

[RDA-EMBRAPA Workshop]



Utilization of Probiotics and Plant Extract as Feed Additives for Safe Livestock Production

National Institute of Animal Science, Rural Development Administration

26 March, 2013

Dong-Woon Kim, Ph.D.

Division of Poultry Science
National Institute of Animal Science



CONTENTS

1. BACKGROUND

2. RECENT RESEARCH ACHIEVEMENTS

- SWINE

- POULTRY

3. FUTURE PLAN



BACKGROUND



Use of antibiotics in livestock

❖ Purpose of antibiotics

- Therapeutic use to treat sick animal
- Prophylactic use to prevent infection
- Growth promoting use for better productivity

❖ Use of antibiotics in Korea

- Total amount used : 956 ton (2011)
- Purpose : in feed 11%, therapeutic 89%
- Species : pig 48%, poultry 21%, aquaculture 25%, cattle 6%

Evolution of Bacteria

- Make world fear to antibiotic-resistant super bacteria
 - Warning the danger of super bacterial infection and spreading
 - ※ British Medical Journal 『Lancet』 (Aug, 2010)



Super bacteria infection



Reporting the first case of super bacteria infection in Korea

Ban on antibiotics

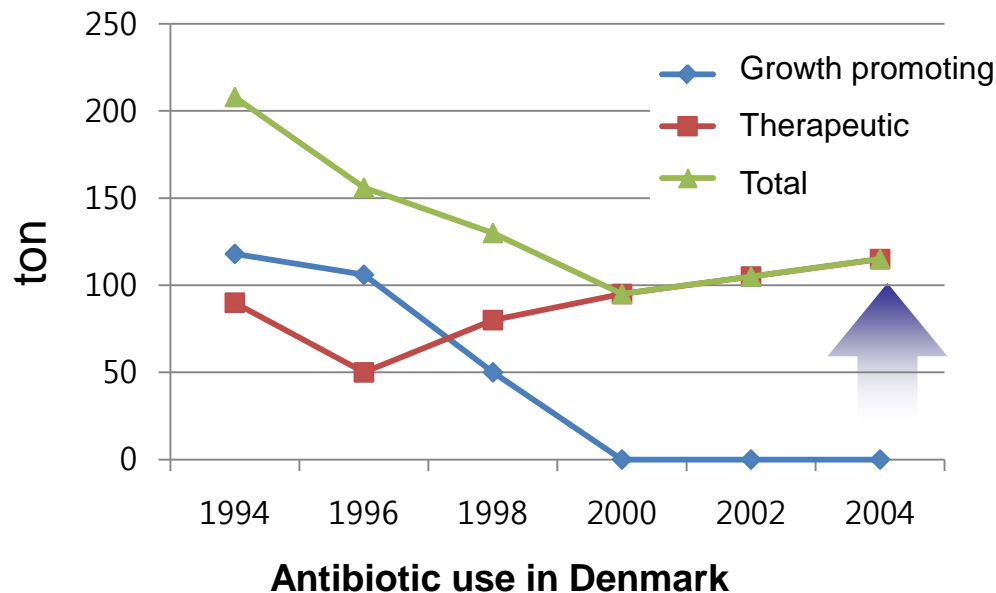
- ❖ Controversy over antibiotic-resistant bacteria and safety issue
 - Antibiotic-resistance as a result of AGPs use in animal feed
 - Increasing interests and demand for safe and eco-friendly animal products
- ❖ Ban on antibiotics in Europe
 - EU : Withdraw all AGPs in feed since 2006
 - Denmark : Ban on AGPs in Finisher pig (1995) and piglet (2000)
- ❖ Korean legislation on AGPs use for safety of animal products
 - AGPs in feed : 44 → 16 (2005) → 9 (2009) → 0 (**July 2011**)

Expected problems after ban on AGPs

- ❖ Higher production cost by reduced growth and increased mortality
 - In EU : About 10% of productivity decrease
 - In Korea : Productivity of antibiotic-free broiler farm reduced by more than 10%
- ❖ Higher treatment cost
 - Hard to maintain good environmental condition due to deteriorated livestock houses (12~15 years old)
 - Necrotic Enteritis (NE), respiratory disease and infectious disease may increase

