## 9. Poultry Research

(1) Development of geothermal heat pumps (GHPS) for poultry house

The principal objective of this study was to develop a cooling and heating system using geothermal heat pumps (GHPs) for broiler and pure line poultry house. A comparative study was also analyzed between geothermal heat pumps (GHPs) and conventional heating system for broilers and for pure line poultry. Loaded calorie was 1.7 RT for cooling and 9.1 RT for heating in one day old chick. Loaded calorie for 35day old broiler was 58.1 RT for cooling and 34.3 RT for heating. On the other hand, loaded calorie for pure line poultry was 30 RT for cooling and heating. Computer Fluid Dynamic (CFD) was analysed to investigate the effect of GHPs in the poultry house. CFD results showed strong and same air fluid was taken 5minutes to reach the target temperature. In windowless broiler house, it was taken 60minutes from the room temperature 23.8℃ to 32.3℃. In winter season, windowless broiler house, which is installed were GHPs, can control suitable temperature when the outside temperature was -10.8℃. To clean the broiler house for rearing during winter season is very expensive due to high heating cost. But the GHPs system reduces heating cost because it doesn't require more energy for heating. In spring season, concentration of ammonia gas in conventional broiler house and in GHPs broiler house were 16.6 and 11.1 ppm, respectively. The CO_2 level in the conventional house was 3,561 ppm, but in the GHPs broiler house, it was reduced to 2,150 ppm due to sufficient fresh air supply. Fuel consumption of conventional broiler house for heating was 27,381.6l/50,000 heads for one year, but in GHPs broiler house, it was reduced to 5,428.2l. Marketing weight of broilers for unconventional house at 5 weeks of age was 1.9kg, but it was increased to 2.0kg in GHPs broiler house. At 6 weeks of age, broiler marketing weight in conventional broiler house was 2.38kg, but it was increased to 2.5kg in GHPs broiler house. It was found that average final body weight to broiler chickens was increased by 5% due to improved air quality in the GHPs broiler house.
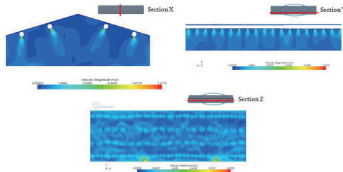
CFD Analysis   Geothermal heat pump system   Applied broiler house

(2) To develop a feeding technology using essential oil originated from Korean pine tree for production performance and meat quality of broilers

In recent global open market situation, food and agriculture is accelerating further due to WTO/DDA trade agreements and FTA between Korea and United States or European Union. The use of idle agricultural products and domestic natural resources becomes more and more important for competitiveness reinforcement and low input sustainable growth of the domestic poultry industry. Therefore, a study was conducted to develop a feeding technology using essential oil originated from Korean pine nut essential oil (KNPE) to measure the effects on growth performance, blood characteristics, and meat quality on broiler chicks.

One thousand and eighty one-day-old male broiler chicks (Ross×Ross 308) were divided into 9 treatment groups with 4 replicates of 30 birds in each group. The treatments were negative control, NC (without antibiotics), Positive Control, PC (avilamycin, 10 ppm and salinomycin, 60 ppm), and 0.02, 0.04 or 0.06% of supplemental KNPE (liquid and ground forms). The effects of dietary supplementation of KNPE on growth performance of broilers were shown in Figure 1. Final body weight and body weight gain were significantly higher in 0.02 and 0.04% KNPE treated groups than in control (NC, PC). Especially, 0.04% KNPE treated groups were better among all of the treatment groups. But, the final body weight, body weight gain, and feed intake of broilers were tended to be decreased in 0.06% KNPE treated groups. Results from blood parameter showed that blood urea nitrogen (BUN), creatinine, total protein (TP), albumin, globulin, and aspartate aminotransferase (AST) were significantly decreased or tended to be decreased in all

treated groups compared to NC. The effects of dietary KNPE on leukocyte composition of broilers were shown in Figure 9-2. The total white blood cell (WBC), heterophil, lymphocyte, and heterophil/lymphocyte ratio which are known as stress indicator were also more significantly decreased or tended to be decreased in all treated groups than NC. Dietary supplementation of KNPE significantly improved meat quality such as pH and water holding capacity of broiler meat compared to control. So, dietary KNPE have positive effects on growth performance, health maintenance, and meat quality of broilers. These results suggest that 0.02-0.04% of KNPE is the optimum supplemental level in the broiler diets and KNPE could serve as an alternative for antibiotic growth promoters or use as a feed additive for high quality chicken meat production.
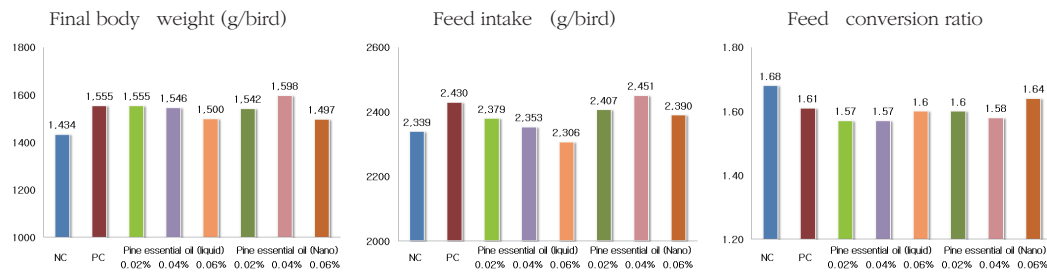

