Block Chain + Big Data

The Integrated Analyzing System

采用区块链和大数据分析技术构建综合检测分析系统

SOUTH CHINA AGRICULTURAL UNIVERSITY
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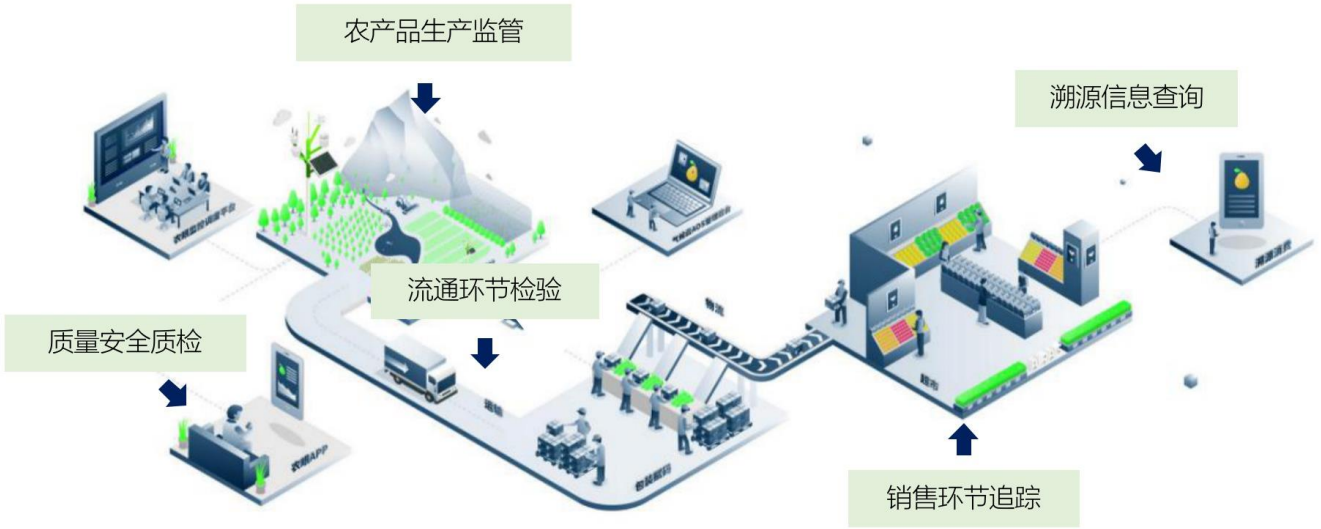
Preface | 前言

Traditional agricultural product traceability has problems in the efficiency of traceability information circulation, data security, and agricultural product information reliability. In the traditional system, the information system of each transfer node is mostly independent, the information can be tampered with and become unreliability, which make it hard to insurance the safety of the food.

传统的农产品溯源存在溯源信息流通效率、数据安全、农产品信息可靠性等问题。在传统的系统中，每个传输节点的信息系统大多是独立的，信息可能会被篡改，变得不可靠，这使得很难保证食品的安全。



Traditional agricultural product traceability system

传统农产品溯源体系

INTRO & INDEX

華南農業大學
South China Agricultural University

Existing working
已有工作基础

Detailed introduction
详细介绍

- Data Analysis-Research on environmental data analysis
- 数据分析-肉禽养殖环境数据分析

- Biological Detection-High-throughput integrated color space detection platform
- 生物检测-高通量一体化颜色空间检测平台

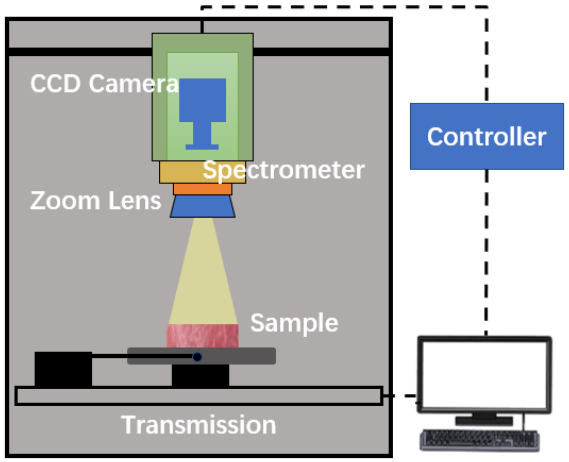
Existing working | 已有工作基础

- Special Project for Key Fields of Artificial Intelligence in Guangdong Province - Research on Key Technologies of Poultry Supply Chain Traceability Oriented to Blockchain Technology（2019KZDZX1001）

  广东省人工智能重点领域专项 - 面向区块链技术的家禽供应链溯源关键技术研究（2019KZDZX1001）

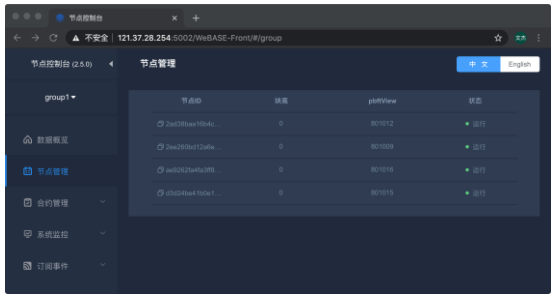
- Wal Mart high quality meat and poultry program (phase II) - China's high quality meat and poultry

  沃尔玛优质肉禽计划（二期）- 中国优质肉禽



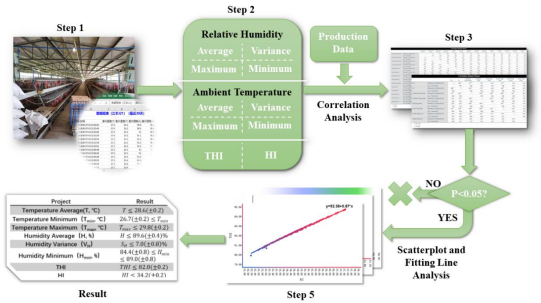
Non-Destructively Meat Quality Monitoring Base on Spectral Detection Techniques

基于光谱的肉品质无损检测技术



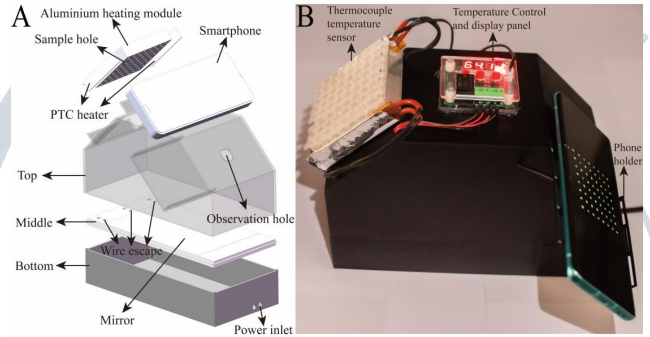
Traceability System Based on Blockchain

区块链溯源系统



Data Analysis

数据分析



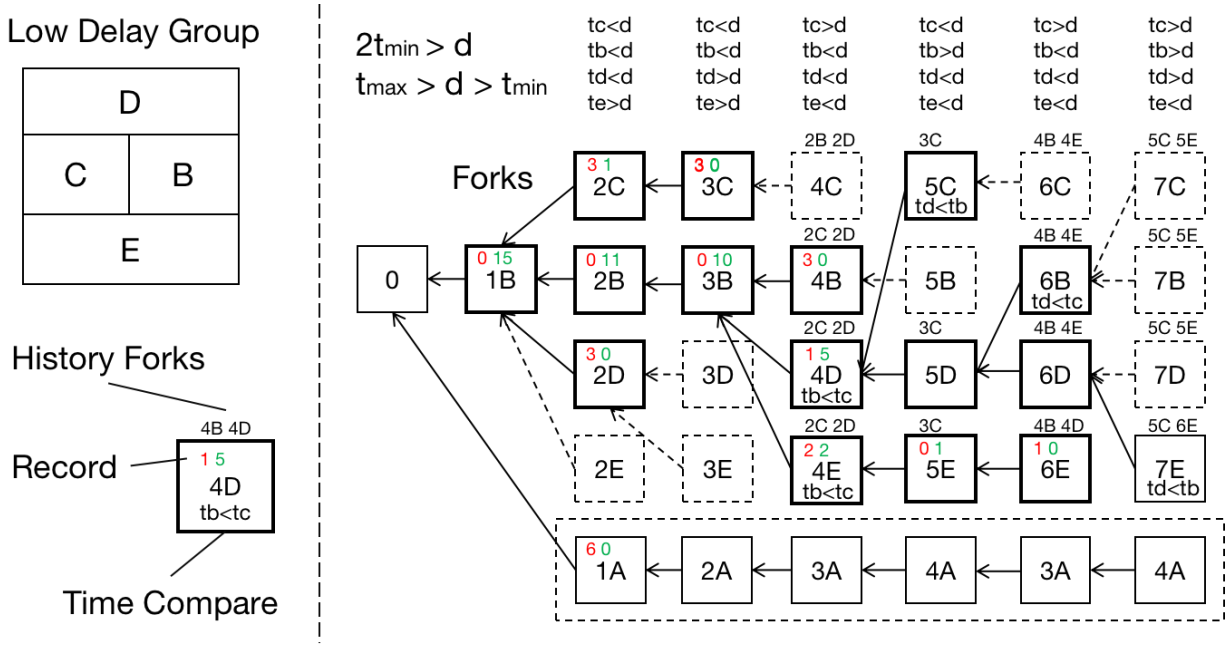
High-throughput integrated color space detection platform

高通量一体化颜色空间检测平台

Existing working | 已有工作基础

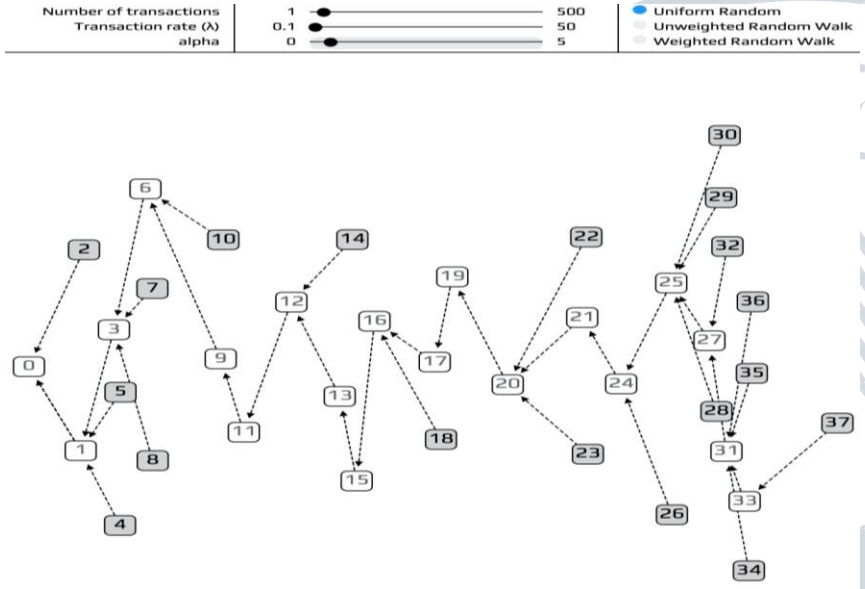
Application of Traceability System Based on Blockchain | 基于区块链的溯源系统应用

High throughput and high security blockchain consensus algorithm
高吞吐高安全区块链共识算法



Graph of efficient DAG consensus algorithm
高效DAG共识算法图解

- Dag based efficient and secure consensus algorithm
- 基于DAG的高效高安全共识算法
- Crisis security switching mechanism
- 危机-安全切换机制

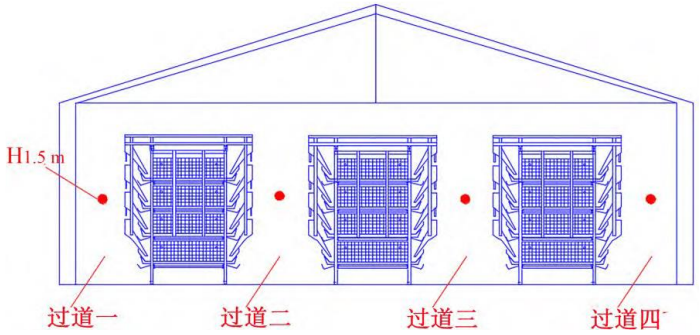


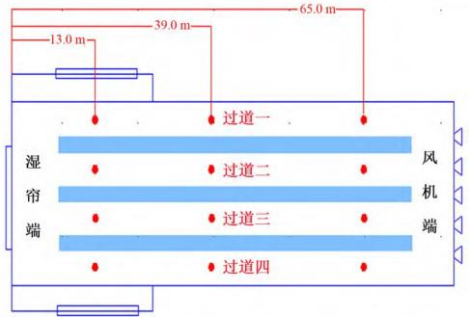
Simulation results
模拟运算结果

Existing working | 已有工作基础

Data Analysis | 数据分析

Research on environmental data analysis | 肉禽养殖环境数据分析





Schematic diagram of sensor monitoring points in chicken house

鸡舍传感器监测点设计示意图

For a long time, we put sensors in the chicken house and tried to get a variety of farming data, mainly environmental data, including temperature, humidity, light and so on. Through the analysis of data, it is helpful to help farmers to change from the simple "experience breeding mode" to the combination of modern "experience-data breeding mode".