Changes after ban in EU

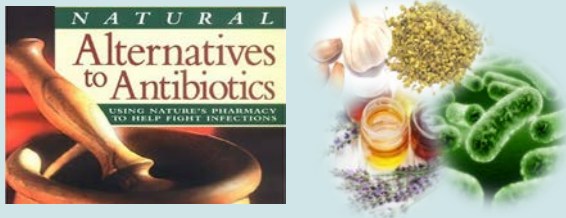
- Decreased antibiotic resistance
 - Vancomycin resistance (VREF) : 80%(1995) → 3%(2005)
- Use of AGPs reduced but therapeutic use of antibiotics increased



- 1995, Denmark ban on avoparcin
- 1999, EU ban on avoparcin, bacitracin, spiramycin, tylosin and virginiamycin

Key to AGP-free livestock farming

Use of antibiotic alternatives



Improvement of animal husbandry practices



EU Scientific Steering Committee (1999)

“Efforts should also be made to replace those antimicrobials promoting growth with no risk of influencing intestinal infections **by non-microbial alternatives**. It is essential that these actions are paralleled by the introduction **of changes in animal husbandry practices** which will maintain animal health and welfare during the phase-out process.”

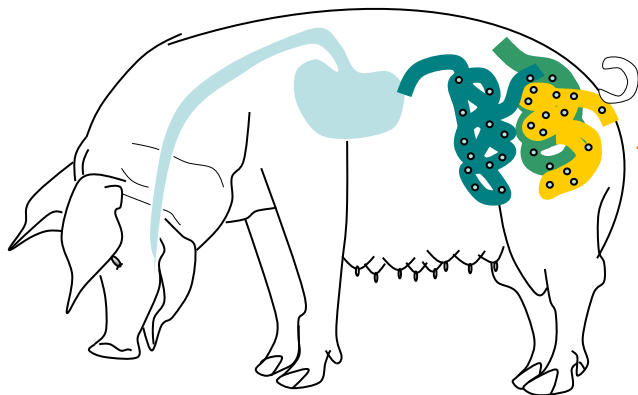
Alternatives to antibiotics

- ❖ Probiotics
- ❖ Prebiotics
- ❖ Acidifiers
- ❖ Plant extract
- ❖ Enzymes
- ❖ Etc.

RECENT RESEARCH IN NIAS

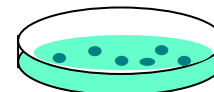


Probiotics for pig

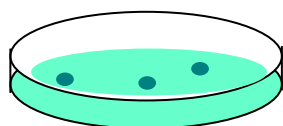


Lactobacillus from
the gut of pig

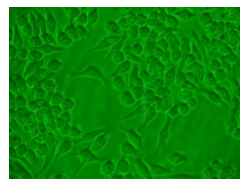
Selective medium
(1st Selection)



