Valorization of waste products from poultry industry

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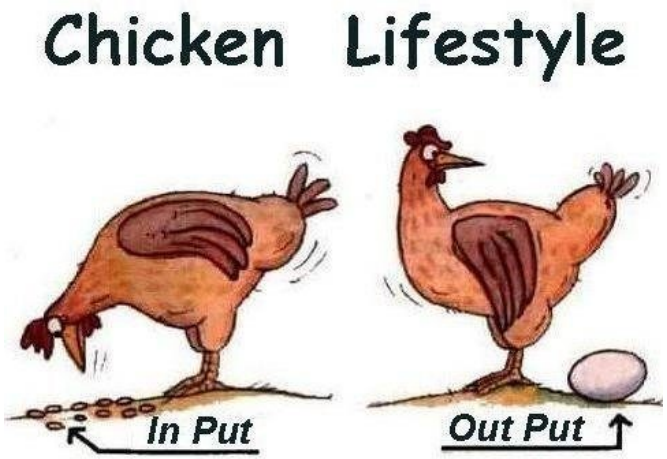
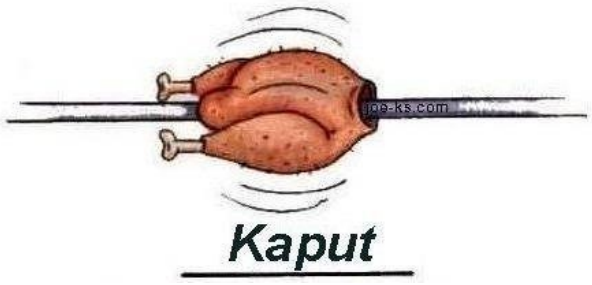
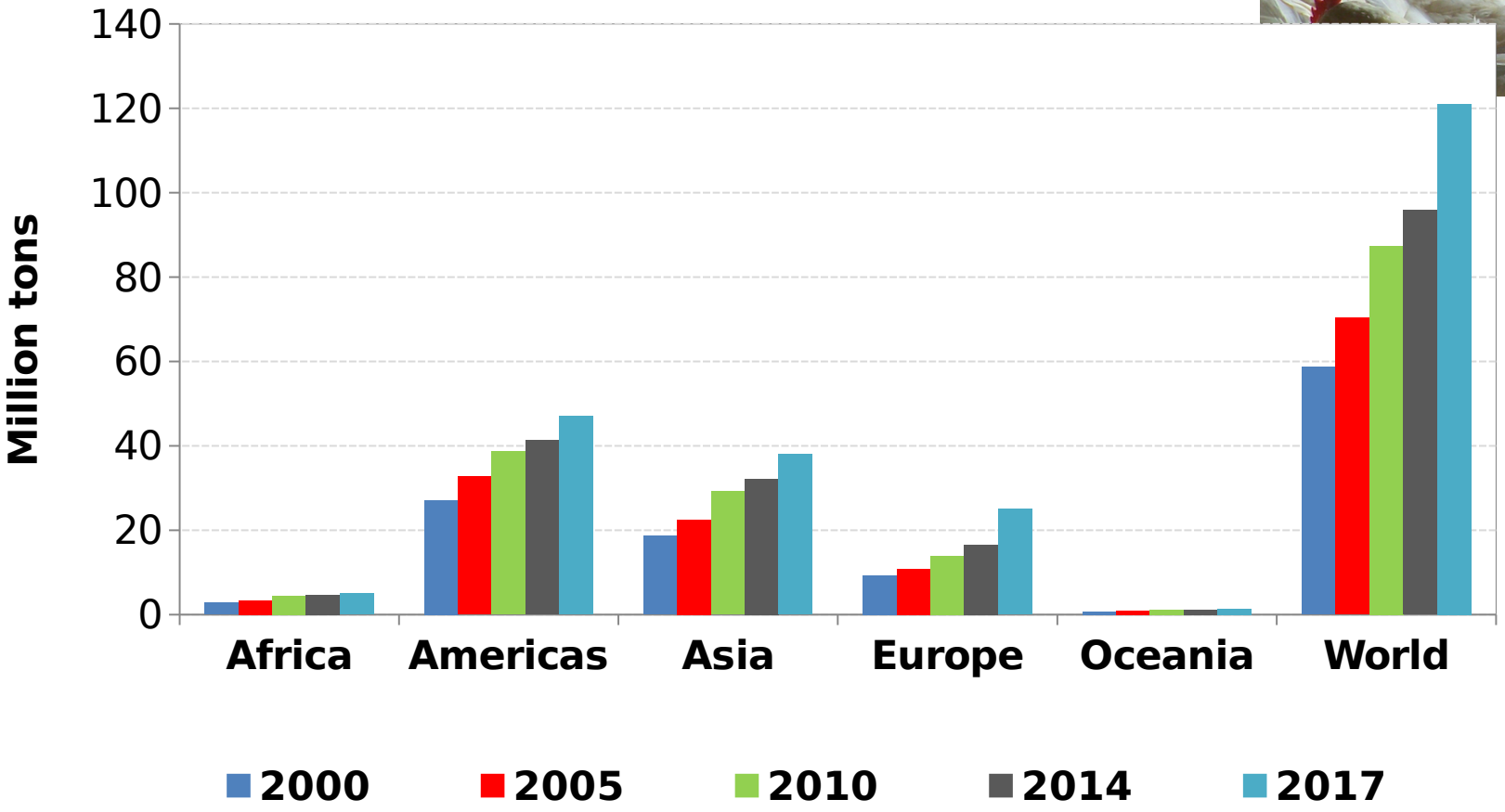
Why waste from poult industry?