在很长一段时间内，我们在鸡舍内布置传感器，并尝试获取多样化的养殖数据，主要以环境数据为主，包括温度、湿度、光照等等。通过对数据的分析，有利于帮助养殖户从单纯的“经验养殖模式”转变为结合现代化的“经验-数据养殖模式”。

Existing working | 已有工作基础

Data Analysis | 数据分析

Temperature
温度

Humidity
湿度

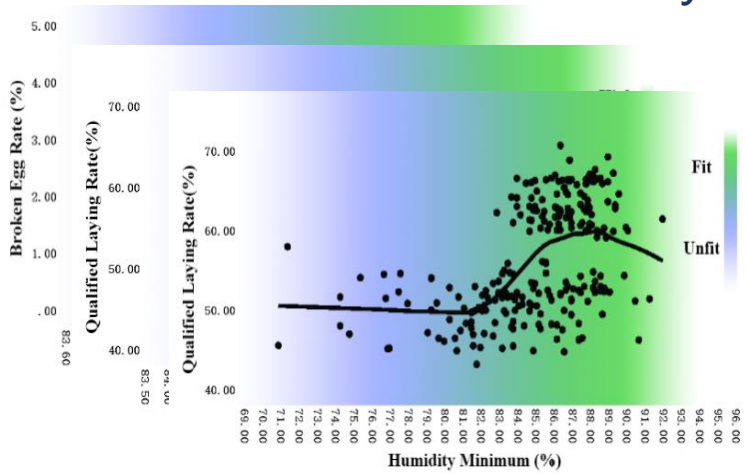
Breed
品种

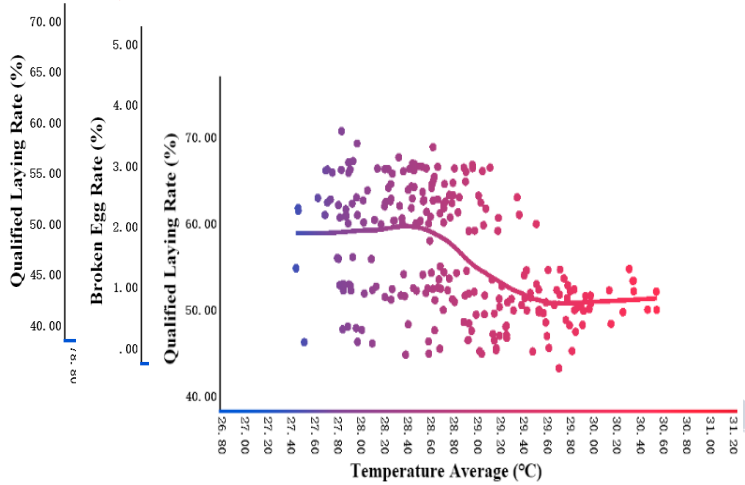
Light
光照

Gas
气体

CO_2

Research on environmental data analysis | 肉禽养殖环境数据分析





Correlation analyzing of Environment feature and Production

环境特征与产能关系分析

Multiple Feature ANN Analyzing Model

多特征人工神经网络分析模型

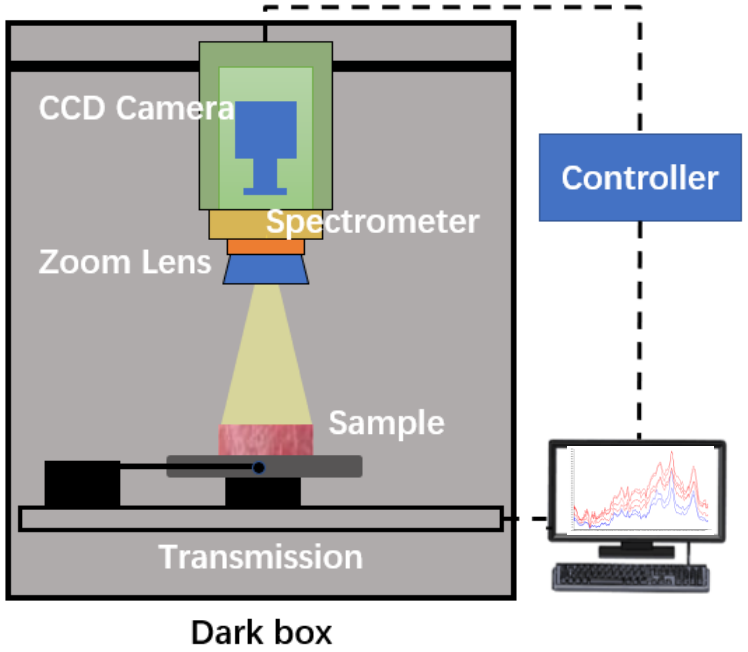
- Risk Assessment 风险评估
- Production Prediction 产能预测
- Environment Assessment 养殖环境评估
- Breeding Suggestion 生产建议

Existing working | 已有工作基础

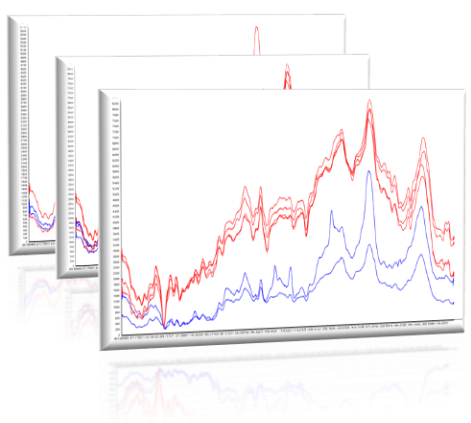
Non-Destructively Meat Quality Quickly Monitoring Base on Spectral Detection Techniques

基于光谱的肉品质快速无损检测技术

From Product Quantity to product Quality
从追求产量到追求质量



Schematic diagram of spectral imaging system for meat quality monitoring
肉类品质监测光谱成像系统示意图



Color 肉色 | Hardness 弹性 | Shear Force 剪切力

Total Volatile Basic Nitrogen （TVB-N）总挥发性盐基氮

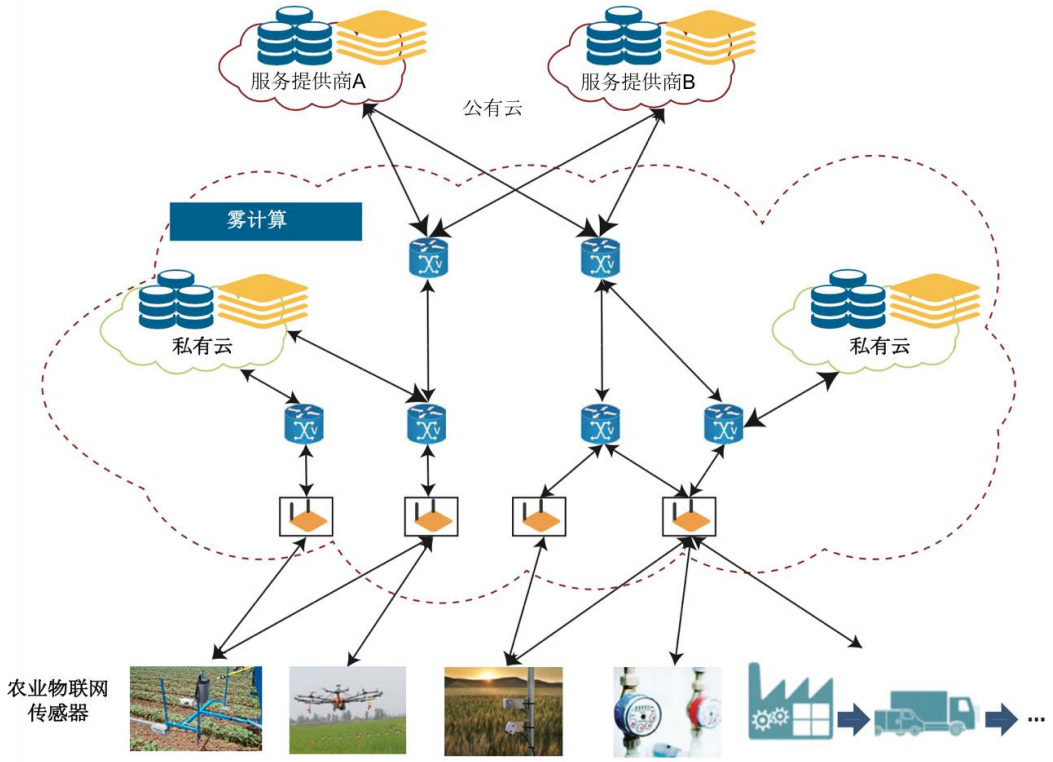
Total Viable Count （TVC） 菌落总数 | Protein 蛋白质

pH 酸碱度 | Fat 脂肪

Analyze and evaluate food quality from spectral data
从光谱数据分析并评估食品质量

Existing working | 已有工作基础

Research on the basic mathematical model of agricultural Internet of Things in the edge computing environment | 边缘计算环境下农业物联网的基础数学模型研究



Distributed data processing framework of Agricultural Internet of things edge computing

农业物联网边缘计算分布式数据处理框架

In the previous work, we proposed a basic mathematical model of Agricultural Internet of things in the edge computing environment, in which the data transmission of agricultural products between nodes, the traceability protocol of agricultural products, and distributed computing provide the technical basis for the traceability of agricultural products in the blockchain.

在先前工作中，我们提出一种边缘计算环境下农业物联网的基础数学模型，其中的节点间农产品的数据传输，农产品的溯源协议，分布式计算为区块链农产品溯源提供了技术基础。

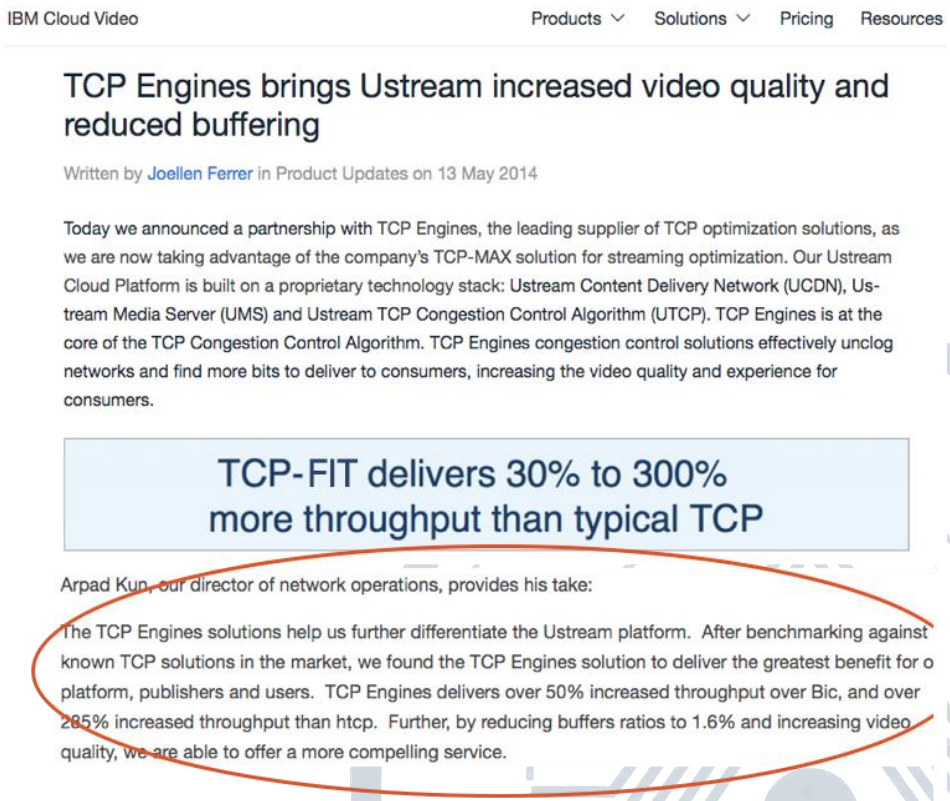
Existing working | 已有工作基础

Data transmission technology for complex network environment

面向复杂网络环境的数据传输技术

Based on the TCP protocol efficiency model and the basic theory of congestion control algorithms, we have established a congestion control algorithm TCP-FIT that can work efficiently in heterogeneous networks. This algorithm improves the TCP slow start algorithm and other modules in response to various complex situations such as packet loss, interference, disorder, and routing re-allocation that are common in the actual blockchain network environment.

在TCP协议效率模型与拥塞控制算法基础理论基础上，我们建立了一种可以高效地在异构网络中工作的拥塞控制算法TCP-FIT。该算法针对实际区块链网络环境中道常见的丢包、干扰、乱序、路由从新分配等多种复杂情况，改进了TCP慢启动算法等模块。



IBM Cloud Video Products Solutions Pricing Resources

TCP Engines brings Ustream increased video quality and reduced buffering

Written by Joellen Ferrer in Product Updates on 13 May 2014

Today we announced a partnership with TCP Engines, the leading supplier of TCP optimization solutions, as we are now taking advantage of the company's TCP-MAX solution for streaming optimization. Our Ustream Cloud Platform is built on a proprietary technology stack: Ustream Content Delivery Network (UCDN), Us-tream Media Server (UMS) and Ustream TCP Congestion Control Algorithm (UTCP). TCP Engines is at the core of the TCP Congestion Control Algorithm. TCP Engines congestion control solutions effectively unclog networks and find more bits to deliver to consumers, increasing the video quality and experience for consumers.

TCP-FIT delivers 30% to 300% more throughput than typical TCP

Arpad Kun, our director of network operations, provides his take:

The TCP Engines solutions help us further differentiate the Ustream platform. After benchmarking against known TCP solutions in the market, we found the TCP Engines solution to deliver the greatest benefit for o platform, publishers and users. TCP Engines delivers over 50% increased throughput over Bic, and over 285% increased throughput than htcp. Further, by reducing buffers ratios to 1.6% and increasing video quality, we are able to offer a more compelling service.

