شیوه های نوین تولید اسیدهای آلی
و بهبود اثر آنها در دستگاه گوارش طیور

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سرآغاز گفتار من نام اوست   که آرامش دل دهد یاد دوست

به او می سپارم سرانجام کار   که هر چیز را او بخواهد نکوست

OA history

OA usage

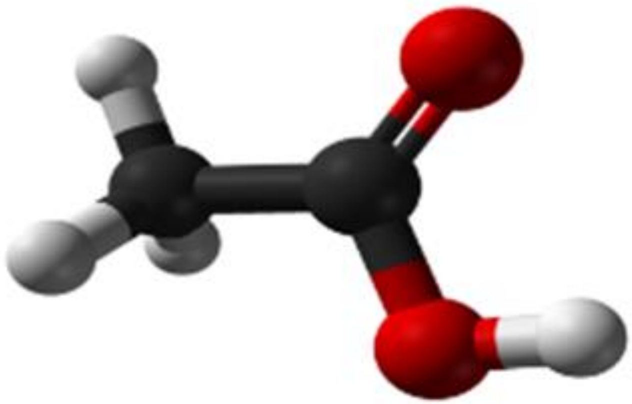

Professional Series
Ready-to-Use
OdoBan
Organic Acid
Shower Cleaner
Ácido orgánico limpiador para duchas