Enormous amount of waste products

World chicken product



Global poultry trends ,2014,

Poultry waste products

Slaughter yields 71 - 79%

Chicken waste products:

1. **Feather (6-9% of weight of chicken)**
2. Skin
3. Organs (*e.g.* intestine, lung)
4. Claws
5. Fat
6. Blood
7. **Waste mixture after mechanical deboning (6-8% of weight of chicken)**

Feather waste

The feather production
Czech Republic - around 12 thousand of tonnes annually
Worldwide - around 6-8 millions of tonnes annually

What happens with feather?

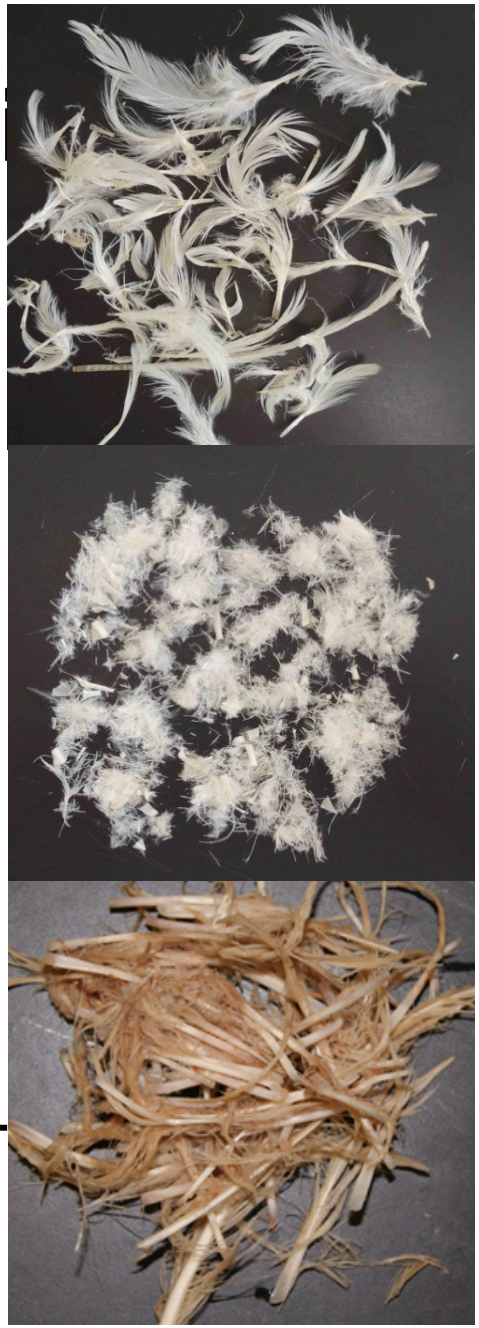
Feather composition

- Over 90% protein, majority is beta-keratine, insoluble structural protein
- Fat 2%