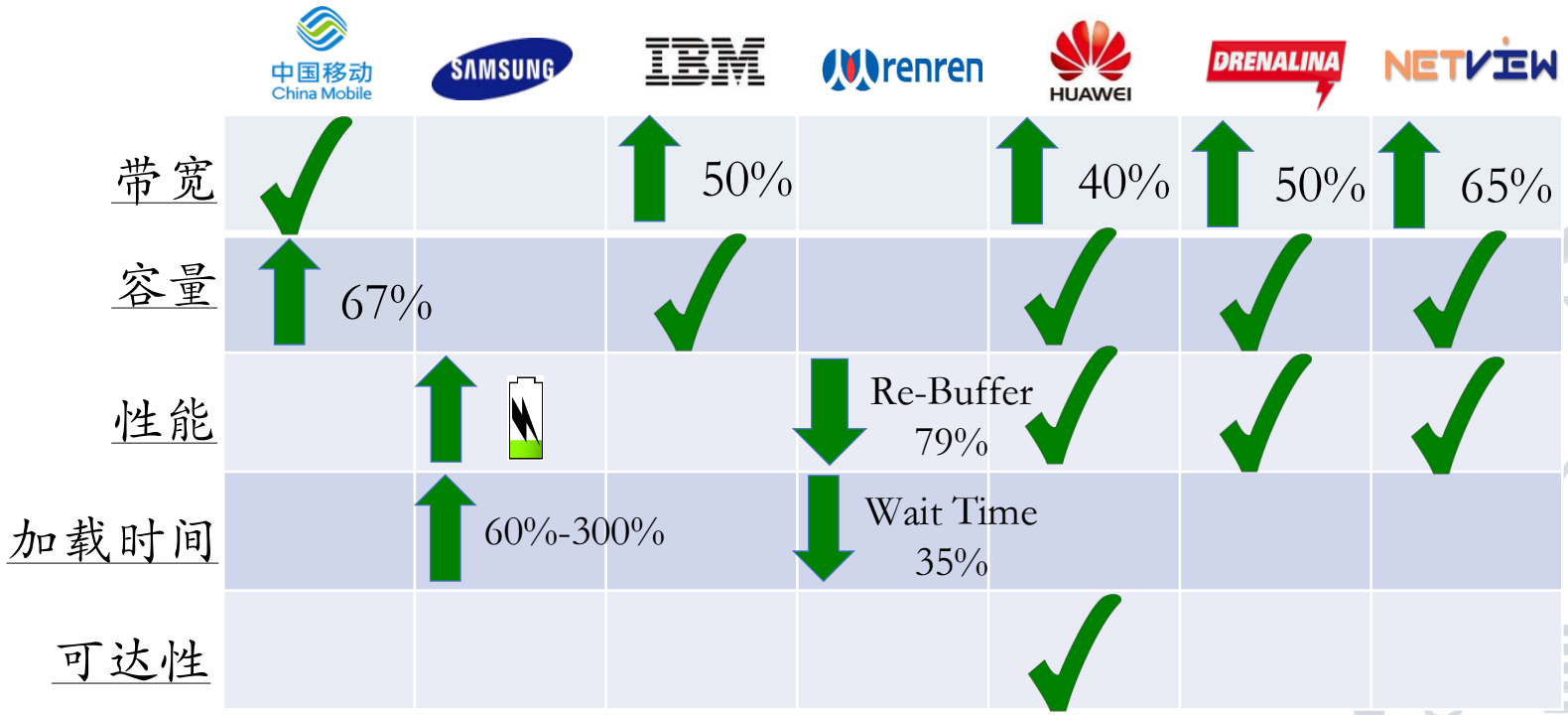
IBM announced on its official website the use of TCO-FIT data acceleration solutions, which increased network throughput by 30%-300%

IBM在其官网宣布采用TCO-FIT数据加速解决方案，网络吞吐率提升30%-300%

Existing working | 已有工作基础

Hybrid network dynamic data transmission technology

混合网络动态数据传输技术

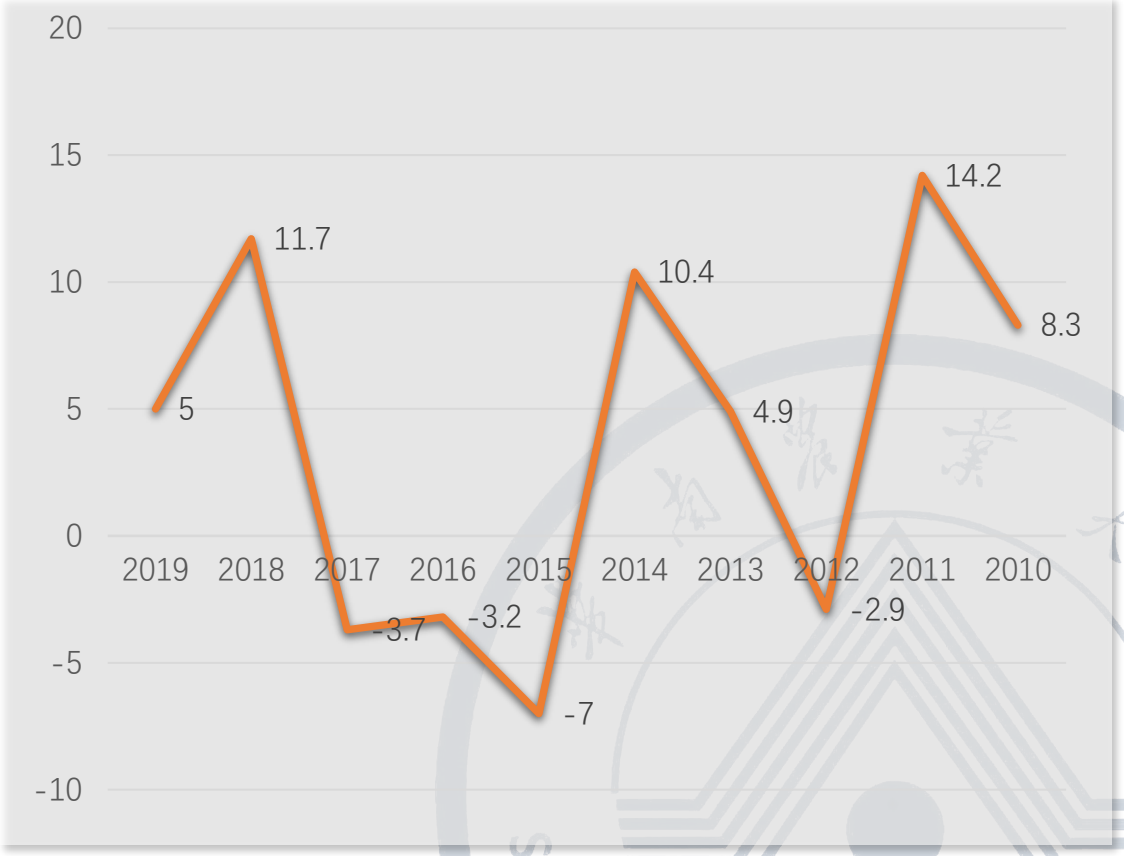


Data Analysis | 数据分析

Research on environmental data analysis | **肉禽养殖环境数据分析**

The egg consumption index of Chinese residents is published by the National Bureau of Statistics of China.From 2010 to 2019, egg consumption in China showed an increasing trend.Compared with 2002, the per capita cash expenditure on eggs in Chinese urban households reached 119 yuan in 2012, an increase of about 101.7 percent.Today, China has become a big consumer of eggs, mainly eggs.Therefore, it is particularly important to study the methods of improving egg productivity and strengthen the modern development of laying hens breeding.

中国居民蛋类消费指数由中国国家统计局公开。2010年至2019年，中国居民蛋类消费基本呈现增长趋势。与2002年相比，2012年中国城镇居民家庭人均蛋类现金支出达119元，增长约101.7%。如今，中国已经成为蛋类消费大国，其中以鸡蛋为主。因此，深入研究提高鸡蛋产能方法，加强蛋鸡养殖现代化发展尤为重要。



Egg consumption index of urban residents in China, 2010-2019 (Last year = 100)

中国居民2010-2019年蛋类消费指数(上一年 = 100)

Data Analysis | 数据分析

Research on environmental data analysis | 肉禽养殖环境数据分析

Correction Analysis: Laying performance of hens and environmental factors in subtropical climate-taking Guangdong Ephedra as an example

亚热带气候下蛋鸡产蛋性能与环境因素关系分析-以广东麻黄鸡为例

来源	温度(℃)	湿度（%）	品种
吴丹[1]	11~23℃无明显变化 29℃后产能明显下滑	无	辽西地区常见品种
毕艳红[2]	14~23℃最优	无	中农3号
杨超[3]	10~25℃（16℃最佳） 30℃后明显下滑	65%	未知
孙晓娟[4]	12~23℃	40%~80%	未知
Castilho [5]	21~28℃	无	海兰蛋鸡
Ferreira [6]	无	40%~70%	海兰蛋鸡

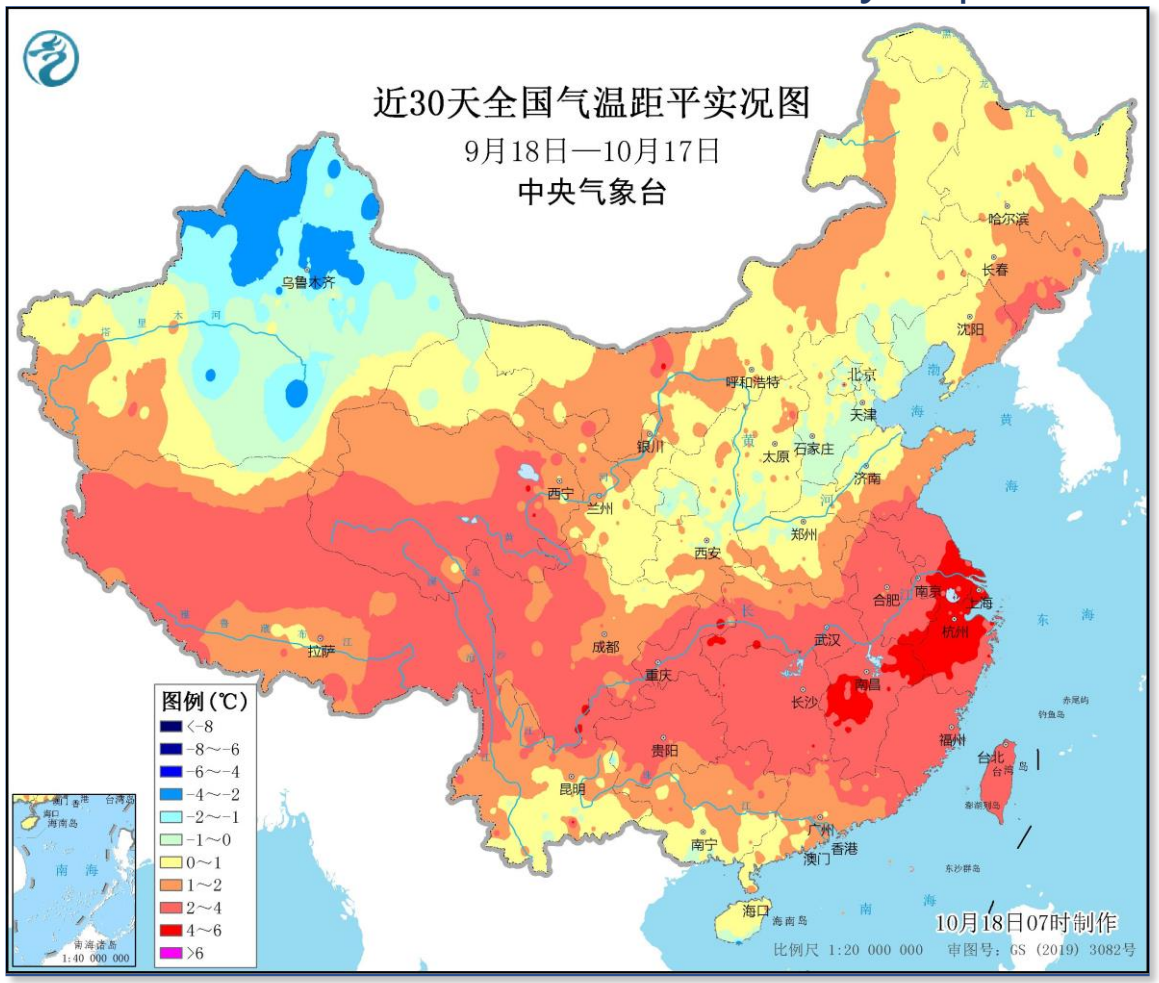
Two-layer cage cultivation of Jiangfeng Paitan chicken farm

江丰派潭双层笼养种鸡场

[1] 吴丹, et al., *辽西地区不同季节鸡舍内温度变化对蛋鸡产蛋重量的影响研究*. 山西农经, 2020(07): p. 105+116.
[2] 毕艳红, *鸡舍温度对蛋鸡采食量和产蛋性能的影响*. 养殖与饲料, 2019(05): p. 19-20.
[3] 杨超, *影响蛋鸡产蛋率的因素及防控措施*. 山东畜牧兽医, 2016. **37**(02): p. 19-20.
[4] 孙晓娟, *影响蛋鸡生产性能的环境因素*. 现代畜牧科技, 2016(10): p. 33.
[5] Castilho, V., et al., Bem-estar de galinhas poedeiras em diferentes densidades de alojamento/Welfare of laying hens in different densities of housing. Revista Brasileira de Engenharia de Biossistemas, 2015. 9(2): p. 122-131.
[6] Ferreira, R.A., Maior produção com melhor ambiente para aves, suínos e bovinos. 2005: Aprenda Fácil Viçosa.

Data Analysis | 数据分析

Research on environmental data analysis | 肉禽养殖环境数据分析



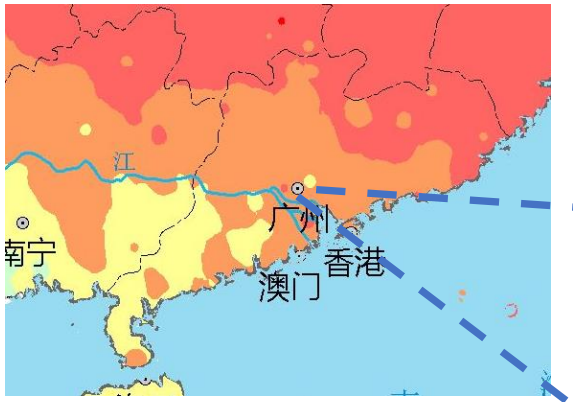
Actual map of national average temperature in recent 30 days | 近30天全国气温距平实况图

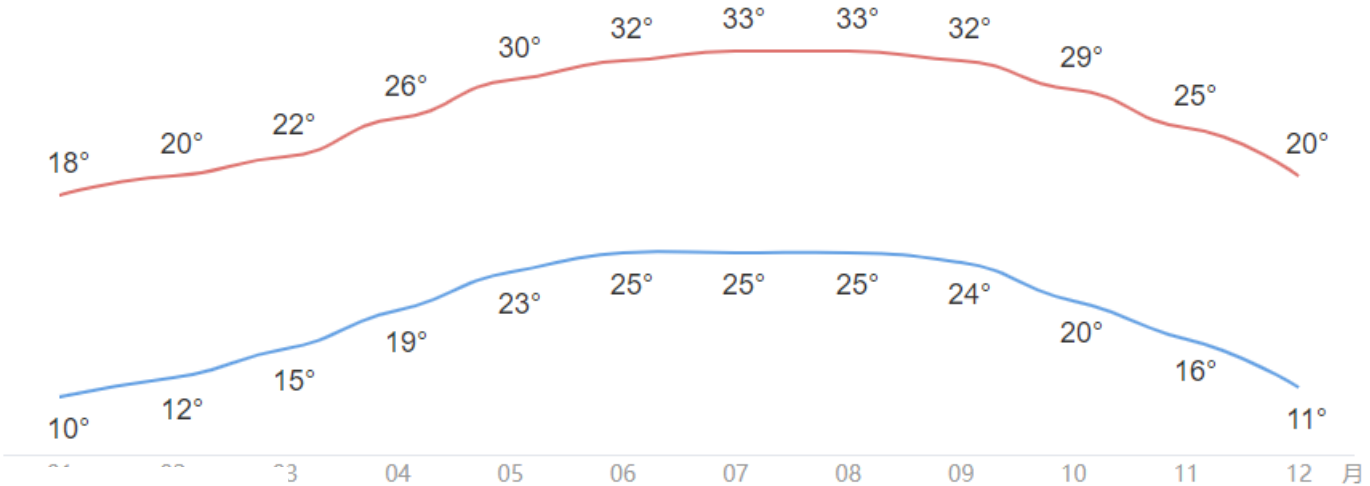
China has a large geographical dimension span, obvious environmental differences between the north and the south, and great differences in breeding conditions, production environment and environmental indicators suitable for production of different varieties. Excessive pursuit of stability and standard suitable range is not only not conducive to the normal growth of laying hens in production, but also increases the production cost.

