

Solution BioSciences, Inc.

RESEARCH CAPABILITIES

LABORATORY CAPABILITIES

<i>RESEARCH AREA</i>	<i>Years of service (2002)</i>
Broiler battery studies (batteries)	15
Broiler pen studies (pens)	15
Clostridium Model (<i>with</i> coccidiosis involvement)	7
Clostridium Model (<i>without</i> coccidiosis involvement)	4
Complete processing capabilities (poultry and swine)	11
Broiler <i>in ovo</i> (egg) studies	14
Full range of SOPs in place	10
Good Laboratory Practices (GLP) capabilities	9
Layer cage studies (5000+ cages)	7
Multi-generation studies	8
Nematode challenge model and count	6
Oocyst production	7
Oocyst sensitivity trials	7
Quail and pheasant cages	7
Rodent cages (individual and group)	7
Swine grow out facility (124 pens, 944 pigs)	11
Turkey battery studies (batteries)	10
Turkey pen studies (pens)	14
USDA Registered	10
Processing research (chill tank simulation and in-plant)	3

MODELS AND/OR TRIAL TYPES CONDUCTED

POULTRY AREA (chickens, turkeys, commercial layers, pheasants, and quail):

1. Chronic and Sub-Chronic studies
2. LD₅₀ studies
3. Target animal safety studies (GLP Guidelines)
4. Disease challenge studies
5. Multi-generation studies
6. NEMATODE CHALLENGE MODEL- Nematode inoculation and potential efficacy of products.
7. Efficacy of coccidiostats (growth and disease responses)
8. Long-term recycling of bacteria and protozoa in determining resistance.
9. COCCIDIOSIS DEVELOPMENT MODEL for testing drug resistance, drug responses, and growth promotion. Specific coccidia of known drug resistance and/or non-resistance are used.
10. Coccidia recycling and/or production
11. Coccidia speciation
12. Clostridium models (either *with or without* coccidiosis involvement) has been developed based on particular needs of customers.
13. Efficacy of antibiotics (growth and disease responses)
14. Vaccine evaluations (USDA registered and CDC's BSL-2 biosafety lab rating)- Merek's, Coccidiosis, bacteria, and Gumboro vaccines.
15. Bacterial Studies that includes culture development, culture growth, and identification of bacteria (API20E serological/biochemical identification system).
16. Processing plant evaluations of bacterial efficacy products
17. NECROTIC ENTERITIS MODEL for testing
18. PASTEURELLA MODEL (development of the disease for evaluating potentially commercial remedies).
19. SALMONELLA MODEL: Applied in either litter or In vivo.
20. MYCOTOXICOSIS MODEL: mycotoxins (particularly fusarium) grown naturally are used to test potential remedies both In vitro (mycotoxin binding studies) and In vivo (animal performance).
21. COMPLETE GROSS NECROPSY EVALUATION
22. GENERAL DISEASE STRESS MODELS: A combination of coccidiosis, E. coli, dietary energy density, mycotoxin contamination, fat peroxidation, and space density have been used to evaluate coccidiostat response, antibiotic response, and vitamin requirements.
23. EGG INJECTION (*in ovo*) MODEL: A local Maryland hatchery allows Solution BioSciences personnel to inject commercially-incubated eggs (16-20 days embryonic growth) for testing potential responses throughout the growout.
24. Egg incubation (up to 2000 eggs)

25. COLIBACILLOSIS MODEL (E. coli development) BOTH CHALLENGED AND NON-CHALLENGED FLOCKS: CHICKS ARE CHALLENGED with virulent and non-virulent E. coli via water and/or litter treatments to determine mortality and morbidity effects for testing either ovo-injection, subcutaneous injectable, feed, and/or water medication remedies.
26. NON-CHALLENGED FLOCKS historically known to have early mortality problems and/or morbidity problems are used to obtain a "field problem flock" for testing either ovo-injection, subcutaneous injectable, feed, and/or water medication remedies.
27. XANTHOPHYLL RESPONSE MODELS: Shank and skin pigmentation is evaluated using the ROCHE COLOR FAN and the MINOLTA COLOR METER (a, b, L values) for testing feed component response, natural feed ingredient xanthophyll sources, and liquid xanthophyll sources. BLOOD XANTHOPHYLLS are determined at the SOLUTION BIOSCIENCES RESEARCH LAB.
28. PROCESSING CAPABILITY: Poultry processing is conducted on site with aid of an experimental poultry processing plant capable of processing up to 1200 birds daily. Processing factors include: feather weight, dry yield (pre- and post-chilled), parts measurement (pre- and post-chilled), fat pad evaluation, and paw evaluation- all factors are calculated on a LIVE BIRD AND CARCASS WEIGHT basis.
29. PROCESSING RESEARCH: Poultry processing research capabilities, especially in the area of microbial evaluations.
30. BREED EVALUATIONS
31. TASTE PANEL EVALUATIONS: With the use of a trained taste panel, sensory evaluations may be conducted using either the RANKING SYSTEM or the GRADING SYSTEM. Commercial radiate ovens are used to process the samples specifically for experimental purposes.
32. TBA STUDIES: Fat rancidity is evaluated using TBA values on either fresh meat or frozen samples stored for various periods of time in a commercial refrigerator or freezer.
33. BODY WEIGHT UNIFORMITY: standard deviation and coefficient of variation using individual body weight variation measurements.
34. MICROBIAL EVALUATION (both live animal/fecal and processed carcasses): include *Salmonella spp.*, *Salmonella* drug-resistant strains (*Agona* and *Kentucky* strains), *Escherichia coli*, *Listeria*, *Pasteurella*, and *Campylobacter*.

