Chinese Egg Industry and Research Trends

Ning Yang, Ph.D.

China Agricultural University
Beijing 100193
nyang@cau.edu.cn
Egg Industry in China

• Top egg producer in the world, 28.8 million tons in 2014, representing 40% of world total production

• One Keyword: Diversity
  – Genetic Diversity
  – Product Diversity
  – Production Diversity
Genetic Diversity

• Commercial Hybrid Layers
  • Brown Egg Layers
  • White Egg Layers
  • Pink (Light Brown) Egg Layers

• Indigenous Chickens

• Egg-type Ducks
Chicken breeds in Jiangxi Province

- Baier
- Kangle
- Chongrenma
- Lingkun
- Silkie
- Ningdusanhuang
- Yuganwugu
- Dongxiang Blue
Diversity in Egg Products
Diversity in Egg Products

**Chicken Eggs**

- Brown Eggs: 60%
- Pink (Light Brown) Eggs: 38%
  - Normal Size (>58g): 30%
  - Smaller Size (40~55g): 8%
- White Eggs: 1%
- Blue Eggs: 1%
Percentage of egg products in total egg output:

- 5%, 1.74 billion eggs
- 8.2%, 95,000 tons
- 1.16 million tons

Percentage of pasteurization eggs in total egg products:

Fresh egg consumption dominates; very few egg processing plants to produce egg products.
From Egg to Egg Products

- Packing
- Grading
- Processing
Diversity in Production Systems

• From backyard to modern farms

9 Leading Provinces:
- Hebei
- Henan
- Shandong
- Jiangsu
- Hubei
- Liaoning
- Heilongjiang
- Anhui
- Sichuan
Survey Data

- Time: Jun ~ July, 2013
- **Comprehensive** survey in 36 typical counties of 9 provinces
- 20,132 farms were investigated. Among them, 18,909 were valid samples
- The total capacity was 114 million hens, and the actual number of stocking hens was 102 million, representing nearly 10% of total hens in China.
## Data of 9 Sample Provinces

<table>
<thead>
<tr>
<th>Province</th>
<th>Cities</th>
<th>No. of Farms</th>
<th>Average Size (hen/farm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jiangsu</td>
<td>Yancheng</td>
<td>5788</td>
<td>4372</td>
</tr>
<tr>
<td>Hebei</td>
<td>Shijiazhuang</td>
<td>3735</td>
<td>3957</td>
</tr>
<tr>
<td></td>
<td>Handan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hubei</td>
<td>Huanggang</td>
<td>3243</td>
<td>6508</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Henan</td>
<td>Xinxiang</td>
<td>1439</td>
<td>5710</td>
</tr>
<tr>
<td></td>
<td>Nanyang</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shandong</td>
<td>Jinan</td>
<td>1384</td>
<td>7724</td>
</tr>
<tr>
<td></td>
<td>Qingdao</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anhui</td>
<td>Shuzhou</td>
<td>1073</td>
<td>7438</td>
</tr>
<tr>
<td>Heilongjiang</td>
<td>Haerbin</td>
<td>984</td>
<td>5097</td>
</tr>
<tr>
<td>Liaoning</td>
<td>Anshan</td>
<td>831</td>
<td>5822</td>
</tr>
<tr>
<td>Sichuan</td>
<td>Leshan</td>
<td>432</td>
<td>10018*</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>18909</strong></td>
<td><strong>5409</strong></td>
</tr>
</tbody>
</table>
## Farm Scale of Laying Hens in 2013

<table>
<thead>
<tr>
<th>Scale Hens/Farm</th>
<th>No. of Farms</th>
<th>%</th>
<th>No. of Hens Housed (x1000)</th>
<th>%</th>
<th>No.of Laying Cages (x1000)</th>
<th>%</th>
<th>Percent Cages not in use</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;2000</td>
<td>2814</td>
<td>14.88</td>
<td>3,590.5</td>
<td>3.51</td>
<td>4,890.6</td>
<td>4.27</td>
<td>26.58</td>
</tr>
<tr>
<td>2000~4999</td>
<td>9386</td>
<td><strong>49.64</strong></td>
<td>28,075.0</td>
<td>27.44</td>
<td>32,973.4</td>
<td>28.82</td>
<td>14.86</td>
</tr>
<tr>
<td>5000~9999</td>
<td>4311</td>
<td>22.80</td>
<td>26,530.0</td>
<td>25.93</td>
<td>28,997.4</td>
<td>25.34</td>
<td>8.51</td>
</tr>
<tr>
<td>10,000~49,999</td>
<td>2285</td>
<td>12.08</td>
<td>35,711.0</td>
<td><strong>34.91</strong></td>
<td>38,595.7</td>
<td><strong>33.73</strong></td>
<td>7.47</td>
</tr>
<tr>
<td>50,000~99,999</td>
<td>92</td>
<td>0.49</td>
<td>5,805.3</td>
<td>5.67</td>
<td>6,237.3</td>
<td>5.45</td>
<td>6.93</td>
</tr>
<tr>
<td>&gt;100,000</td>
<td>21</td>
<td>0.11</td>
<td>2,570.0</td>
<td>2.51</td>
<td>2,716.5</td>
<td>2.37</td>
<td><strong>5.39</strong></td>
</tr>
<tr>
<td>Total</td>
<td><strong>18,909</strong></td>
<td>100.0</td>
<td><strong>102,28</strong></td>
<td>100.0</td>
<td><strong>11,441</strong></td>
<td>100.0</td>
<td><strong>10.60</strong></td>
</tr>
</tbody>
</table>
Housing system