中国地理上维度跨度大，南北环境差异明显，养殖条件、生产环境、不同品种适合生产的环境指标差异较大。过度的追求稳定和标准的适合区间不仅不利于蛋鸡的正常生长于生产，同时也增大了生产成本。

Data Analysis | 数据分析

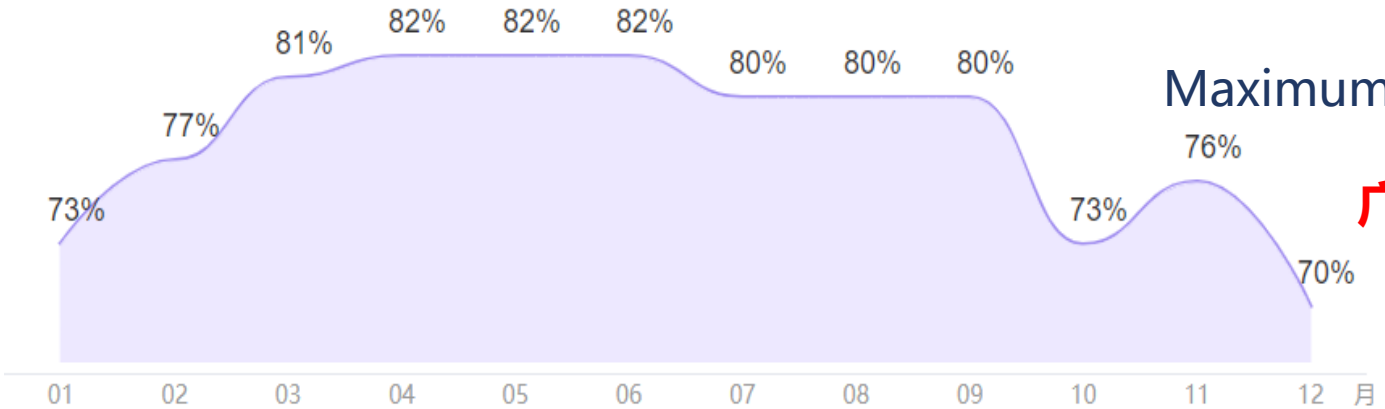
Research on environmental data analysis | **肉禽养殖环境数据分析**





Maximum/minimum temperature in Guangzhou every month (2009–2018)

广州每月最大/平均温度（2009-2018）



Maximum/minimum humidity in Guangzhou every month (2009–2018)

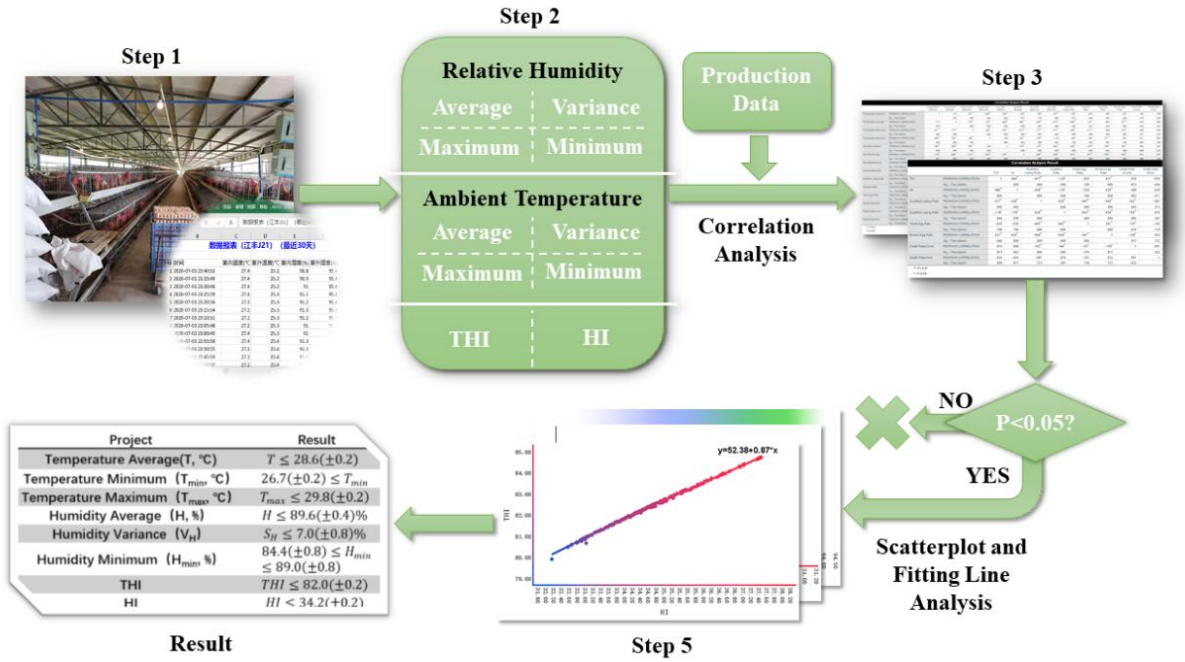
广州每月最大/平均湿度（2009-2018）

Data Analysis | 数据分析

Research on environmental data analysis | 肉禽养殖环境数据分析

Correction Analysis: Laying performance of hens and environmental factors in subtropical climate-taking Guangdong Ephedra as an example

亚热带气候下蛋鸡产蛋性能与环境因素关系分析-以广东麻黄鸡为例



Flow chart of analysis

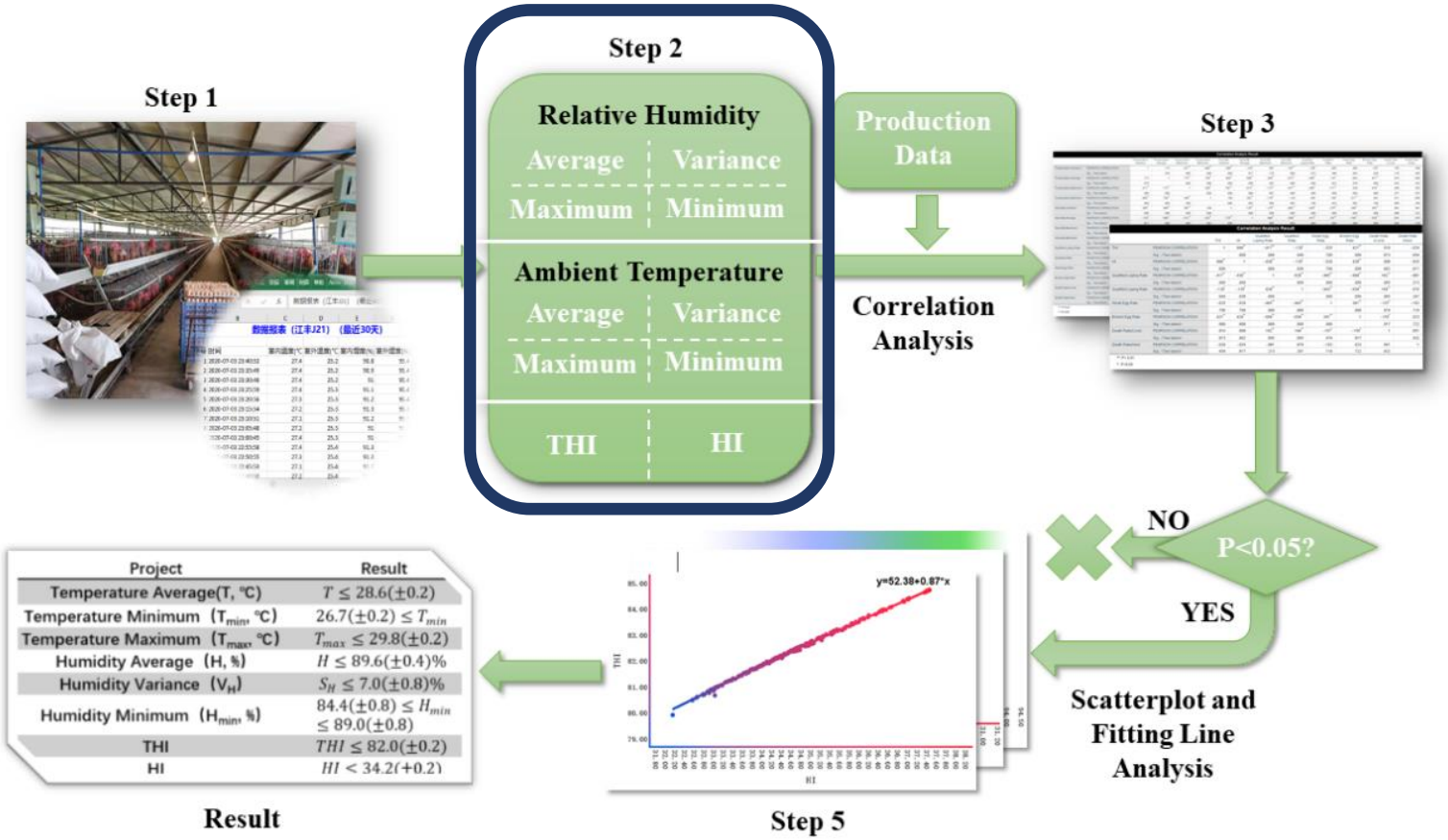
分析流程图

In this analysis, we collected 248 sets of production data of four chicken houses from July to September, and adopted a new analysis method, combined with the actual characteristics of layer production, to complete data analysis without affecting the actual production.

在本次分析中，我们采集了7月-9月约三个月四个鸡舍共248组生产数据，并采用了一种新的分析思路，结合蛋鸡生产的实际特点，在不影响实际生产的前提下完成数据分析。

Data Analysis | 数据分析

Flow chart of analysis | 分析流程

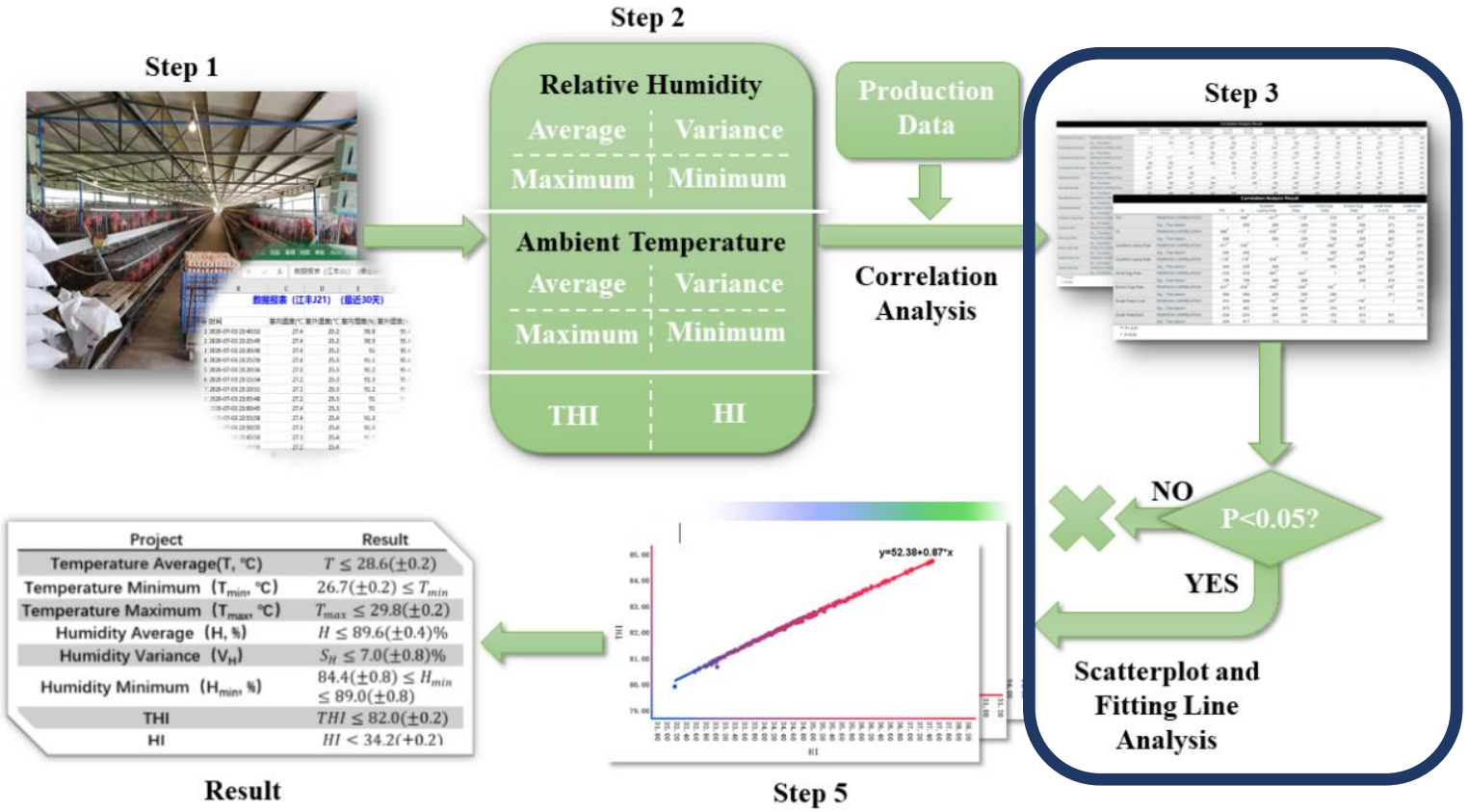


We also considered the mean, maximum, minimum and variance of temperature and humidity to analyze the effects of extremes, variations and general levels of temperature and humidity on the productivity of laying hens in a day.