Survivability in gut
-Acid-resistance(pH 2.5)
-Bile acid-resistance



Isolation of
Lactobacillus



Macrophage
activation test

❖ Characteristics of developed probiotics



Lactobacillus platarum
Immune stimulation, Antimicrobial effect

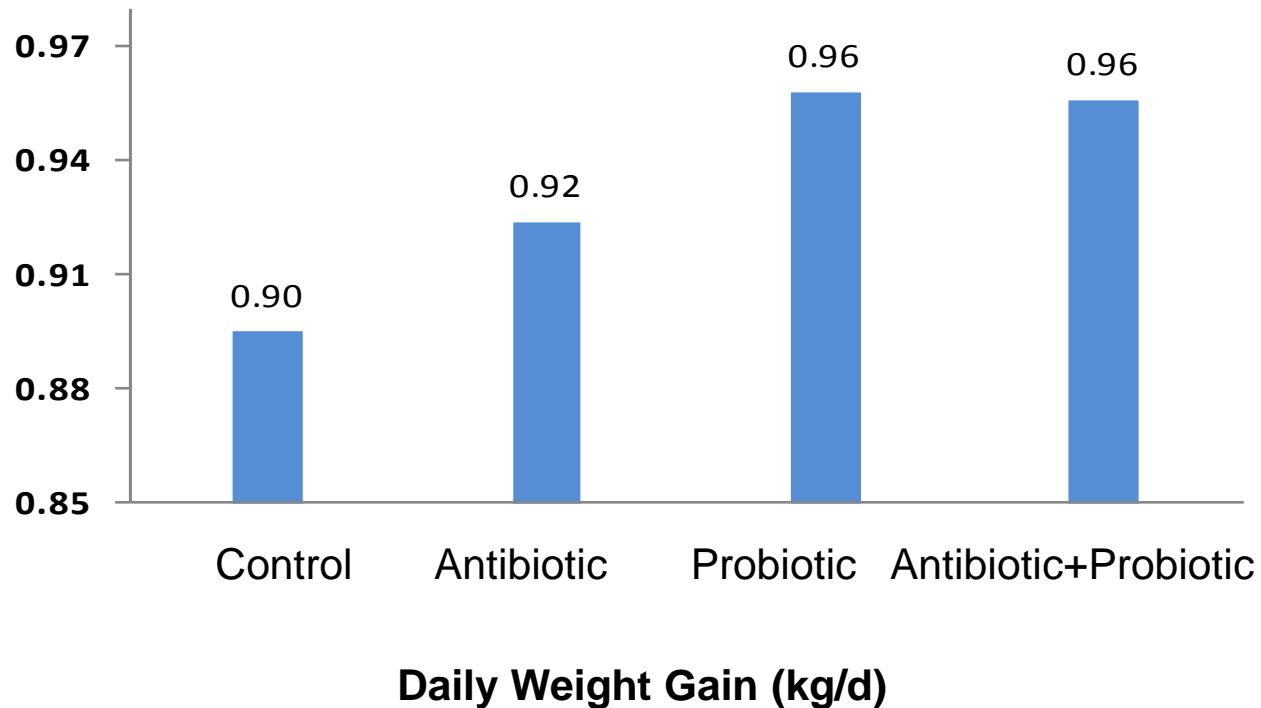


Bacillus subtilis
Secretion of enzyme, removal of ammonia



Saccharomyces cerevisiae
Producing alcohol, nutrients

❖ Effect of probiotics on growth in pig



◆ DWG 8% ↑, Market age 6d ↓

❖ Effects of probiotics in pig farm field test

- Saving 6% in feed cost and improved FCR (3.3→ 3.1)
- Reduced market age by 7d
- Better carcass quality (Grade A+ 5% → 10%)
- Increased MSY (16 head → 18 head)
- Reduced medical expense by 50%



Plant extract for pig

❖ Effect of Evening Primrose

Anti-microbial, removal of fever, anti-inflammatory



Evening Primrose



Extraction



Drying



Feeding trial



❖ Effect of Evening Primrose on growth of weaned piglets

Items	NC	PC	0.05%	0.1%	0.2%	SE ²
ADG, g	454 ^b	478 ^{ab}	485 ^a	479 ^{ab}	471 ^{ab}	8
ADFI, g	647	645	650	653	646	14
G/F	0.702 ^b	0.741 ^a	0.746 ^a	0.734 ^{ab}	0.729 ^{ab}	0.012

◆ DWG 6.8% ↑ : Control (454g) vs. EP 0.05% (485g)



❖ Effect of Evening Primrose on digestibility

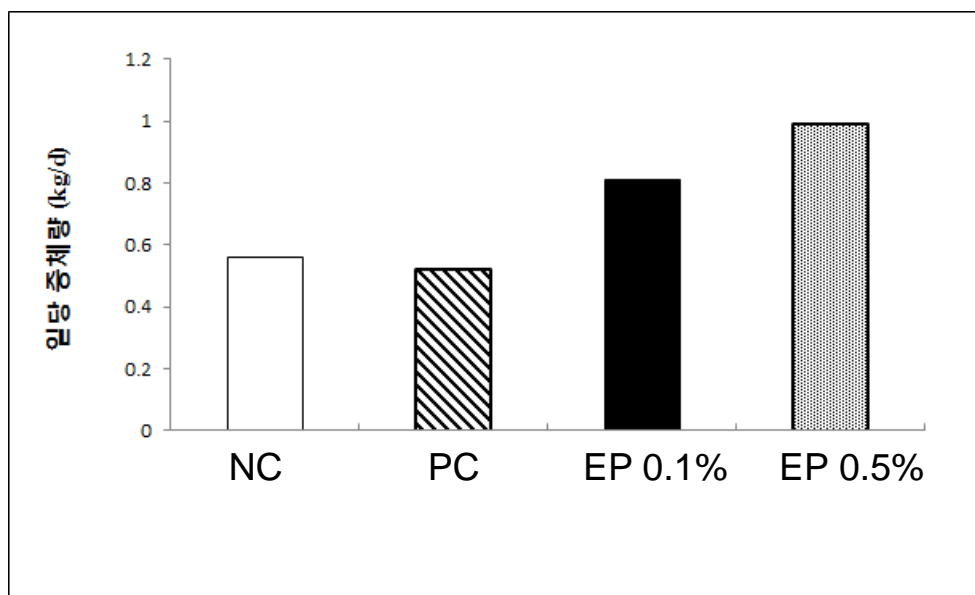
Items	NC	PC	0.05%	0.1%	0.2%	SE ²
Dry matter	79.86 ^b	80.42 ^{ab}	82.31 ^a	81.20 ^{ab}	80.37 ^{ab}	0.75
Nitrogen	78.67	78.83	80.08	79.53	79.20	1.26
Energy	79.61	79.81	81.93	80.64	80.01	0.77

