The Future of Poultry Research - Challenges as Opportunities

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West Virginia University
Outline

Background
Task ahead
Three challenges (key questions)
  What?
  Who?
  How?
Conclusions
MOLECULAR STRUCTURE OF NUCLEIC ACIDS

A Structure for Deoxyribose Nucleic Acid

We wish to suggest a structure for the salt of deoxyribose nucleic acid (D.N.A.). This structure has novel features which are of considerable biological interest.

A structure for nucleic acid has already been proposed by Pauling and Corey\(^1\). They kindly made their manuscript available to us in advance of publication. Their model consists of three intertwined chains, with the phosphates near the fibre axis, and the bases on the outside. In our opinion, this structure is unsatisfactory for two reasons: (1) We believe that the material which gives the X-ray diagrams is the salt, not the free acid. Without the acidic hydrogen atoms it is not clear what forces would hold the structure together, especially as the negatively charged phosphates near the axis will repel each other. (2) Some of the van der Waals distances appear to be too small.

J. D. Watson
F. H. C. Crick

Medical Research Council Unit for the Study of the Molecular Structure of Biological Systems,
Cavendish Laboratory, Cambridge.
April 2.
Robert L. Taylor, Jr.

37 year PSA member (1978)
Section Editor = Poultry Science
Publication Strategic Plan chair
Immunology, genetics expertise
30 years = New Hampshire
2 years = West Virginia
The Task Ahead

Examine current poultry research challenges

Forecast opportunities those challenges present
2050 World Population

National Academy of Sciences US
National Research Council (NRC)

“Critical Role of Animal Science Research in Food Security and Sustainability”

9 to 10 billion people estimated
How big is 9.5 billion?

<table>
<thead>
<tr>
<th>Unit</th>
<th>Amount</th>
<th>Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>second</td>
<td>301 years</td>
<td>3.77 lifespans of 80 years</td>
</tr>
<tr>
<td>gram</td>
<td>9,500 metric tons</td>
<td>52.78 great blue whales</td>
</tr>
<tr>
<td>inch</td>
<td>149,936 miles</td>
<td>6.02 x Earth’s circumference</td>
</tr>
</tbody>
</table>
# Change in U. S. Meat Consumption

<table>
<thead>
<tr>
<th>Unit</th>
<th>1970 / capita</th>
<th>2009 / capita</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>meat</td>
<td>104.9 lbs</td>
<td>110.4 lbs</td>
<td>5.2% Increase</td>
</tr>
<tr>
<td>beef</td>
<td>51.8 lbs</td>
<td>37.8 lbs</td>
<td>27% decrease</td>
</tr>
<tr>
<td>poultry</td>
<td>20 lbs</td>
<td>41 lbs</td>
<td>105% increase</td>
</tr>
<tr>
<td>poultry % of total</td>
<td>19.1%</td>
<td>37.1%</td>
<td></td>
</tr>
</tbody>
</table>
## Animal Productivity Increases

<table>
<thead>
<tr>
<th>Species</th>
<th>Trait</th>
<th>1960s</th>
<th>2005</th>
<th>% change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicken, broiler</td>
<td>Days to reach 2 kg</td>
<td>100</td>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>Feed conversion ratio (FCR)</td>
<td>3.0</td>
<td>1.7</td>
<td>43</td>
</tr>
<tr>
<td>Chicken, layer</td>
<td>Eggs/ton of feed</td>
<td>5,000</td>
<td>9,000</td>
<td>80</td>
</tr>
<tr>
<td>Cow, dairy</td>
<td>kg milk/cow/lactation</td>
<td>6,000</td>
<td>10,000</td>
<td>67</td>
</tr>
<tr>
<td>Pig</td>
<td>FCR</td>
<td>3.0</td>
<td>2.2</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>kg lean meat/ton feed</td>
<td>85</td>
<td>170</td>
<td>100</td>
</tr>
</tbody>
</table>
Greater production efficiency I
Success through research
Genetics, nutrition, health and management = less feed needed
Same progress for next 40 years?
FCR by 2045 = 0.963 FCR
Greater production efficiency II

Parameter limit may be unknown until progress slows or stops.

Advances may have adverse impacts on related systems that ultimately offset progress.
Three key questions

What research will be done? needs
Who will perform the research? next generation of scientists
How will the research be funded?

Complex answers
Creative solutions
What research?