我们同时考量温度与湿度的平均值、最大值、最小值与方差，用以分析一天中温度与湿度的极端情况、变化情况与一般水平对蛋鸡产能的影响。

Data Analysis | 数据分析

Flow chart of analysis | 分析流程



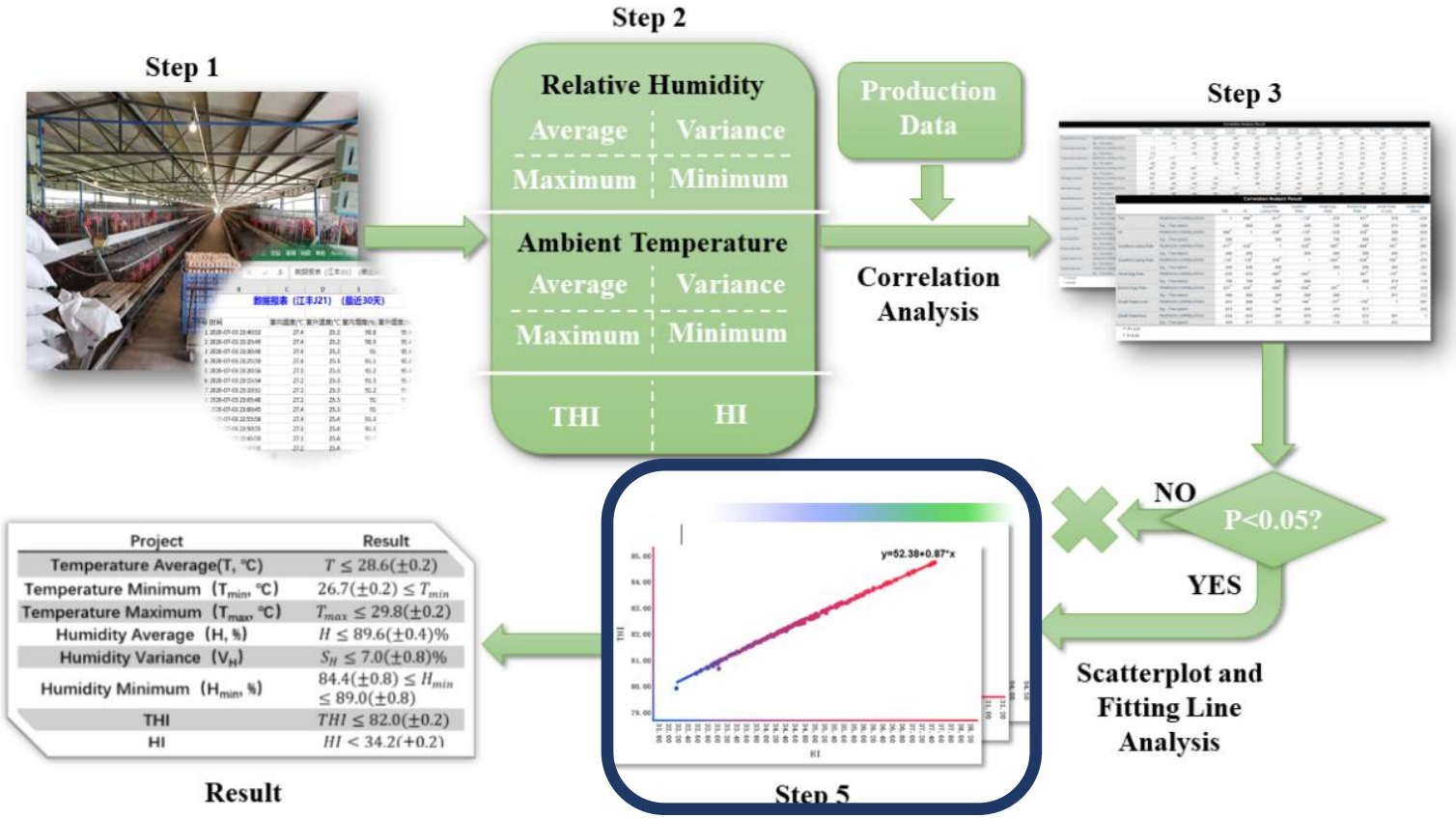
Project	Result
Temperature Average(T, ℃)	$T \le 28.6(\pm 0.2)$
Temperature Minimum (T_{min}, ℃)	$26.7(\pm 0.2) \le T_{min}$
Temperature Maximum (T_{max}, ℃)	$T_{max} \le 29.8(\pm 0.2)$
Humidity Average (H, %)	$H \le 89.6(\pm 0.4)\%$
Humidity Variance (V_H)	$S_H \le 7.0(\pm 0.8)\%$
Humidity Minimum (H_{min}, %)	$84.4(\pm 0.8) \le H_{min} \le 89.0(\pm 0.8)$
THI	$THI \le 82.0(\pm 0.2)$
HI	$HI < 34.2(+0.2)$

Then the correlation between environmental index and production index is analyzed and significant correlation index is obtained.

接着对环境指标与生产指标进行相关性分析，获得相关性显著指标。

Data Analysis | 数据分析

Flow chart of analysis | 分析流程



Draw scatter diagram and fitting curve, analyze curve and inflection point, get the final analysis result

绘制散点图和拟合曲线，对曲线以及拐点进行分析，得到最终分析结果。

Data Analysis | 数据分析

Flow chart of analysis | 分析流程

In addition to single factor analysis of environmental variables, we also analyzed comprehensive index Temperature–Humidity Index (THI) and Heat-index (HI). THI and HI take into account the comprehensive effects of temperature and humidity, and are used to express the comfort and adaptability of animals under different temperature and humidity environments.

除了对环境变量进行单因素分析，我们也同时分析了综合性指标THI(舒适度指数)[1]与HI(热指数)[2]。THI与HI同时考虑了温度与湿度的综合影响，并用以表达动物在不同温度、湿度环境下的舒适度与适应性水平。

$$THI = 1.8 \times T_a - (1 - RH) \times (T_a - 14.3) + 32$$

$$HI = T_a - 1.0799 e^{0.03755 T_a} \times [1 - e^{0.0801 \times (D - 14)}]$$

$$D = \frac{b \times \alpha}{a - \alpha} \qquad \alpha = \frac{a \times T_a}{b + T_a} + \ln(RH)$$

$$b = 237.3 \qquad a = 17.27$$

[1] Kibler, H., Thermal effects of various temperature-humidity combinations on Holstein cattle as measured by eight physiological responses. Research Bulletin Missouri Agricultural Experiment Station, 1964. 862: p. 1-42.

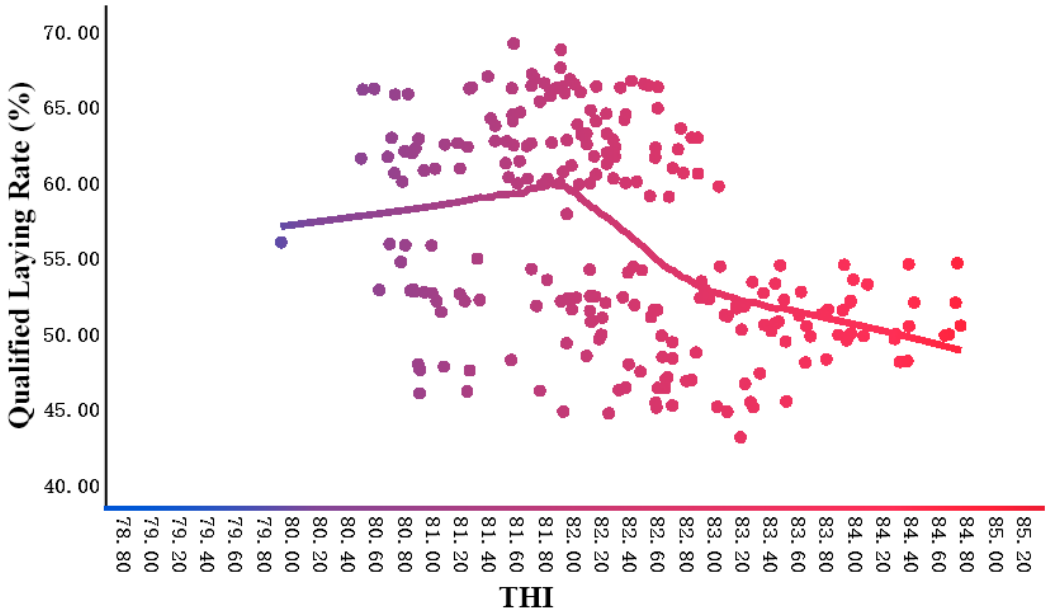
[2] Schoen, C., A new empirical model of the temperature–humidity index. Journal of applied meteorology, 2005. 44(9): p. 1413-1420.

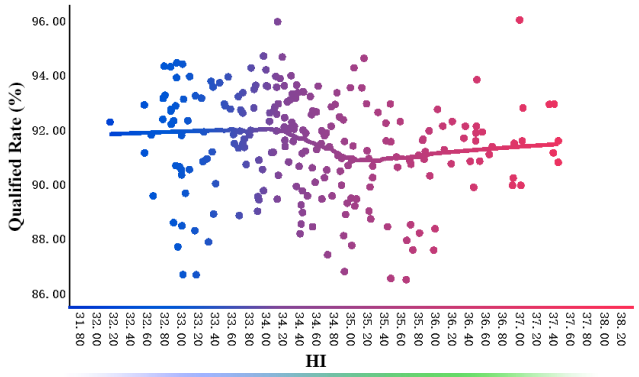
Data Analysis | 数据分析

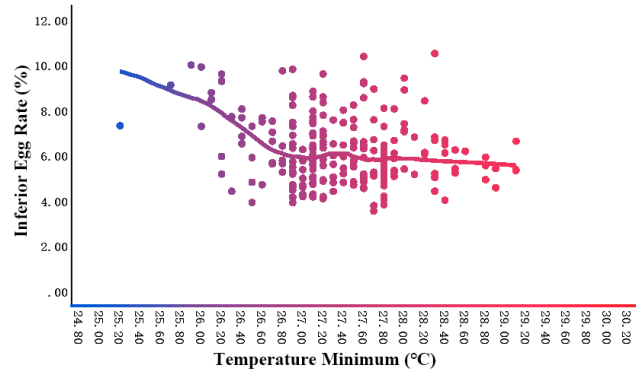
Flow chart of analysis | 分析流程

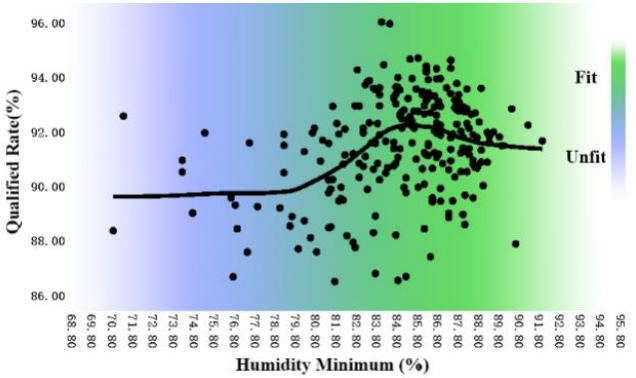
Finally, scatter diagram and inflexion point of fitting curve are analyzed and the analysis results are obtained.

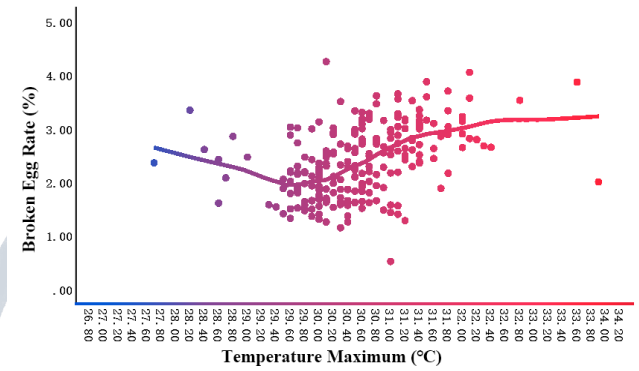
最终对散点图与拟合曲线拐点进行分析，得到分析结果。

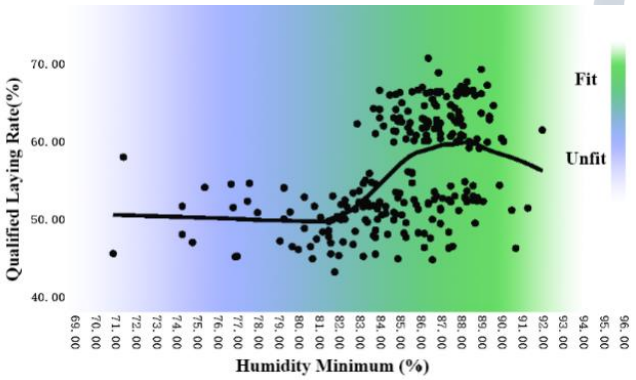


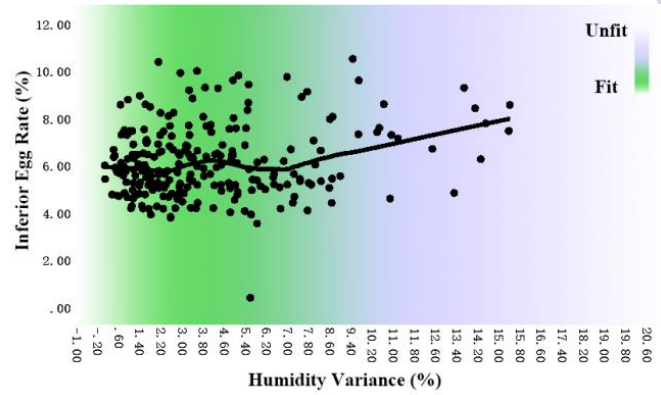










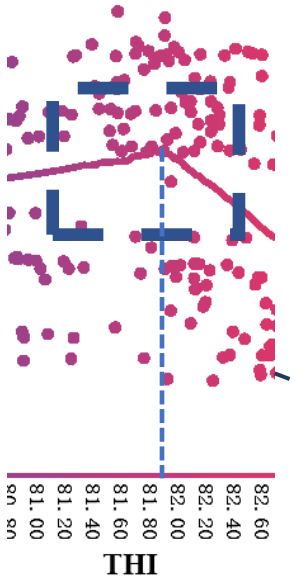


Data Analysis | 数据分析

Flow chart of analysis | 分析流程

Finally, scatter diagram and inflexion point of fitting curve are analyzed and the analysis results are obtained.