Figure 9-1. Effect of Korean nut pine essential oil on growth performance in chicks
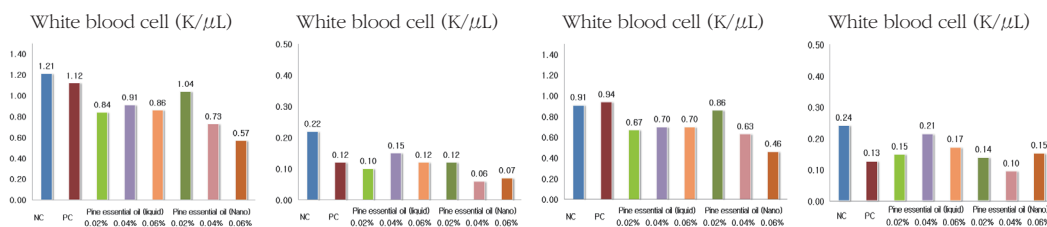

Figure 9-2. Effect of Korean nut pine essential oil on leukocyte composition in chicks

Table 9-1. Effect of Korean nut pine essential oil on meat quality of broiler chicks

	NC	PC	Pine essential oil (liquid)			Pine essential oil (ground)			SEM
			0.02%	0.04%	0.06%	0.02%	0.04%	0.06%	
pH	5.62c	5.86b	5.89b	5.85b	5.89b	6.00a	6.02a	5.85b	0.15
CIE value									
L*	54.13	53.19	54.61	53.45	51.16	49.55	51.50	51.52	3.44
a*	2.67	2.52	2.35	3.40	3.04	3.32	2.29	2.86	1.05
b*	10.59	14.44	9.36	9.57	9.32	7.56	9.51	8.87	2.55
Cooking loss (%)	16.10	14.92	15.62	18.18	18.44	18.72	17.13	15.87	1.84
Shear force (kg/0.5inch2)	2.57	2.77	2.34	2.47	2.74	3.11	3.02	2.88	0.35
Water holding capacity (%)	57.80c	58.79b	60.55a	59.02ab	58.69b	59.01ab	60.36a	61.16a	1.16

(3) Development of rearing technology for reduction of abnormal chicken

This study was conducted to investigate the factors involved with appearance of abnormal chickens and to develop a technology for reducing the damages of external chicken carcass quality by investigating housing environment, feeding program, chicken shipment, slaughtering process, and housing type of chickens.

The comparison results of various farms classified according to the occurrence rate of abnormal chicken carcass have found to be related to the high frequency of broiler housing condition and a large area exposed to sunlight. We found that chickens were injured in the house by visitors or the sunlight. The major risk factors were high stocking density and infrequent changes of litters. The results of investigating the occurrence rate of abnormal chicken carcass according to diet energy density have found that the high energy density diet (fat content: starter 4.1%, finisher 4.8%; occurrence rate: 48.5%) significantly increased abnormal chicken carcass compared to low energy density diet (fat content: starter 3.1%, finisher 3.6% occurrence rate: 39.0%). We investigated the correlation between the growth phase and abnormal chicken carcass and found that the injury of chicken started from the age of 20 days. The pinfeather reduction rate in thigh and back were 20.8, and 56.8%, respectively. In this experiment we found that good

housing management program, the installation of shading curtains, strict bio security, and change of litters at 20 days decreased the abnormal chicken occurrence by 7.6% as compared to control. We also found that the occurrence rate of abnormal chicken carcass was reduced by 0.74% when the coops size increased. The results from the investigation of the effects of electrical stunning and scalding temperature on abnormal chicken occurrence rate at slaughtering process have found that the optimum electrical stunning and scalding temperature were 800KHZ, 40V and 58.5℃, respectively. In another experiment, we found that the occurrence rate of abnormal chicken carcass was decreased by 23.5%, and final body weight increased by 160 g/bird in the elevated chicken house than in the floor house.

Lighting control chicken house   Improved chicken transporter   Elevated chicken house