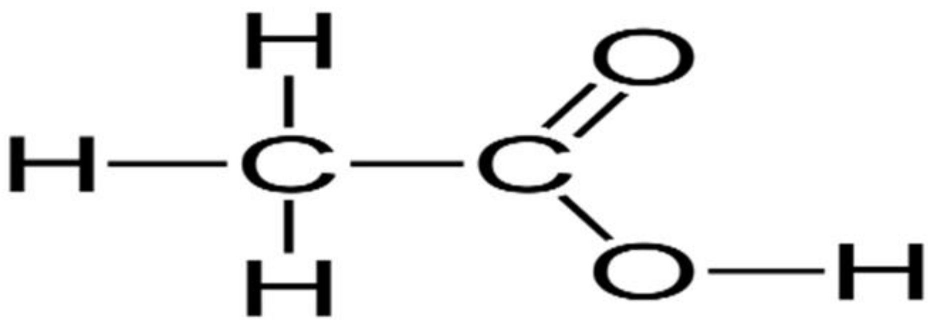
OA structure

LCA	≥C12
MCA	C6 to C10
SCA	≤C4

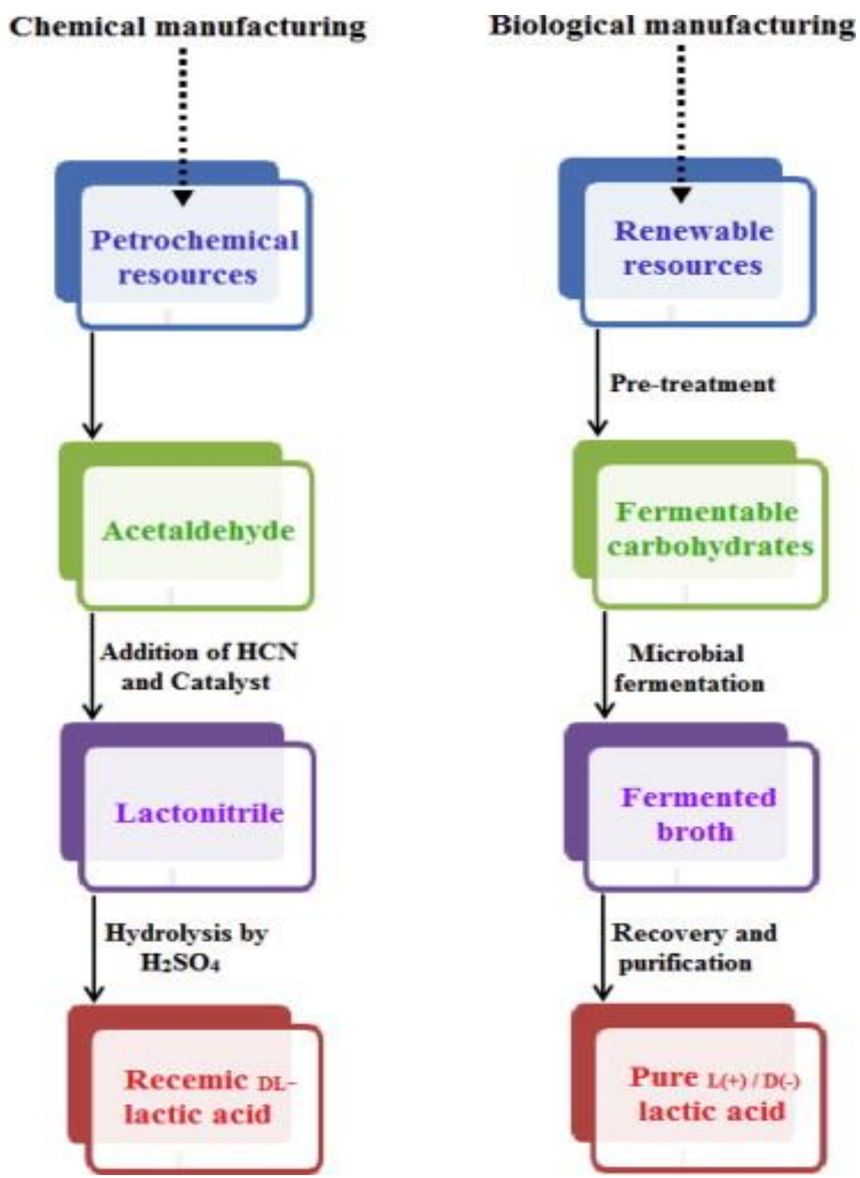
OA

short chain (1-7 C) carboxylic (R-COOH) acids

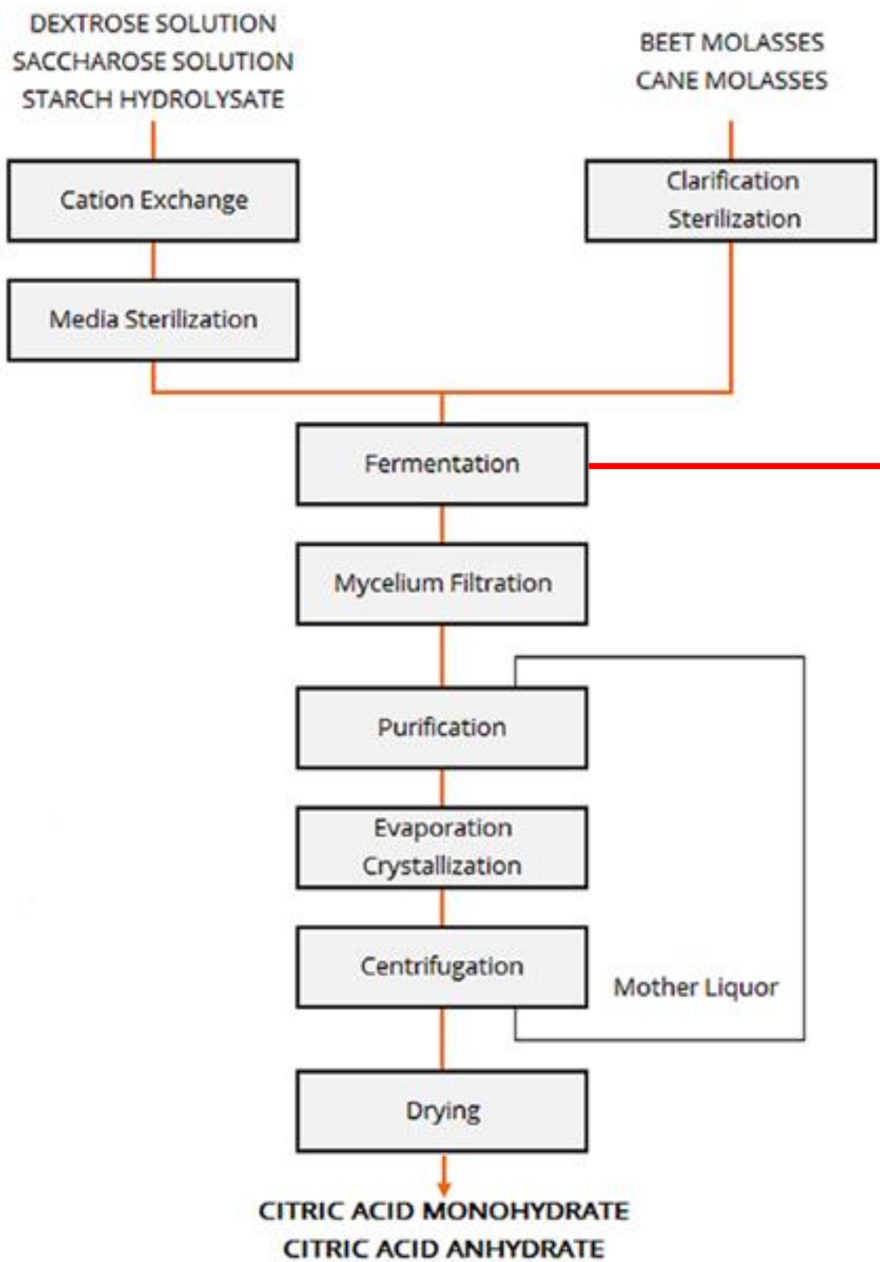




OA production



OA production



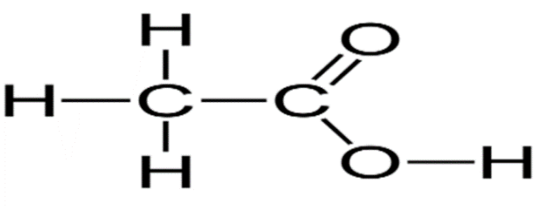
Composition and parameters

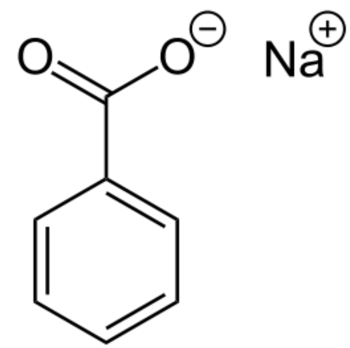
OA production

- Particular species like A.niger (for citric acid production)
- Source of Carbon: Sucrose is considered as the best source for citric acid
- Medium should be slightly deficient in phosphates or one or more of the metals Mn, Fe, Zn and Cu
- More than 2.5 g of NH_4NO_3 decreases the yield of citric acid
- Time: 7-10 days
- Yields: 60-80g / 100g of sugar incorporated
- pH: adjusted to 3.4 - 3.5 using HCl fermentation have
- Sodium or potassium carbonate is added- to control low pH

OA production

Organic acids *vs* synthetic uncouplers





OA mode of action

The mode of action of organic acids on bacteria is related to:

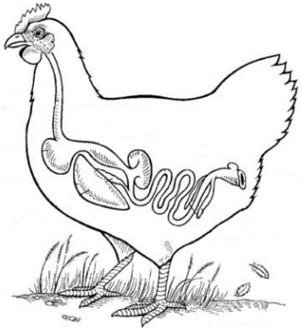
- Undissociated organic acids entering the bacteria cell
- Bacteria membrane disruption (leakage, transport mechanisms)
- Inhibition of essential metabolic reactions (ex. ↓ of glycolysis)
- Stress on intracellular pH homeostasis (normal bacteria pH is ± neutral)
- Accumulation of toxic anions
- Energy stress response to restore homeostasis
- Chelation as permeabilizing agent of outer membrane and zinc binding