◆ Digestibility(DM) 3.0% ↑

: Control (79.86%) vs. EP 0.05%(82.31%)



❖ Effect of Evening Primrose on growth in piglets infected by *Salmonella typhimurium*

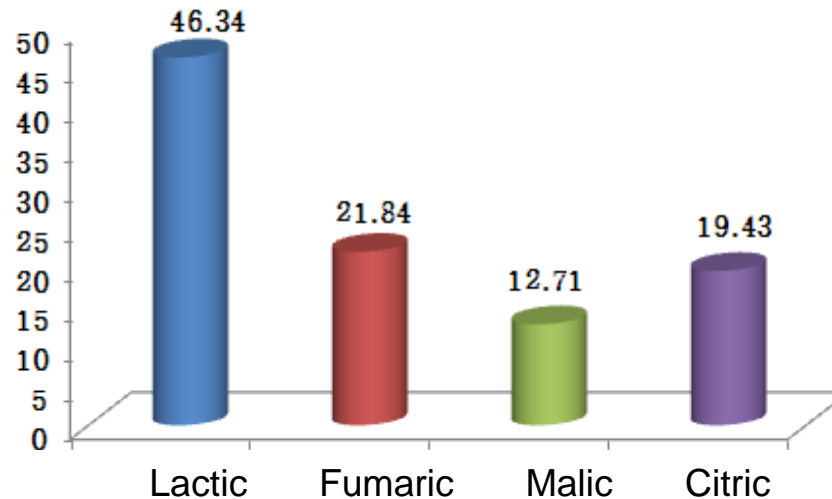


◆ Daily Wt. Gain

EP 0.1%, 0.5% treated groups showed higher weight gain by 58%, 99% respectively when compared to Positive control group

Fermented feed for poultry

- ❖ Development of fermented feed using food by-product
 - Apple pomace 100kg + Lactobacillus 300g → Anaerobic fermentation for 3~7d
 - Organic acid content : Lactic 46%, Fumaric 22%, Malic 13%, Citric 19%