最终对散点图与拟合曲线拐点进行分析，得到分析结果。



ITEM	RESULT
Indoor temperature average (T，℃)	$T \leq 28.6(\pm 0.2)$
Indoor temperature minimum （T_{min}，℃）	$26.7(\pm 0.2) \leq T_{min}$
Indoor temperature maximum （T_{max}，℃）	$T_{max} \leq 29.8(\pm 0.2)$
Indoor humidity average （H，%）	$H \leq 89.6(\pm 0.4)\%$
Indoor humidity variance （V_H）	$V_H \leq 7.0(\pm 0.8)\%$
Indoor humidity minimum （H_{min}，%）	$84.4(\pm 0.8)\% \leq H_{min} \leq 89.0(\pm 0.8)\%$
Temperature–Humidity index(THI)	$THI \leq 82.0(\pm 0.2)$
Heat index(HI)	$HI \leq 34.2(\pm 0.2)$

Analysis result

分析结果

High-throughput integrated color space detection platform
高通量一体化颜色空间检测平台

Key scientific problems to be solved | 要解决的关键科学问题

Campylobacter is one of the most common food-borne pathogens and caused more than $200 million in losses in the United States in 2018
弯曲菌是最常见的食源性致病菌之一，2018在美国造成了两亿多美元的损失

- Strict control of its spread is urgently needed
- 迫切需要对其传播进行严格把控
- However, there is still a lack of efficient detection methods
- 但目前尚缺少高效的检测方法

The isolation and identification of Campylobacter is difficult, the culture period is long, and the detection is difficult
弯曲菌分离鉴定困难，培养周期长，检测难度大

- It is necessary to reduce testing cost, improve testing efficiency and develop new detection methods
- 必须降低检测成本，提高检测效率， 开发新型检测方法

Traditional PCR method has low sensitivity and requires expensive variable temperature reaction equipment
传统PCR方法灵敏度低，且需要昂贵的变温反应设备

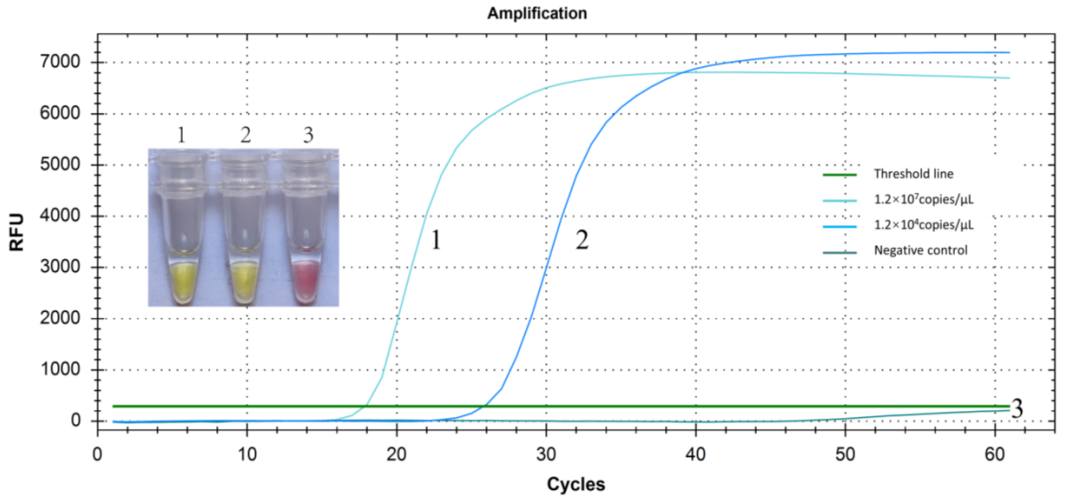
- Loop-mediated isothermal amplification (LAMP) detection can effectively reduce the cost of detection, that is, it does require temperature changing equipment, and has higher sensitivity than traditional nucleic acid detection methods
- LAMP检测可以有效降低检测成本，即不需要变温设备，并且灵敏度比传统核酸检测方法更高
- LAMP method lacks a high throughput, integrated and automatic transmission detection platform
- LAMP检测方法缺少高通量、一体化和自动传输的检测平台

Platform Development | 检测平台开发

LAMP assay | LAMP检测方法建立

ceuE (ID: 17456756) was used as the target gene for the detection of C. coli and start the Establishment and optimization of a basic LAMP reaction system.

我们计划使用弯曲菌的*ceuE* (ID: 17456756) 基因作为目标基因。建立并优化基本的LAMP反应体系。



Establish reaction system

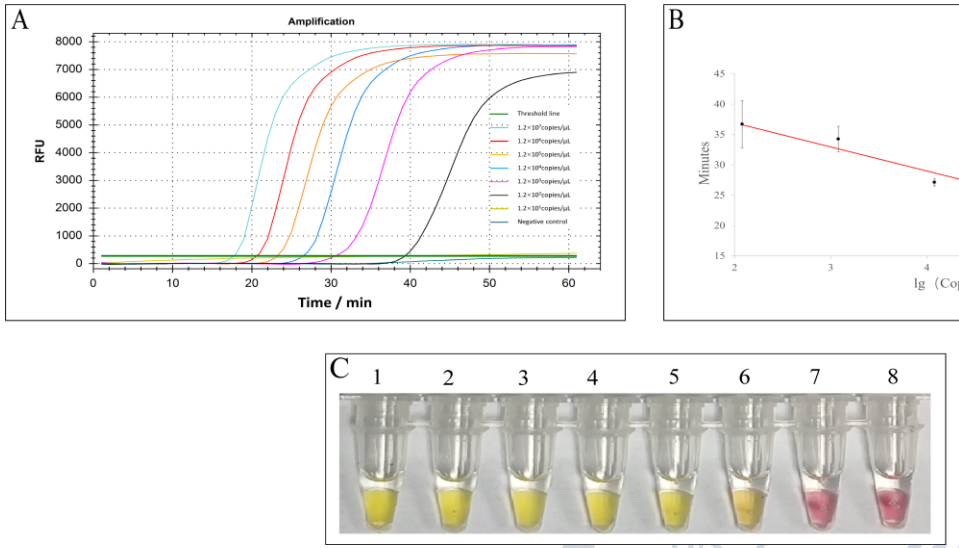
建立反应体系

Platform Development | 检测平台开发

LAMP assay | LAMP检测方法建立

To determine the limit of detection (LOD) of our LAMP method and to compare its sensitivity with that of PCR, ceuE-containing plasmids were used as the template. They were serially diluted by 10-fold to achieve copy numbers ranging from 1.2 × 107 copies/μL to 12 copies/μL. The fluorescent dye SYTO9 was added to characterize the reaction; fluorescence signals were subsequently detected and a standard curve was constructed. All experiments were performed in triplicate.

为了确定我们的 LAMP 方法的检测限 (LOD) 并将其灵敏度与 PCR 的灵敏度进行比较，使用含有 ceuE 的质粒作为模板。 它们被连续稀释 10 倍，以实现从 1.2 × 10^7 拷贝/μL 到 12 拷贝/μL 的拷贝数。加入荧光染料SYTO9对反应进行表征；随后检测荧光信号并构建标准曲线。所有实验一式三份进行。



Sensitivity experiment

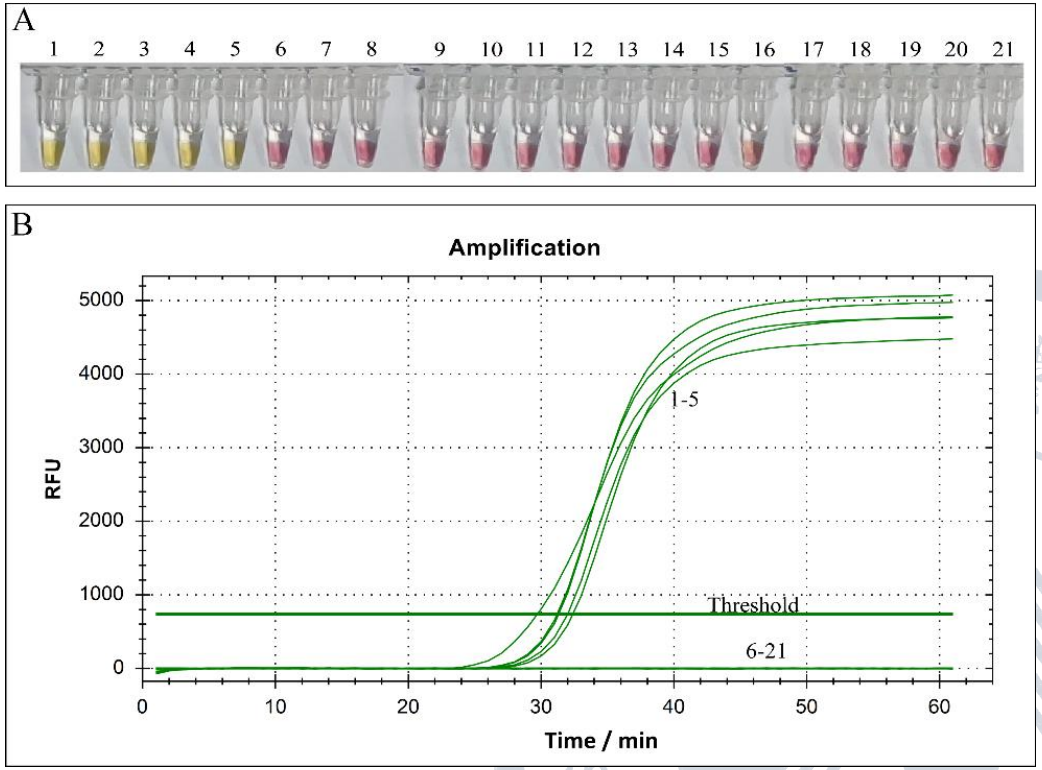
敏感性实验

Platform Development | 检测平台开发

LAMP assay| **LAMP检测方法建立**

To determine the specificity of our method, we tested five C. coli, five C. jejuni, and 10 non-Campylobacter (Salmonella pullorum, S. typhimurium, S. enteritidis, Pseudomonas aeruginosa, Escherichia coli, Listeria monocytogenes, L. iuanuii, Staphylococcus aureus, Shigella, and Riemerella anatipestifer) strains. In the control group, deionized water was added instead of the template. All experiments were replicated three times.

为了确定我们的方法的特异性，我们测试了 5 种大肠杆菌、5 种空肠弯曲杆菌和 10 种非弯曲杆菌（白喉沙门氏菌、鼠伤寒沙门氏菌、肠炎沙门氏菌、铜绿假单胞菌、大肠杆菌、单核细胞增生李斯特菌、伊万里李斯特菌、金黄色葡萄球菌、志贺氏菌和鸭疫里默氏杆菌）菌株。对照组加入去离子水代替模板。所有实验均重复 3 次。



Establish reaction system

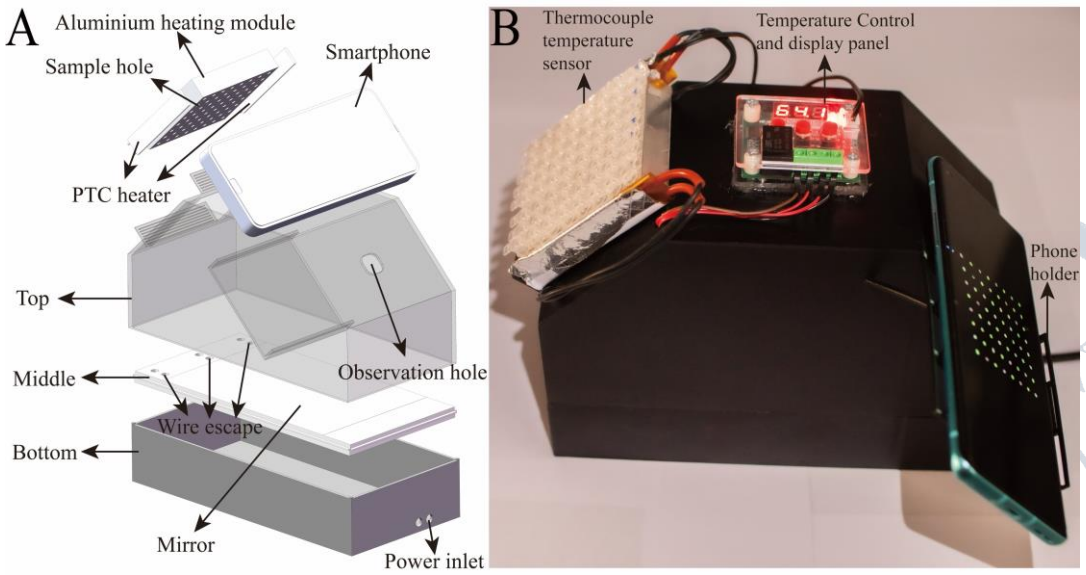
建立反应体系

Platform Development | 检测平台开发

Design and manufacture of the detection cassette | 检测暗盒的设计与制造

For high-throughput analyses of samples, we developed a portable all-in-one cassette, which consisted of three parts: upper, middle, and lower. On the upper part of the cassette, a self-made aluminum heating module was present along with a OnePlus 8 smartphone for result visualization (90° angle between them).

对于样品的高通量分析，我们开发了一种便携式一体化暗盒专职，它由上、中、下三部分组成。 在盒子的上部，有一个自制的铝制加热模块以及一个用于结果可视化的智能手机（它们之间的角度为 90°）。



Detection Cassette

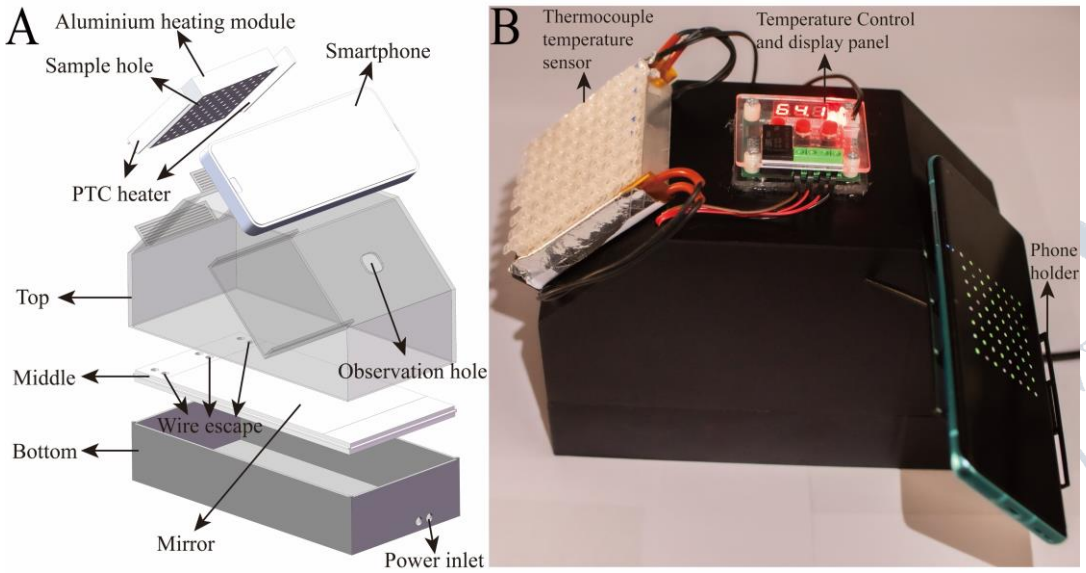
检测暗盒

Platform Development | 检测平台开发

Design and manufacture of the detection cassette | 检测暗盒的设计与制造

The bottom of the heating module had 64 1.5-mm radius holes, which could accommodate 64 EP tubes, and its square design ensured uniformity in temperature sensing. On the sides of the heating module, 2 to 3 positive temperature coefficient ceramic heating plates were placed; thermal conductive silicone grease was used to keep the plates close to the module to ensure proper heat transfer.