Raw feather hydrolysis

- Whole cell microbial hydrolysis
  - using strains with keratinolytic activities
- Enzymatic hydrolysis
  - using semipurified keratinase
- Chemical hydrolysis
  - using mild alkali condition
    - 0.6% of NaOH, 70 °C

Compare the hydrolysates



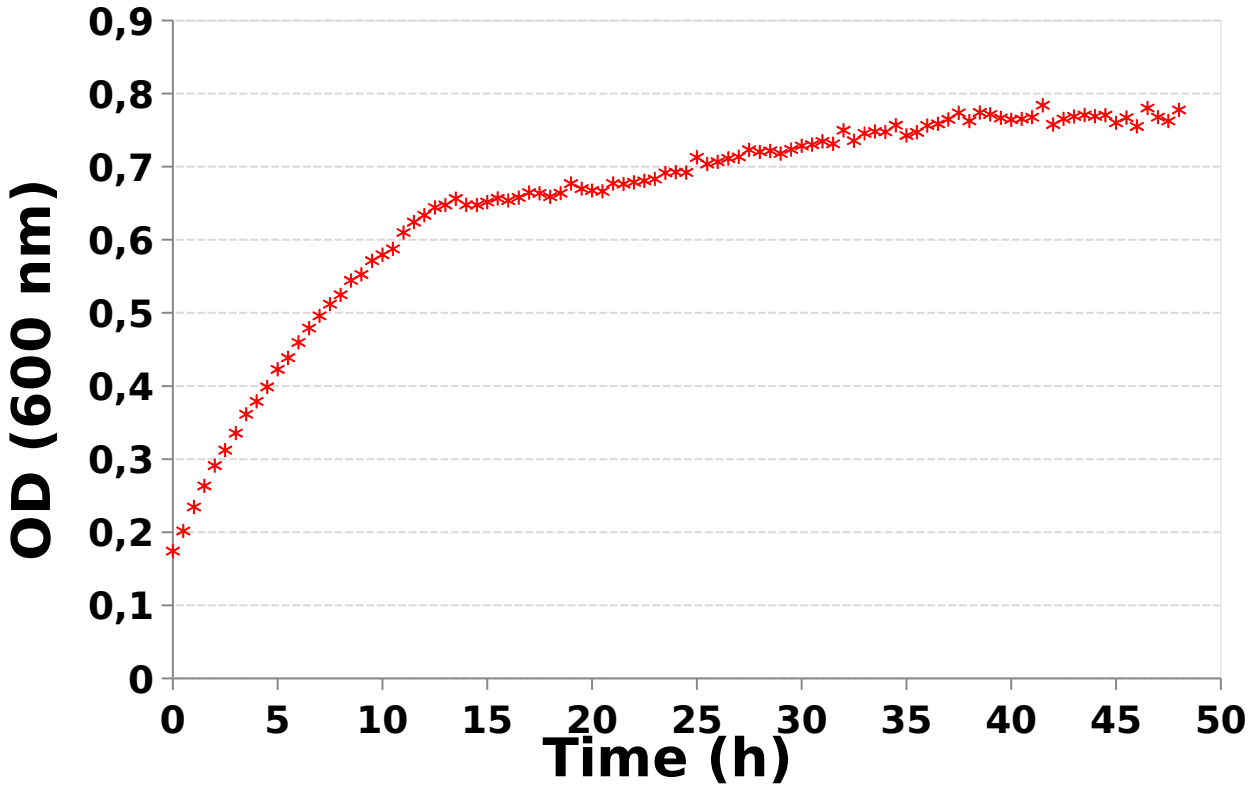
Feather hydrolysates

Type of hydrolysis	Amino acids [g/L]	Peptides [g/L]
***Pseudomonas* sp. P5 (A)**	0.30 ± 0.03	6.2 ± 0.2
***Pseudomonas* sp. P5 (B)**	0.27 ± 0.07	4.6 ± 0.1
Keratinase (A)	**1.05 ± 0.15**	3.2 ± 0.2
Keratinase (B)	**1.09 ± 0.08**	3.3 ± 0.2
Alkali cond. (A)	0.33 ± 0.05	**17.2 ± 2.6**
Alkali cond. (B)	0.38 ± 0.02	**14.3 ± 0.1**

A - The initial amount of wet raw feather material was 90 g/L (31.9 g of dry feather /L).
B - The initial amount of wet raw feather material was 70 g/L (24.9 g of dry feather g/L).

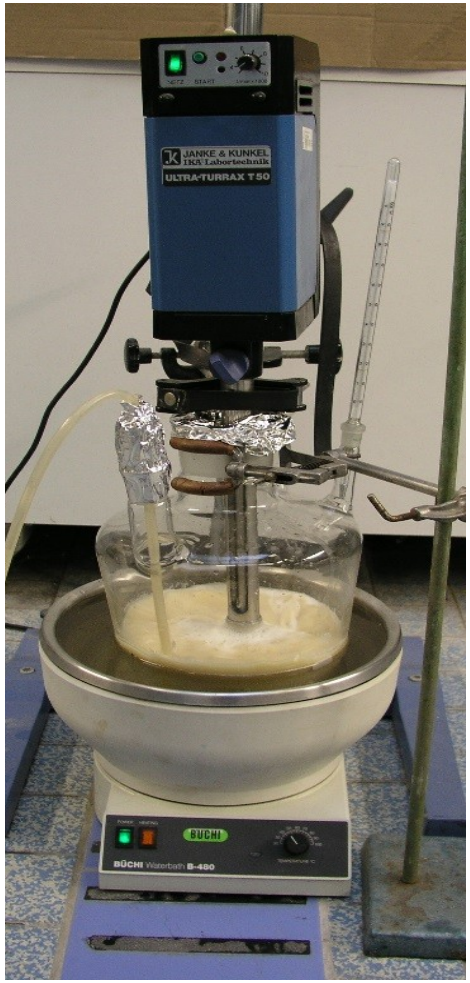
Hydrolysates – source of nutrients for bacterial growth

Hydrolysates – sterilized, neutralized with HCl (alkali hydrolysis)
Tested microorganism – *Escherichia coli*
Biomass concentration measured for 48 h on Bioscreen system



Hydrolyzates obtained by Alkali, Enzymatic, Microbial
Luria-Bertani broth, Control - unhydrolyzed feather

Alkaline hydrolysis – semi-scale operation



5 L volume
Temperature70 °C
0.6% NaOH
Dispensator Ultra-Turrax T50

Feather hydrolysis 90%

Before hydrolysis

hydrolysis

After

Conclusions – feather re-utilization

Application of hydrolysates:

- Organic fertilizers
- Peptone substituent in a culture media
- Low cost supplements
- In cosmetics

Publication:

Stiborova H., *et al.*: **Transformation of raw feather waste into digestible peptides and amino acids**., J. Chem. Technol. Biotechnol. 2016, 91: 1629-1637

Patent:

PV 2015-102: Complete cultivation medium for production of ethanol or butanol, its production ways and production ways of ethanol or butanol - Patakova P., *et al.*

Waste after mechanical deboning

Waste after mechanical deboning - 6-8% weight of chicken
Contain - cartilage, bones and skin and meat