Set research priorities
dialogue among stakeholders, academia, government

Limitations
funds, personnel, facilities

Regular evaluation of priorities
Critical research issues (unranked)

resources (food, water, land)
efficiency = produce, reproduce
food safety
alternate animal feed sources
disease resistance/protection
animal production w/o antibiotics
adapt to environmental change
animal welfare (NRC, 2015).
2003-2012 NIFA funding by knowledge area

Flexibility

emergent disease health threat
animal, human or both
threats realign priorities set
adjust to needs
Balance short-term results against long-term gain (+/- 10 year window)

Basic research leads to translational efforts

Research programs that are sustainable
Translational Basic

Basic & translational mix

Advances traverse the lamp
Solving real problems

All basic
All translational

AI = basic to translational

Adapted from Rees, Science 296:698, 2002
Infrastructure investment

Crucial experiments yielding data with high potential value cannot be done without an enduring commitment.

Siegel’s long-term selections
Who will perform research?

Set research priorities
dialogue among stakeholders, academia, government

Limitations
funds, facilities, personnel

Regular evaluation of priorities
Needs and obstacles

Personnel to conduct studies

Obstacles

consolidation in academia
poultry science

six remaining university units

Poultry research (Taylor, 2009)

“...a victim of its success...”
Needs and obstacles

Vertical integration
small number of companies
HQ outside institution’s state
desire immediate benefit
external grants with indirect $$
units need a mix of endeavors
basic = fundamental questions
translational = solve problems
Hire the best people

Don’t be afraid to hire someone smarter than you

This candidate is the most qualified and the best scientist,

but is that really what we want?
Elevate emphasis on outputs [results] (publication, student degree, seminar, popular article, etc.) versus inputs [process] (grant, contract, MOU, etc.)
Realize and acknowledge that each individual contributes but each contribution will be different.

Educators    Rainmakers
Communicators Integrators
Facilitators  Collaborators

Scientific, practical bird knowledge
Engage students!

Encourage STEM students in science, tech, math, engineering.

Science as stimulating & rewarding.

PSA opportunities:
- Experiential internships

Andrew F. Giesen III Internships:
- Direct poultry science knowledge

Other internship opportunities
Engage students II

Demand remains for specific poultry science expertise

Stakeholder cooperation to identify educational needs, enhance productivity & develop products

Protect academic units from shifting emphases = financial or administrative change
How will research be funded?

AS research allocation U.S.
0.20% food animal production

Animal agriculture
60-70% total U.S. ag economy
1.5% world GDP
NIFA AS funds by species 2003-2012

NIFA AS funds by species 2003-2012

Avg yearly NIFA funds allocation across species

lower % for poultry

reasoned distribution by species

Year to year critical issues may create short-term discrepancies
Funding challenge

more critical = funding declined

AS research $$ adjusted to 2003

Fewer $$ means lower funding %

Grants unfunded for lack of money rather than lack of quality

Little difference from prior report (Taylor, 2009)
Funding opportunity I

Greater agency collaboration
Minimize topical barriers
Dual Purpose Dual Benefit
USDA & NIH interface of human health & animal agriculture
Raise risk profile for some work
## Funding opportunity II

<table>
<thead>
<tr>
<th>Species</th>
<th>2012 Production</th>
<th>$ 0.001</th>
<th>$ 0.005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicken</td>
<td>50.3 billion lbs</td>
<td>$50.3 million</td>
<td>$251.5 million</td>
</tr>
<tr>
<td>Turkey</td>
<td>7.5 billion lbs</td>
<td>$7.5 million</td>
<td>$37.5 million</td>
</tr>
<tr>
<td>Eggs</td>
<td>7.42 billion</td>
<td>$7.42 million</td>
<td>$37.1 million</td>
</tr>
<tr>
<td>Funds</td>
<td></td>
<td>$65.2 million</td>
<td>$326.1 million</td>
</tr>
<tr>
<td>1:1 match</td>
<td></td>
<td>$65.2 million</td>
<td>$326.1 million</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>$130.4 million</td>
<td>$652.2 million</td>
</tr>
</tbody>
</table>
Conclusions

Challenges remain
No single remedy

Inventive, balanced approach to prioritizing research, recruiting & retaining quality scientists & obtaining financial resources

Scientist & stakeholder interaction
Poultry Science Association
Since 1908

Upcoming Meetings

• PSA Annual Meeting
  New Orleans, Louisiana
  July 11-14, 2016

• Latin American Meeting
  Campinas, São Paulo, Brazil
  October 4-6, 2016

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