SWINE (early wean to market and gestating and lactating sows): specially designed stainless-steel feeders (which emphasize feed conversion and/or reduced feed wastage) capable of feeding early wean to maturity have been developed by Solution BioSciences.

1. Chronic and Sub-Chronic studies
2. LD₅₀ studies
3. Target animal safety studies (GLP Guidelines)
4. Efficacy of coccidiostats (growth and disease responses).
5. Disease challenge studies
6. Multi-generation studies
7. NEMATODE CHALLENGE MODEL- Nematode inoculation and potential efficacy of products.
8. Efficacy of antibiotics (growth and disease responses).
9. NECROTIC ENTERITIS MODEL for testing drug responses.
10. COCCIDIOSIS DEVELOPMENT MODEL for testing drug resistance, drug responses, and growth promotion. Specific coccidia of known drug resistance and/or non-resistance are used.
11. SALMONELLA MODEL: Applied in either litter or In vivo.
12. MYCOTOXICOSIS MODEL: mycotoxins (particularly fusarium) grown naturally are used to test potential remedies both In vitro (mycotoxin binding studies) and In vivo (animal performance).
13. Bacterial Studies that includes culture development, culture growth, and identification of bacteria (API20E system).
14. COLIBACILLOSIS MODEL (E. coli development): Both challenged and non-challenged herds.
15. COMPLETE NECROPSY EVALUATION
16. GENERAL DISEASE STRESS MODELS: A combination of coccidiosis, E. coli, dietary energy density, mycotoxin contamination, fat peroxidation, and space density have been used to evaluate coccidiostat response, antibiotic response, and vitamin requirements.
17. ROLE OF MICROFLORA IN DIGESTION MODEL: model used to determine the efficacy of antibiotics and/or bactericidal components on nutrient absorption.
18. PROCESSING CAPABILITY: Market size (up to 260#) processing is conducted at either Hatfield or Smithfield processing plants (both about 140 miles from SOLUTION BIOSCIENCES' SWINE FACILITY). Processing factors include: necessary sample collection, standard yield, parts measurement, fat thickness evaluation (FAT-O-METER), muscle thickness, percent lean cut, and yield variation based both on LIVE AND CARCASS WEIGHTS. Both sides of the carcass are tattooed in order to follow individual pigs

completely through processing.

19. Product evaluation in field trials and processing plants (outside monitor duties)
20. SHELF-LIFE DETERMINATION: Measure fluid loss (WEEPAGE) and external skin bacteria content (using MacConkey and Blood Agar split plates).
21. PROXIMAL AND DISTAL GUT VISCOSITY (In vitro): Using the technique by Bedford and Classen (Poultry Science 72:137:143) 1993.
22. BREED EVALUATIONS
23. Plant variety evaluations
24. TASTE PANEL EVALUATIONS: With the use of a trained taste panel, sensory evaluations may be conducted using either the RANKING SYSTEM or the GRADING SYSTEM.
25. TBA STUDIES: Fat rancidity is evaluated using TBA values on either fresh meat or frozen samples stored for various periods of time in a commercial refrigerator or freezer.
26. STANDARD DEVIATION and COEFFICIENT OF VARIATION using individual body weight variation measurements.
27. LONG-TERM GENERATION STUDIES: Local sows are used and placed in Solution BioSciences' research facility to conduct long-term (several generations) studies.

RODENT RESEARCH:

1. Chronic and Sub-Chronic studies
2. LD₅₀ studies
3. Oral toxicity studies
4. Intravenous toxicity study
5. Animal safety studies (GLP Guidelines)
6. Rat-Swine Model for evaluation of small quantities of products (too small for an adequate swine trial).
7. Multi-generation studies

NUTRITION AREA (poultry and swine)

1. Nutritional product evaluation
2. Growth promotion product evaluation
3. Nutrient availability (P, Ca, Zn, Cu, Mb, Cr, Mn, protein, energy, fat, amino acids especially lysine and methionine) using blood, bone ash, and growth response. Solution BioSciences evaluates nutrients in the Solution BioSciences RESEARCH LAB with the use colorimetry and/or absorbance in feedstuffs and nutrient balance studies.
4. Apparent metabolizable energy (ame_n)
5. Apparent fat energy (afe_n)
6. Mineral (P, Ca, Zn, Cu, Mn, Mg, Mb and Cr) availability using blood nutrient levels, bone ash, bone ash nutrient levels.
7. Plant variety evaluations (both animal response and nutrient availability).
8. Vitamin requirements based on growth response, performance, and processing factors.
9. Feed enzyme evaluations: Evaluating performance and nutrient availability.