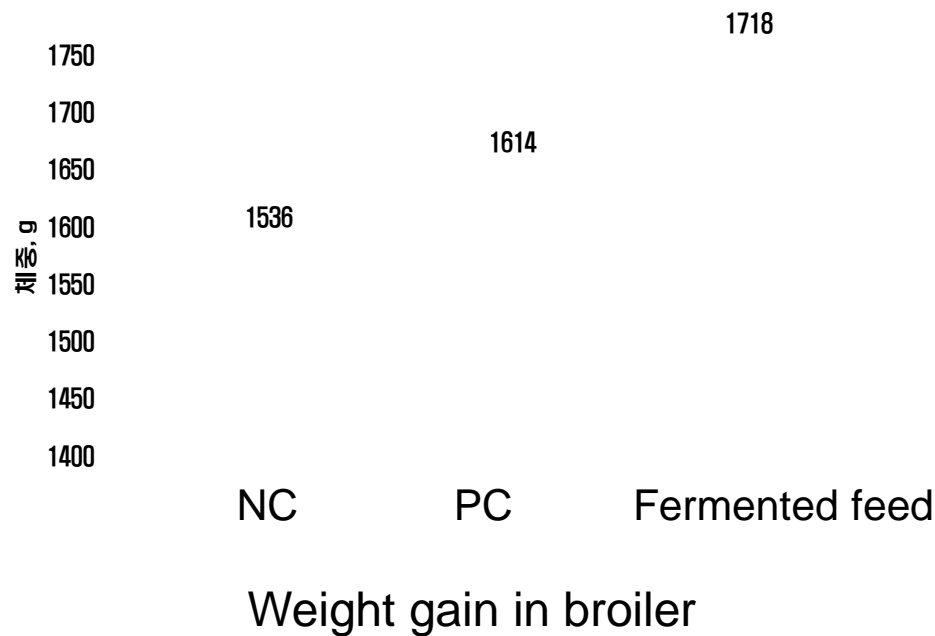


Organic acids content of fermented feed using apple pomace



❖ Effect of fermented feed using apple pomace on performance in broiler

- Fermented apple pomace supplementation : 1~3% in feed
- Effect :10% improvement in Wt. gain and FCR comparing to NC

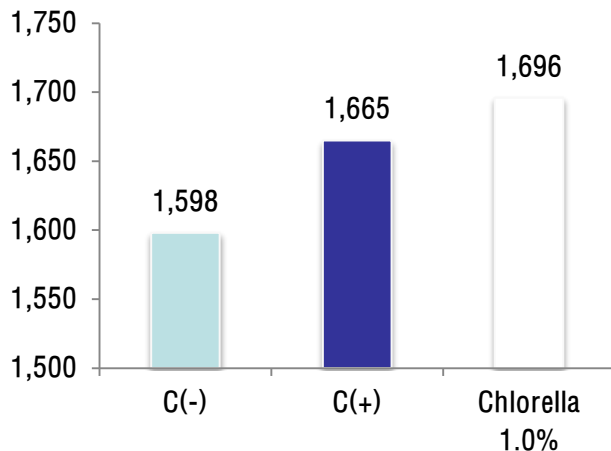


Chlorella

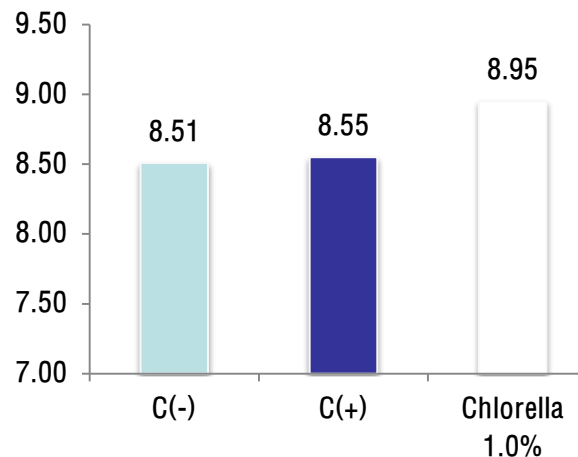


- Improve performance: Increased wt. gain (6.2%) compared to NC
- Enhance immune response
- Stabilize the microbial community: Increase good bacteria in the gut

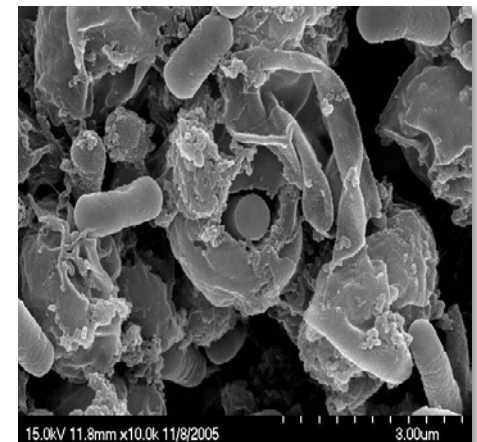
❖ Final BW (g/birds)



❖ Lactic acid bacteria



❖ Chlorella SEM



Plant extract

- ❖ Medicinal plants have various effects related to antioxidant, antimicrobial, anticancer and antiviral and immune modulating effects
- ❖ Development of antibiotic replacement using Korean medicinal plants (mixture of green tea, mistletoe, mugwort, etc.)
 - Increase wt. gain (3.6~8.6%)
 - Reduce gut pathogen (0.6~3.6%)
 - Chicken meat storage improvement