Mechanical separator

Wast
e

Process of bioactive compounds isolation

Waste after mechanical deboning

Phosphate buffer

Sterilization

Hydrolysis - papain

Enzyme inactivation

Removal of unhydrolyzed parts

Fat separation

Filtration of the hydrolyzate through kieselguhr

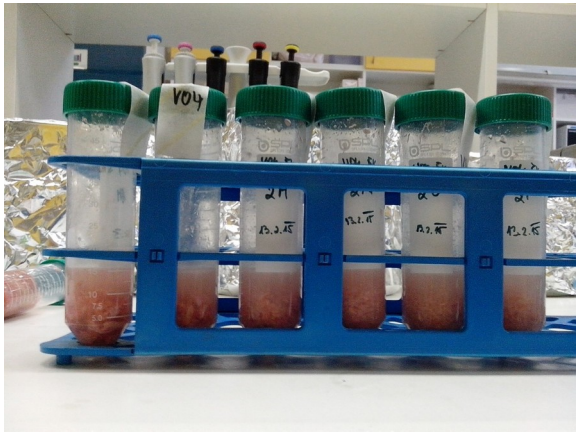
Product concentration

Lyofilization or drying

Product - CHONDROMIX

Chondroitin, hyaluronic acid, peptides, amino acids

Product CHONDROMIX - processing scale-up



Lab-scale: 10 g of waste

Lab-scale: 60 - 600 g of waste

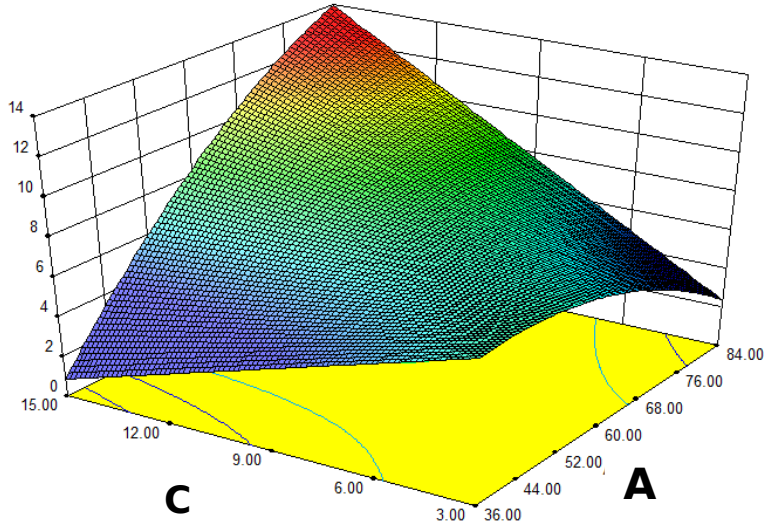
Product CHONDROMIX

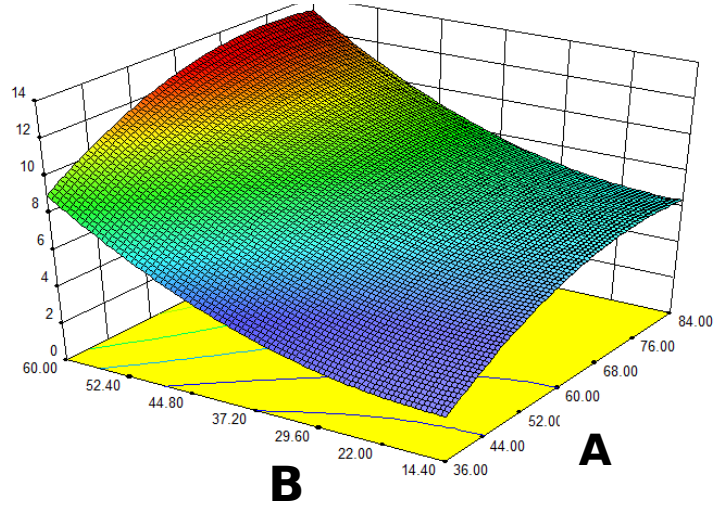
Product

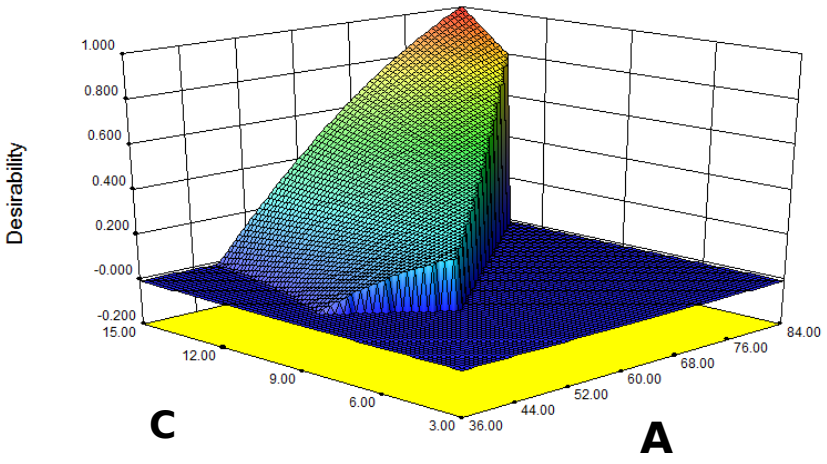
Semi-scale: 25 kg of

Process optimization

- to obtain minimum 10% of hydrolyzate (containing at least 10% hyaluronic acid)







<u>Process optimization -</u> Expert Design 8

A – volume of buffer/60 g of waste material

tested from 36 to 84 ml

B – amount of enzyme (papaine)/60 g of waste material

tested from 14.4 mg to 60 mg/60 g of waste material

C - time of hydrolysis

tested from 3 to 15 hrs

Products comparision

Pure cartilage mixture product