加热模块底部有64个半径为1.5mm的孔，加热模块可容纳64支EP管，其方形设计确保了温度传感的均匀性。在加热模块的侧面，放置2～3块正温度系数陶瓷加热板； 导热硅脂用于保持板靠近模块以确保适当的热传递。



Detection Cassette

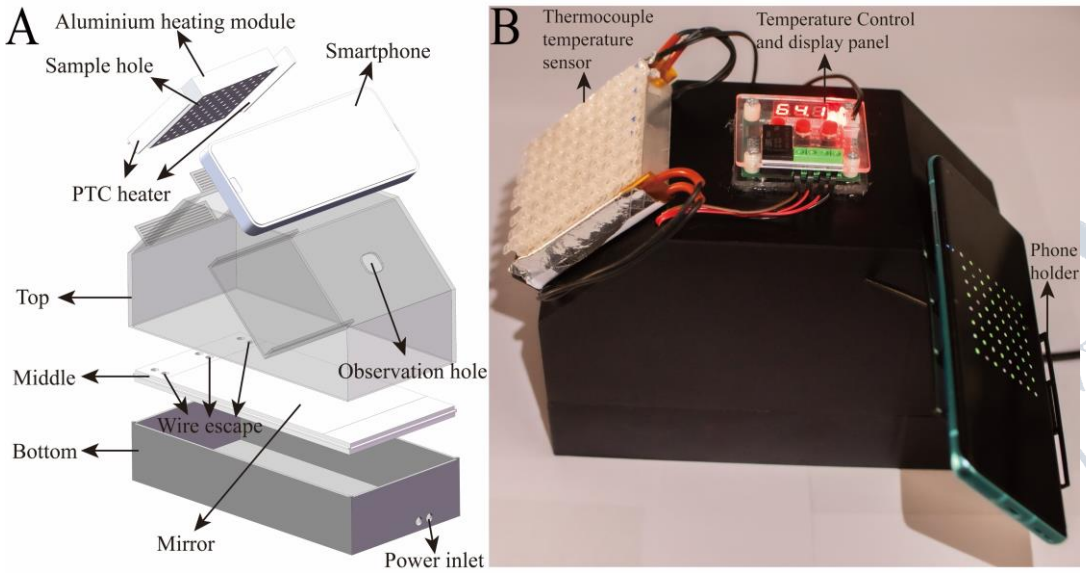
检测暗盒

Platform Development | 检测平台开发

Design and manufacture of the detection cassette | 检测暗盒的设计与制造

Natural light penetrated the sample tube via a diffuser, which was made of expandable polyethylene and served as a thermal insulator; consequently, the color of each sample was reflected on the smartphone camera through a mirror installed in the middle part of the cassette.

自然光通过漫射器穿透样品管，扩散器由发泡聚乙烯制成并用作热绝缘体； 因此，每个样品的颜色通过安装在暗盒中间部分的镜子反映在智能手机相机上。



Detection Cassette

检测暗盒

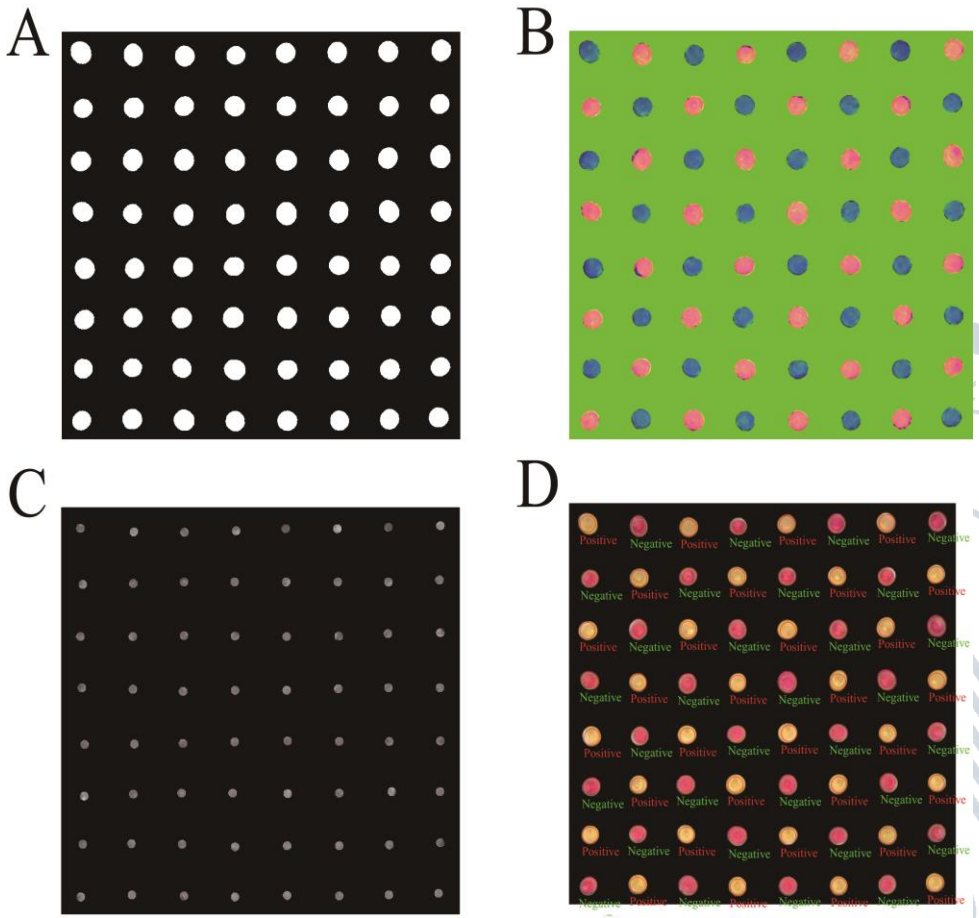
Platform Development | 检测平台开发

Automated, high-throughput detection algorithm based on HSI color space

自动化、高通量的基于HSI颜色空间的检测算法

The sample images obtained on the smartphone were analyzed using a self-created program. The images in red–green–blue (RGB) color space were converted to HSI color space, and the hue (H channel) value was then used to determine the output signal of the sample hole. The H channel value is expressed as angular quantity, and the value was between 0 and 1 after normalization through dividing by 2π.

使用自创程序分析在智能手机上获得的样本图像。将红绿蓝(RGB) 颜色空间中的图像转换为HSI颜色空间，然后使用色调（H 通道）值来确定样品孔的输出信号。H通道值用角度量表示，除以2π归一化后，其值在0到1之间。



Detection Algorithm flow

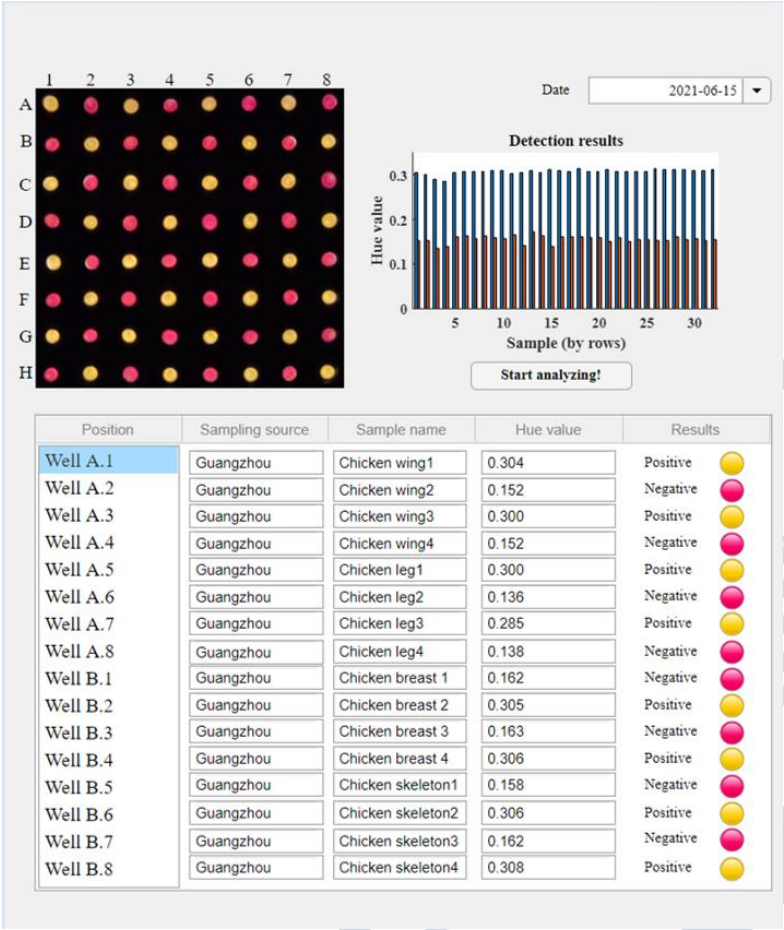
检测算法流程

Platform Development | 检测平台开发

Cloud processing software | 云处理软件

For uploading sample images obtained by the smartphone to the cloud, the MATLAB® Drive connector was connected to the computer, and images were added to the inspection program directory; data were then uploaded to the cloud postreaction. The mobile terminal was able to view information pertaining to negative and positive samples in real time.

将智能手机获取的样本图像上传到云端，将MATLAB® Drive连接器连接到计算机，并将图像添加到检测程序目录中；然后将数据上传到云后分析。移动终端能够实时查看有关负样本和正样本的信息。



Position	Sampling source	Sample name	Hue value	Results
Well A.1	Guangzhou	Chicken wing1	0.304	Positive
Well A.2	Guangzhou	Chicken wing2	0.152	Negative
Well A.3	Guangzhou	Chicken wing3	0.300	Positive
Well A.4	Guangzhou	Chicken wing4	0.152	Negative
Well A.5	Guangzhou	Chicken leg1	0.300	Positive
Well A.6	Guangzhou	Chicken leg2	0.136	Negative
Well A.7	Guangzhou	Chicken leg3	0.285	Positive
Well A.8	Guangzhou	Chicken leg4	0.138	Negative
Well B.1	Guangzhou	Chicken breast 1	0.162	Negative
Well B.2	Guangzhou	Chicken breast 2	0.305	Positive
Well B.3	Guangzhou	Chicken breast 3	0.163	Negative
Well B.4	Guangzhou	Chicken breast 4	0.306	Positive
Well B.5	Guangzhou	Chicken skeleton1	0.158	Negative
Well B.6	Guangzhou	Chicken skeleton2	0.306	Positive
Well B.7	Guangzhou	Chicken skeleton3	0.162	Negative
Well B.8	Guangzhou	Chicken skeleton4	0.308	Positive

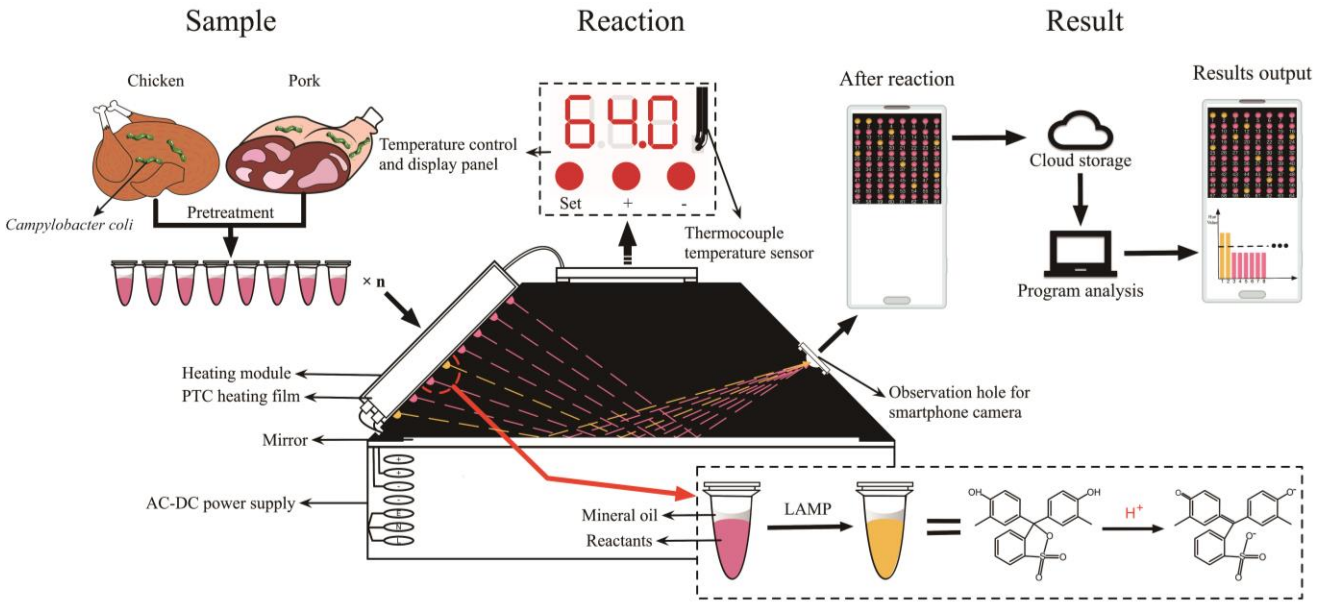
Software Interface
软件界面

Platform Performance | 检测平台性能

The performance of detection platform | **检测平台的性能**

In comparison to using a smartphone app, using cloud storage and cloud computing facilitates the processing of a large quantity of output data, making real-time high-throughput detection possible.