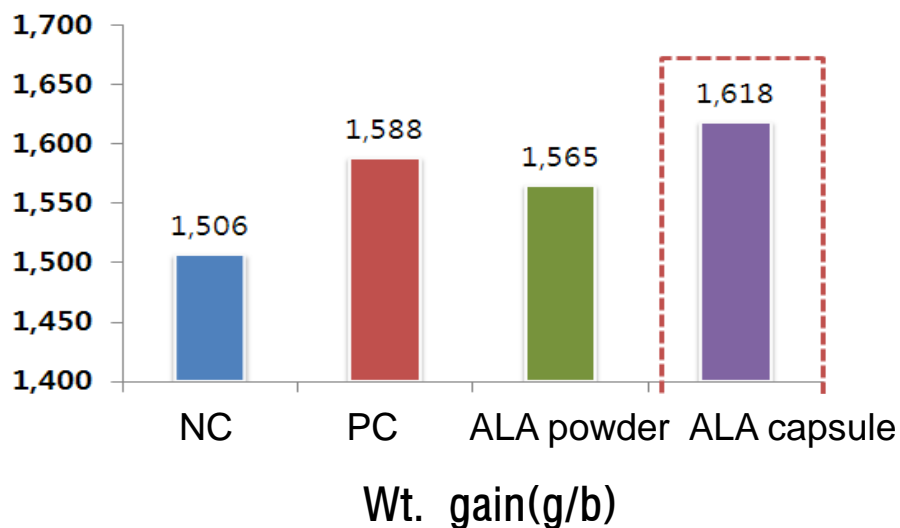
Alpha-lipoic acid

- ❖ Alpha-lipoic acid: vitamin-like chemical exists in liver and kidney
- ❖ Role as antioxidant or coenzyme
- Developed capsulation technique to maximize absorbability as feed additives

additives

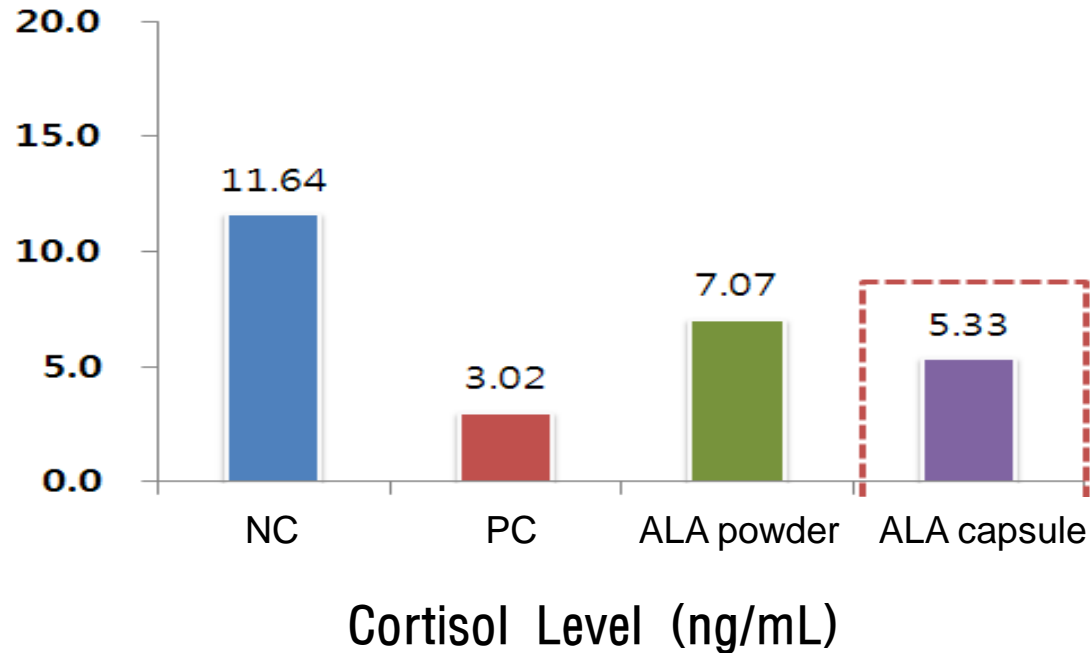


Alpha lipoic acid



- ❖ Effect of 0.5% Supplementation of alpha lipoic acid in broiler feed
- **Higher wt. gain by 7.4%** comparing to NC(non AGP)