Source – pure cartilage

Patent - WO2012143324

Mixture

- chondroitin sulfate 15% - 25% (w/w)
- hyaluronic acids 0.1-1.0% (w/w)
- protein and peptides 67% - 87% (w/w)

CHONDROMIX

Source – waste after mechanical deboning

Patent - PV 2016-788

Mixture

- chondroitin sulfate 6% - 17% (w/w)
- hyaluronic acids 10 - 15% (w/w)
- protein and peptides 60% - 80% (w/w)
- amino acids up to 3%

Stiborova *et al.* **Waste products from the poultry industry: a source of high-value dietary supplements**, J. Chem. Technol. Biotechnol., accepted

Founding and team collabor

Founded by Technological Agency of the Czech Republic
- project BIORAF TE 01020080

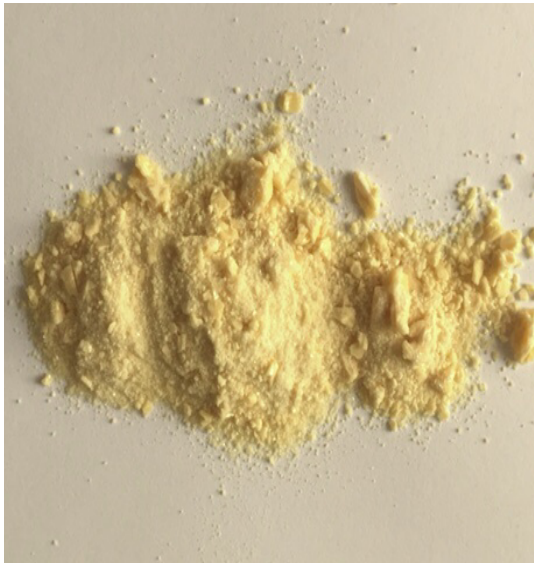
Teams from University of Chemistry and Technology

Group of prof. Demnerová – Dr. Hana Stiborová, doc. Dr. Petra Lovecká
Group of prof. Melzoch – doc. Dr. Petra Patáková, Dr. Barbora Branská, Dr. Leona Paulová
Group of prof. Hajšlová and prof. Poustka – doc. Dr. Milena Zachariášová, Dr. Monika Jírů

Ecofuel Laboratory s.r.o.

- Dr. Petr Kaštánek and Ing. RABBITová

Product CHONDROMIX – from waste after mechanical deboning



Product - CHONDROMIX