与使用智能手机应用程序相比，使用云存储和云计算有助于处理大量输出数据，使实时高通量检测成为可能。



Automated, high-throughput detection platform

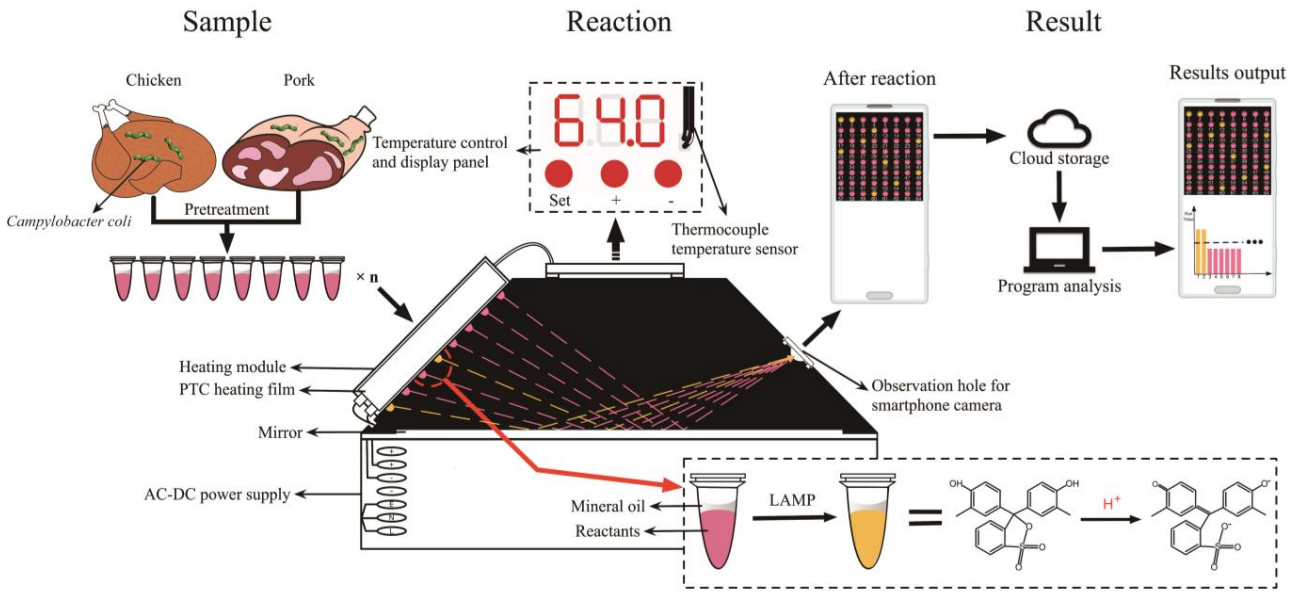
高通量、一体化检测平台

Platform Performance | 检测平台性能

The performance of detection platform | 检测平台的性能

In addition, the cassette ensured a stable focusing distance, and sample information could be quickly and conveniently obtained via the smartphone camera. Considering the design of our HICS platform, we could achieve higher throughput at a lower price as compared to other detection methods; moreover, our platform showed better integration. These advantages, such as low cost and rapid high-throughput detection, imply that our HICS platform has broad application prospects.

此外，暗盒保证了稳定的对焦距离，可以通过智能手机摄像头快速方便地获取样品信息。考虑到我们的HICS 平台的设计，与其他检测方法相比，我们可以以更低的价格实现更高的吞吐量；此外，我们的平台显示出更好的集成。这些低成本和快速高通量检测等优势意味着我们的HICS平台具有广阔的应用前景。



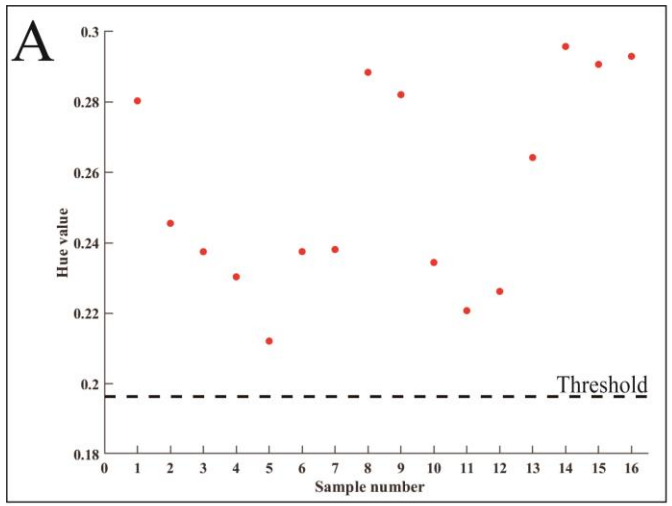
Automated, high-throughput detection platform

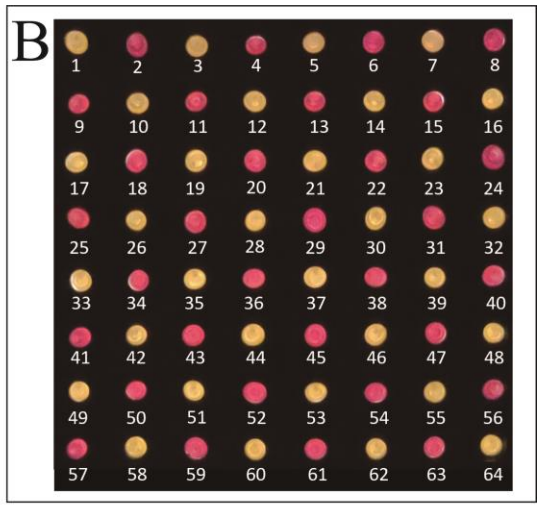
高通量、一体化检测平台

Platform Performance | 检测平台性能

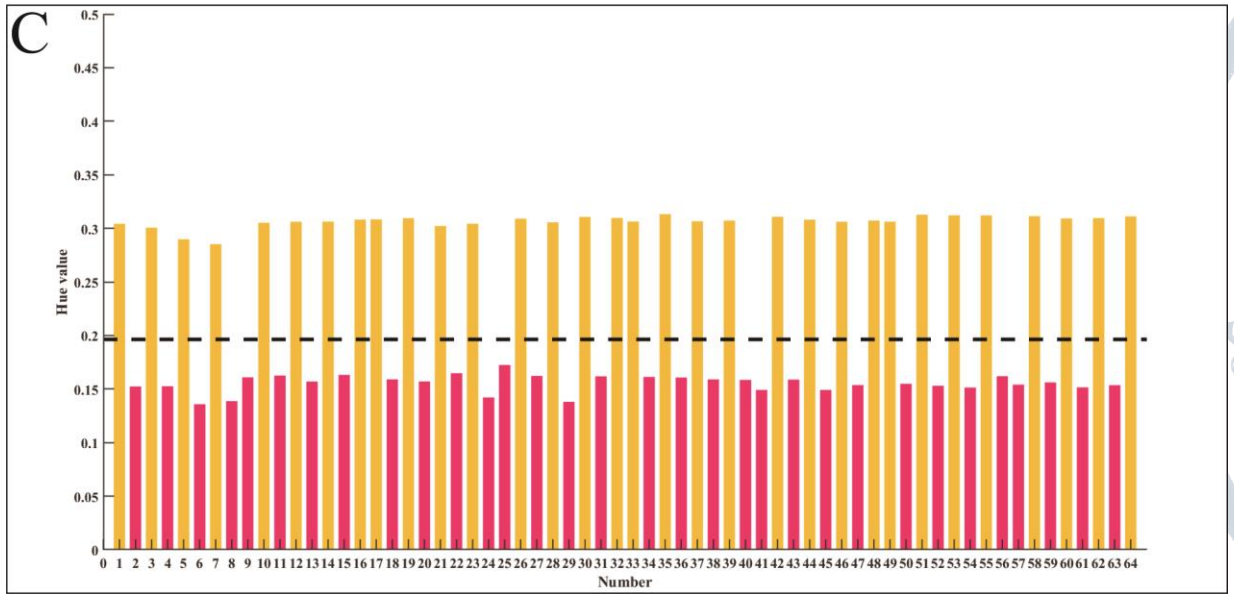
The performance of detection platform (Laboratory sample) | 检测平台的性能

Determine the detection threshold
确定检测阈值





Sample image acquisition
获取样品图像



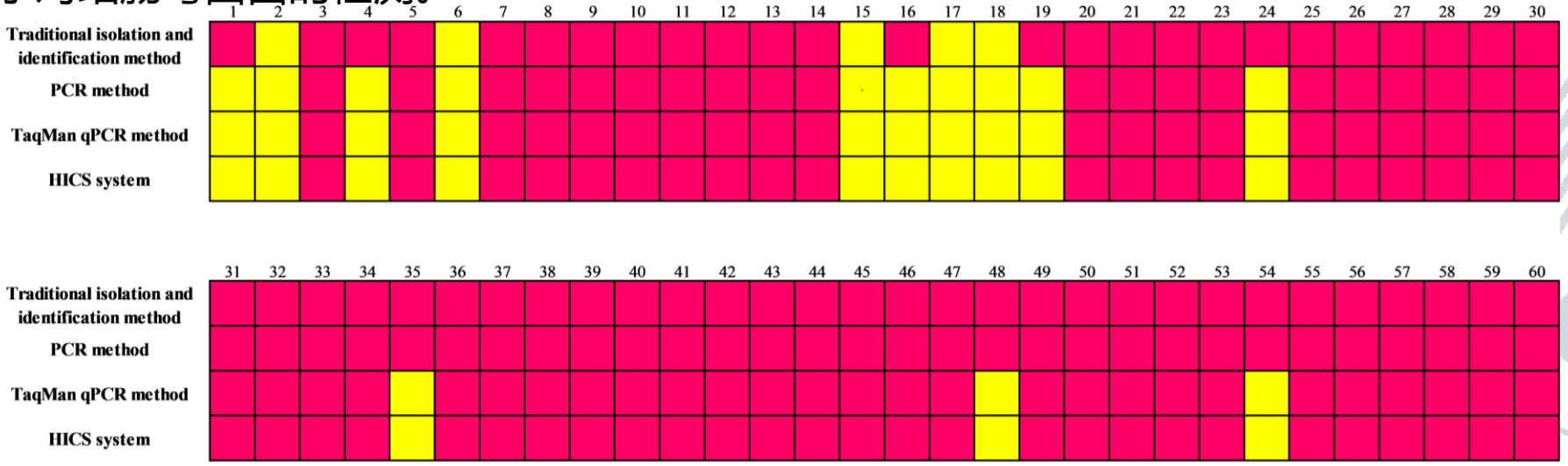
Automatic qualitative analysis
自动定性分析

Platform Performance | 检测平台性能

The performance of detection platform (Actual sample: pork, chicken) | **检测平台的性能**

All samples detected as positive by the traditional isolation and identification method or PCR were also detected as positive by our method; in addition, three samples detected as positive by our method were completely missed by the other two methods, but captured by HICS platform and TaqMan qPCR. These findings indicated that the HICS platform could detect C. coli in meat samples with adequate sensitivity and did not produce any false-negative results. To the best of our knowledge, such a high-throughput, smart detection platform has been used for the first time for Campylobacter detection.

通过传统的分离鉴定方法或PCR检测为阳性的所有样品也被我们的方法检测为阳性；此外，我们的方法检测为阳性的三个样本被其他两种方法完全遗漏，但被 HICS 平台和 TaqMan qPCR 方法检测到。这些发现表明 HICS 平台可以以足够的灵敏度检测肉类样品中的结肠弯曲菌，并且不会产生任何假阴性结果。据我们所知，这种高通量、智能的检测平台是首次用于对结肠弯曲菌的检测。

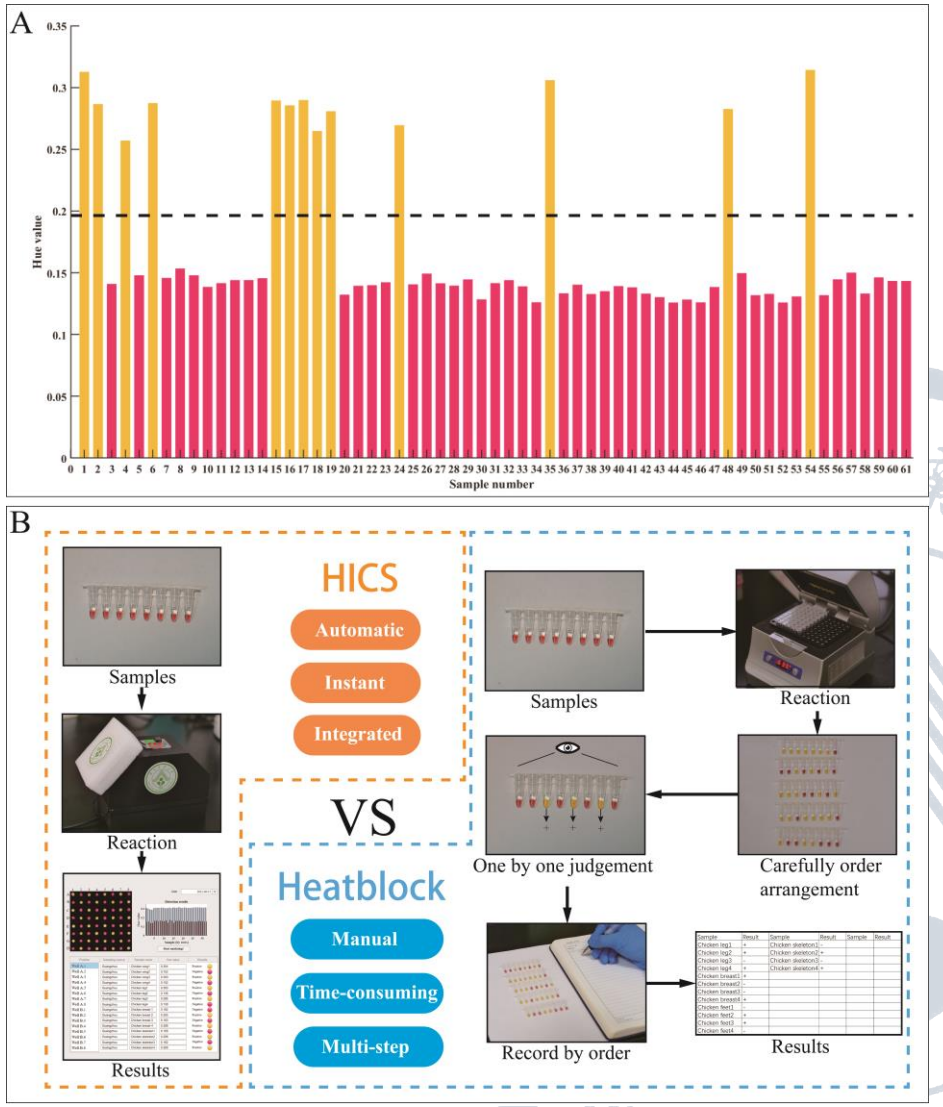


Platform Performance | 检测平台性能

Comparison with traditional methods | 与传统方法的对比

In comparison with traditional approaches, our method is more efficient and does not require complex procedures, thus offering a new alternative for the on-site detection of Campylobacter spp.

与传统方法相比，我们的方法效率更高，不需要复杂的程序，从而为弯曲杆菌属的现场检测提供了一种新的选择。



Thank You For Listening

感谢聆听

华南农业大学

South China Agricultural University