- Most layer farms use open or semi-open layer house
Housing system

- Use of close house are more and more common.
Housing system

- Stair cage is a major housing system
- Use of vertical cages with manure belt is increasing
- The animal welfare is not an important issue yet

<table>
<thead>
<tr>
<th>Scale (hen)</th>
<th>Percent in Stair Cages</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;2,000</td>
<td>92.54</td>
</tr>
<tr>
<td>2,000～4,999</td>
<td>87.17</td>
</tr>
<tr>
<td>5,000～9,999</td>
<td>87.68</td>
</tr>
<tr>
<td>10,000～49,999</td>
<td>92.89</td>
</tr>
<tr>
<td>50,000~99,999</td>
<td>91.37</td>
</tr>
<tr>
<td>&gt;100,000</td>
<td>95.17</td>
</tr>
</tbody>
</table>
Drinking Water

Nipple drinker is a major way to supply clean water, while 17.76% farms still use water channel.
Feeding System

Feed is supplied mainly by labor, while more cart feeding is used in larger farms.
Egg Collection

Most eggs are collected by hands, Automatic egg collection systems are used in large farms.
Manure Processing

• More manure processing in larger farms: fertilizer
Feed supply

The bigger the scale, the more farms with their own feedmills:

- Safety of egg products
- Reducing production costs.
Egg marketing

- Marketing by dealer is the major way of egg sales;
- Own brands are developing fast.
Managers’ Age

Age of farm managers is mainly between 40~60.

<table>
<thead>
<tr>
<th>Scale</th>
<th>No. Farms</th>
<th>Under 30</th>
<th>30~40</th>
<th>40~50</th>
<th>50~60</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;2000</td>
<td>2674</td>
<td>44</td>
<td>303</td>
<td>975</td>
<td>1063</td>
</tr>
<tr>
<td>2000~4999</td>
<td>8716</td>
<td>200</td>
<td>1440</td>
<td>3975</td>
<td>2591</td>
</tr>
<tr>
<td>5000~9999</td>
<td>4037</td>
<td>138</td>
<td>777</td>
<td>1940</td>
<td>985</td>
</tr>
<tr>
<td>10k~50k</td>
<td>2145</td>
<td>77</td>
<td>400</td>
<td>1082</td>
<td>497</td>
</tr>
<tr>
<td>50k~100k</td>
<td>82</td>
<td>1</td>
<td>15</td>
<td>41</td>
<td>18</td>
</tr>
<tr>
<td>&gt;100k</td>
<td>20</td>
<td>0</td>
<td>2</td>
<td>11</td>
<td>4</td>
</tr>
</tbody>
</table>
The bigger the scale is, the better managers’ educational background are. In general, the educational background is not quite good.

<table>
<thead>
<tr>
<th>Scale</th>
<th>No.</th>
<th>Under High School</th>
<th>High School</th>
<th>College</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>%</td>
<td>No</td>
<td>%</td>
</tr>
<tr>
<td>&lt;2000</td>
<td>2569</td>
<td>2058 80.11</td>
<td>499 19.42</td>
<td>12 0.47</td>
</tr>
<tr>
<td>2000～4999</td>
<td>8505</td>
<td>6651 78.20</td>
<td>1815 21.34</td>
<td>39 0.46</td>
</tr>
<tr>
<td>5000～9999</td>
<td>3976</td>
<td>2879 72.41</td>
<td>1041 26.18</td>
<td>56 1.41</td>
</tr>
<tr>
<td>10k～50k</td>
<td>2133</td>
<td>1319 61.84</td>
<td>742 34.79</td>
<td>72 3.38</td>
</tr>
<tr>
<td>50k～100k</td>
<td>81</td>
<td>30 37.04</td>
<td>30 37.04</td>
<td>20 24.69</td>
</tr>
<tr>
<td>&gt;100k</td>
<td>20</td>
<td>4 20.00</td>
<td>12 60.00</td>
<td>4 20.00</td>
</tr>
</tbody>
</table>
Trends of Egg Industry in China

◆ **Standardizing egg industry:**
  ◆ Ministry of Agriculture of the People’s Republic of China (MOA) is encouraging standardized and scale-up production system
  ◆ MOA is implementing “National Genetic Improvement Program of Layers (2012-2020)”
  ◆ The State Council has issued “Regulation on Pollution Prevention of Large-scale Livestock Production”

◆ **Challenges:**
  ◆ Diversified industrial structure
  ◆ Inaccurate data
  ◆ Over production: especially of breeder
  ◆ Diseases threats: avian flu
Standardized and Scale-up Production of Layers

Standardization and scale-up are development direction of poultry production in China.