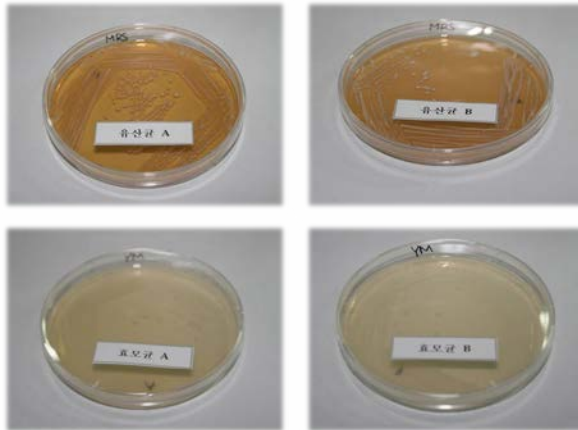
❖ Effect of ALA on stress in broiler



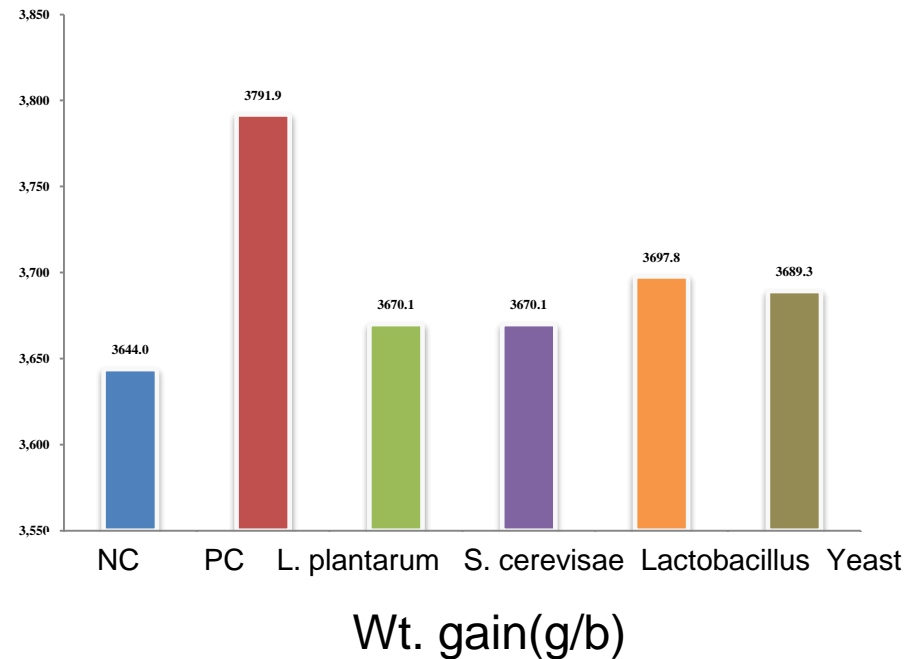
- Cortisol level decreased by 54% comparing to NC

Gut microbes in ducks

- ❖ Lactobacillus and yeast isolated from the gut of duck and incubated
- Higher wt. gain comparing to NC (1.3~1.5%)
- FCR: 5.1% improved



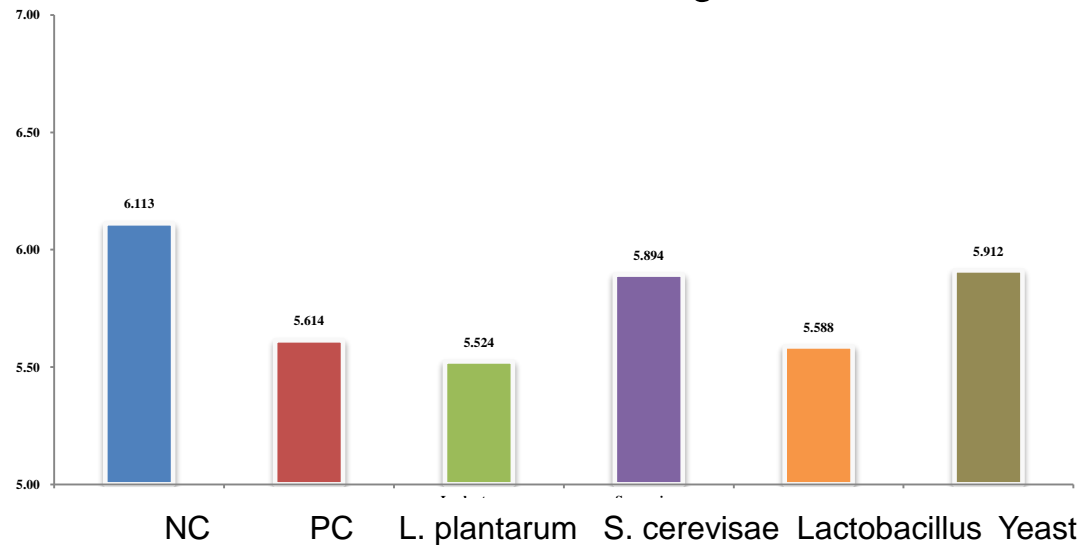
Gut microbes (duck)



