a	0.002	0.001
Total phase						
Water (L/day)	8.433 ^b	8.534 ^{ab}	8.446 ^{ab}	8.676 ^a	0.127	0.042
Na (g/day)	0.000^{d}	1.552°	2.304 ^b	3.944ª	0.035	0.001
Cl (g/day)	0.000^{d}	3.310°	4.914 ^b	8.413 ^a	0.075	0.001
Ca (g/day)	0.000 ^d	0.283°	0.420 ^b	0.719 ^a	0.006	0.001
Mg (g/day)	0.000 ^d	0.170 ^c	0.252 ^b	0.432 ^a	0.004	0.001
Se (mg/day)	0.000 ^d	0.082 ^c	0.122 ^b	0.208 ^a	0.004	0.001

319 a-d Means in the same row with different superscripts differ (p < 0.05)

320 Growing phase, 0 to 27 days; Finishing phase, 28 to 56 days; Total phase, 0 to 56 days; SEM, standard error mean

323	Table 5. Effects	s of brine minera	l water (BMW) o	on the complete bloo	d corpuscle count	t of blood, biochemical
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324	analysis, and immune re	sponse of the serum i	in the growing-fini	ishing pigs (0 to 56 days)
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Itoma	Di	Diluted BMW in intake water (%)				
Items	0	2	3	5	SEM	<i>p</i> -value
Complete blood corpuscle co	ount					
RBC (×10 ⁶ cell/ μ L)	6.963 ^c	7.216 ^{bc}	7.593 ^a	7.296 ^b	0.085	0.006
HGB (g/dL)	13.033 ^b	13.872 ^{ab}	14.561ª	14.172 ^a	0.273	0.033
HCT (%)	38.100 ^b	39.311 ^{ab}	41.539 ^a	38.606 ^{ab}	0.859	0.139
MCV (fL)	54.689	54.494	55.183	55.222	0.724	0.899
MCH (pg)	18.767	19.317	19.294	19.322	0.423	0.765
MCHC (g/dL)	34.344	35.417	34.989	35.172	0.511	0.602
WBC (×10 ⁶ cell/ μ L)	16.639	15.206	18.533	13.433	1.359	0.135
PLT (×10 ⁶ cell/ μ L)	195.333	195.333	160.056	100.778	29.048	0.187
Biochemical analysis						
GLU (mg/dL)	95.389	96.333	103.527	95.167	2.473	0.181
CHOL (mg/dL)	93.444	85.111	98.833	96.111	4.071	0.196
HDL (mg/dL)	35.333ª	33.667 ^{ab}	36.000ª	28.333 ^b	1.563	0.054
LDL (mg/dL)	38.889	38.167	39.611	38.667	0.898	0.798
TG (mg/dL)	47.667	38.556	46.000	31.667	9.902	0.455
Serum immunoglobulins						
IgG (mg/dL)	383.167 ^b	437.111ª	429.556ª	409.500 ^{ab}	8.096	0.017
IgM (mg/dL)	102.889°	138.778ª	121.778 ^b	126.722 ^{ab}	3.348	0.001

325 ^{a-c}Means in the same row with different superscripts differ (p < 0.05)

RBC, red blood cell; HGB, hemoglobin; HCT, hematocrit; MCV, mean corpuscular volume; MCH, mean
corpuscular hemoglobin; MCHC, mean corpuscular hemoglobin concentration; WBC, white blood cell; PLT,
platelet; GLU, glucose; CHOL, total cholesterol; HDL, high-density lipoprotein cholesterol; LDL, low-density
lipoprotein cholesterol; TG, triglyceride; IgG, immunoglobulin G; IgM, immunoglobulin M; SEM, standard error
mean

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