STATISTICAL EVALUATIONS:

SAS and/or Statgraphics Plus 6.1 are used.

FDA/CVM AND USDA CLINICAL TRIALS:

Clinical trial studies in both the poultry and swine areas have been conducted over the last five years. FDA/CVM inspections have been completed successfully. The current FDA/CVM EXPERIMENTAL GUIDELINES are used in all clinical and non-clinical trials. The batching system is employed to assure uniform nutrient evaluations. Both internal and external QA insures accuracy and accountability.

USDA STUDIES:

Vaccine evaluations (USDA registered)

Vaccine development (preparation of cultures for vaccine development and culture cleaning).

FEED MILLING CAPABILITIES:

Solution BioSciences is well experienced with mixing experimental rations and the need for complete accuracy. The batch system is used in all research trials.

PROCESSING CAPABILITIES:

Solution BioSciences personnel is well experienced with commercial animal processing and product evaluation at poultry and swine.

CHICKS, POULTS, COMMERCIAL LAYERS, AND QUAIL SOURCES:

Chicks are obtained from local Maryland commercial hatcheries (all breeds are available) and shipped in by a well-ventilated vehicle. Poults are obtained from either Virginia or North Carolina and shipped in by a well-ventilated vehicle. Mature commercial layers and quail are obtained in Pennsylvania, North Carolina, and South Carolina.

PIGLET SOURCE:

Piglets of any post wean age (early or late) obtained from Virginia, Maryland, North Carolina, and Pennsylvania and used in Solution BioSciences' swine grow out facilities.

DETERMINATION OF TRIAL SUCCESS RATE (1987 to 2002)

PRODUCT AREA	TOTAL TRIALS	SUCCESS RATE (TOTAL)	SUCCESS RATE ¹ (%)
Antibiotics	29	18	62
Coccidiostats (non-challenged)	9	2	22
Coccidiostats (challenged)	38	32	84
Probiotics	11	6	55
Probiotics + Antibiotics	5	5	100
Enzymes (All products)	20	12	60
Energy Level	18	18	100
Protein/Lysine	12	11	92
Methionine	13	8	62
Betaine	18	14	78
Vitamins (non-stress)	14	3	21
Vitamins (stress)	17	17	100
Minerals (non-stress)	23	8	35
Minerals (stress)	12	11	92
Breed Evaluations	14	14	100
Meat Products	18	17	94
Grain Evaluations	24	18	75
Nutrient Balance Studies	27	24	89
In ovo Studies	24	24	100
Vaccine Evaluations	8	6	75
Others	21	5	24
Blinded Studies	51	27	53
GRAND TOTAL (or Mean)	426	300	71.45

¹ Success is defined as having some significance (either positively or negatively) at the 5% Level of Probability (P<.05).

NUMBER OF TRIALS PER SPECIE (1987 to 2002)

PRODUCT AREA	TOTAL TRIALS PER SPECIE
Broilers	284
Turkeys	56
Laying Hens	38
Swine (nursery)	12

Swine (grow out)	21
Dairy Cattle (Field Studies)	15
GRAND TOTAL (or Mean)	426

RESEARCH FARM FACILITY

PRODUCT AREA	TOTAL UNITS	UNIT SIZE
Broiler/turkey research floor pens	96	3.5' x 10'
Broiler/turkey research floor pens	48	3' x 3.5'
Broiler cages (up to 21 days)	360	12" x 24"
Broiler/turkey cages (up to 49 days)	96	18" x 24"
Commercial egg pullet cages	120	18" x 24"
Layer cages	120	12" x 18"
Quail/pheasant cages	75	12" x 18"
Swine grow out facility (up to 250 pounds)	124	4' x 8'
Swine posting/processing laboratory	-----	8' x 36'
Laboratory (microbiology and chemical)	-----	16' x 24'
Battery rooms	2	25' x 30'
Processing facility	----	20' x 20'

TRIAL CONDUCTED (1986 to 2003)

PRODUCT AREA	TOTAL TRIALS
Antibiotics and/or Probiotics	29
Coccidiostats (non-challenged)	9
Coccidiostats (challenged)	31
Enzymes (All products)	15
Energy Level	18
Protein/Lysine	12
Methionine and Betaine	18
Vitamins (non-stress)	14
Vitamins (stress)	17
Microbiology	51
Minerals (non-stress)	23
Minerals (stress)	12
Breed Evaluations	7
Meat Products	18
Grain Evaluations	24
Nutrient Balance Studies	27
<i>In ovo</i> Studies	24
Vaccine Evaluations	8
GRAND TOTAL (or Mean)	357

NUMBER OF TRIALS PER SPECIE (1987 to 2002)

PRODUCT AREA	TOTAL TRIALS PER SPECIE
Broilers	284
Turkeys	56
Laying Hens	38
Swine (nursery)	12
Swine (grow out)	21
Dairy Cattle (Field Studies)	15

GRAND TOTAL (or Mean)	426
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