❖ Effect of microbes originated from duck on pathogenic bacteria in the gut



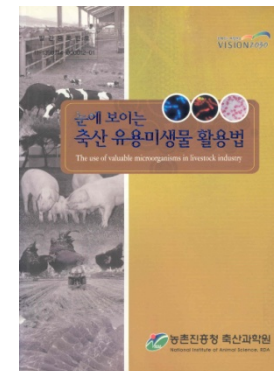
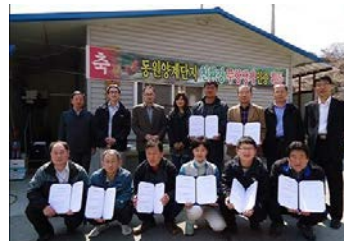
- *E. coli* in caeca of duck reduced compared to NC
- Help stabilization of intestinal microorganisms



Level of *E. coli* (log₁₀ cfu/g)

Extension

- ❖ Introducing techniques for farmers to use microbes through the regional extension centers nationwide
 - Educate extension specialists in 150 centers
 - Supply textbooks on 'Utilization of microbes in livestock'
- ❖ Application of developed techniques in pig and poultry farms
 - AGP replacement, Feeding program, Biosecurity, etc,



Publication

Publish and supply books and leaflets on antibiotic-free farming



Raising Healthy Pig (Book)



Raising Healthy Chicken (Book)



Raising Pig without AGP (Leaflet)



Raising Chicken without AGP (Leaflet)

FUTURE PLAN

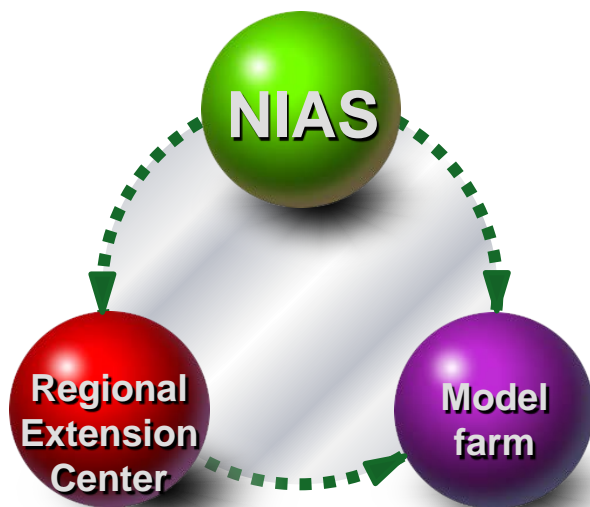


Research projects

- ❖ Development of application technique of antibiotic alternatives to control poultry diseases
 - Investigate and select the antibiotic alternatives which can control necrotizing enteritis, fowl typhoid and duck septicemia
- ❖ Development of pathogen control technique using bioactive substances in chicken gastrointestinal tract
 - Identify the mechanisms by which bioactive molecules influence growth performance, health, gene expression profiles, and intestinal microbial community in poultry using molecular biological approaches

Application and extension

- ❖ Promote model farm to spread the microbes using technique
 - Gunsan-city Seosu pig farm complex
 - Field application experiment using microbes replacing antibiotics
 - Model farm is under co-management by NIAS and Regional Extension Center



THANK YOU
FOR YOUR ATTENTION