- Changing from dispersed and small-scale production to standardized and large-scale farms.
- The urgency and importance of achieving standardized management of poultry production has been recognized in many regions.
Promote Standardized Poultry Production

- Improved Varieties
- Better Facilities
- Production Regulation
- Systematic Disease Control
- Manure Processing
- Promoting Standardized Poultry Production
China Agricultural Research System for Layers

- National System for Layer Production Technology (NSLPT)
- Established in 2008 to promote the research innovation and technology transfer to the egg industry
- There are 6 research divisions with 26 top research scientists in China, working together to develop egg production technology
  - Division of Genetics and Breeding: 6 Scientists
  - Division of Disease Control: 6 Scientists
  - Division of Nutrition and Feed: 5 Scientists
  - Division of Production and Environment Control: 5 Scientists
  - Division of Egg Processing and Quality Test: 3 Scientists
  - Division of Economics: 1 Scientist
Experimental Stations

- Industry-based
- Collaborated closely with scientists for innovations related to egg industry
- Base for technology transfer
- 25 stations now, covering 17 provinces across the country
### Key projects for 2011-2015

<table>
<thead>
<tr>
<th>Project</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Comprehensive Technology for Standardized Layer Production System</td>
</tr>
<tr>
<td>2</td>
<td>Development of New Varieties and Breeding Technology</td>
</tr>
<tr>
<td>1</td>
<td>Genetic Improvement in Layers</td>
</tr>
<tr>
<td>2</td>
<td>Control of Main Virus Diseases in Layers</td>
</tr>
<tr>
<td>3</td>
<td>Eradication of <em>Salmonella</em> in Layers and Eggs</td>
</tr>
<tr>
<td>4</td>
<td>Development of Efficient and Environment-friendly Feeds</td>
</tr>
<tr>
<td>5</td>
<td>Processing and Utilization of Farm Wastes</td>
</tr>
<tr>
<td>6</td>
<td>Processing, Detection and Grading of Clean Quality Eggs</td>
</tr>
<tr>
<td>7</td>
<td>Production, Marketing and Industry Policies</td>
</tr>
</tbody>
</table>
Major Modes of Standardized Layer Production

1. Large-scale and automatic production mode
2. Family farm mode
House Design of 4-Tier Cages with 30,000~50,000 Hens

House Design of 8-Tier Cages with 100,000 Hen Capacity
Family Farm Mode

- 5,000~20,000 hen per house, and 10,000~50,000 hen in a whole farm
- Fully enclosed house
- Three or four tiers cages: stair or vertical
- Artificial lighting, fan-curtain ventilation, automatical light control, drinking, and manure cleaning system
- Most manure applied to filed, only few manure was processed to organic fertilizer
- Egg processing and brand establishment with cooperation in a region
Manure belt is used in newly built or reconstructed houses, which could reduce the pollution and improve the manure value.
From Functional Gene to New Varieties

- A single dominant gene O for blue eggshell

- Two Approaches to identify the O gene
  - Genetic: Linkage analysis
  - Genomic: GWAS Expression Sequencing
With resequencing, we found an extra 24bp at the upstream of SLCO1B3 mRNA and a 4.2kb EAV-HP insertion at 5’flanking region of SLCO1B3 in blue eggshell chicken. The EAV-HP insertion could promote the expression of SLCO1B3.
Mechanism of SLCO1B3 in Forming Blue Eggshell

Protoporphyrin

Fe²⁺

Heme oxygenase

NADPH

O₂

CO, Fe

Biliverdin

HEME

OATP1B3\SLCO1B3

Biliverdin

blood capillary shell gland eggshell
Application of the blue eggshell molecular marker for chicken breeding

- Diagnostic genotyping test of EAV-HP insertion

- Direct Selection for blue eggshell by using the molecular marker
  - Male
  - Female
  - Fixation of O gene in the population
Two Patterns of Crossbreeding

Two patterns of crossbreeding are shown in the diagram. The first pattern involves crossing birds from pure lines A and B to create a hybrid line CD. The second pattern involves crossbreeding GGS, GS, PS, and CS lines. The diagram illustrates the genetic relationships and resulting offspring in each pattern.
Dwarf Layers: CAU-3

- Application of dwarf gene (dw)
- Commercialized and extended widely as efficient layers

- Three-way cross
- BW~1500g
- FC~90g/day,
- FCR<2.0
The XXV World’s Poultry Congress (WPC2016)

- To be held from the 5th to 9th September, 2016
- Welcome to Beijing!
谢谢！
Thanks!