ORGANIC ACIDS

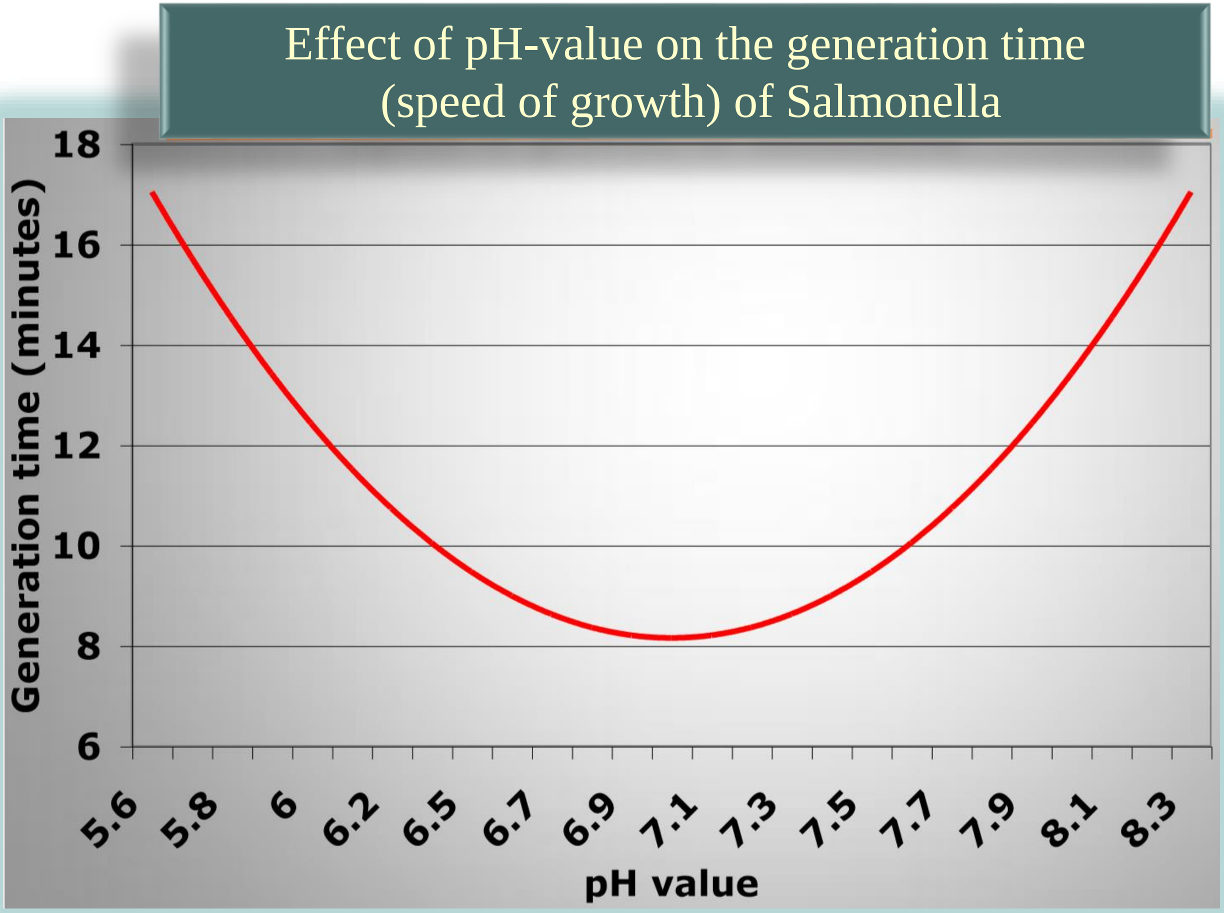
May have dual functions in reducing pathogenic bacteria contamination.

- First, they may reduce bacterial load in the feed.

- second, they may reduce the potential for infection and shedding in the animal.

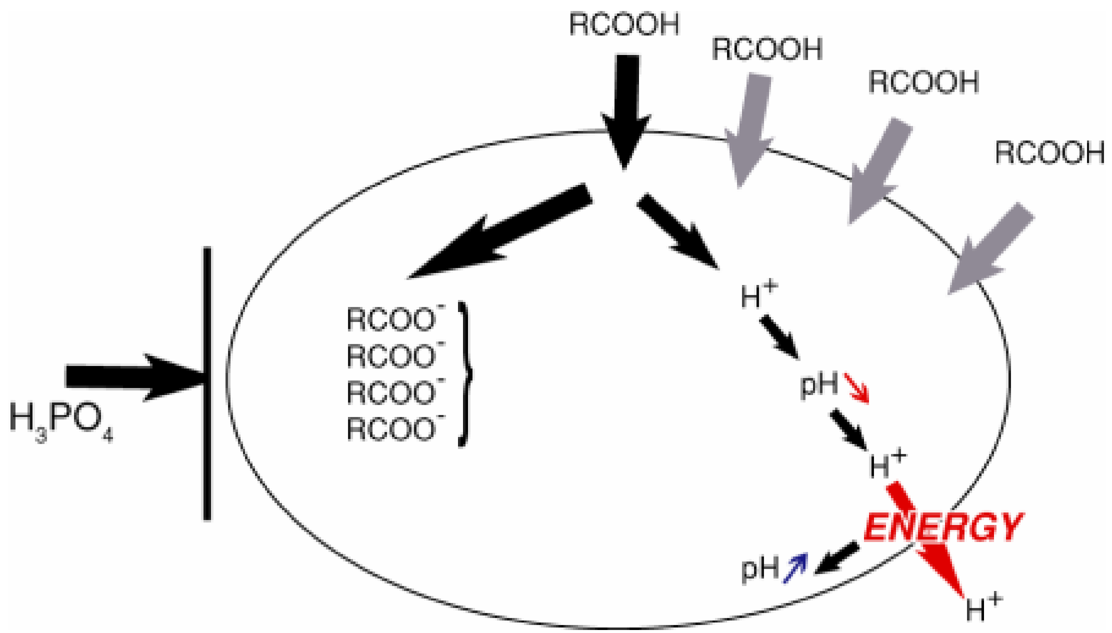


OA mode of action

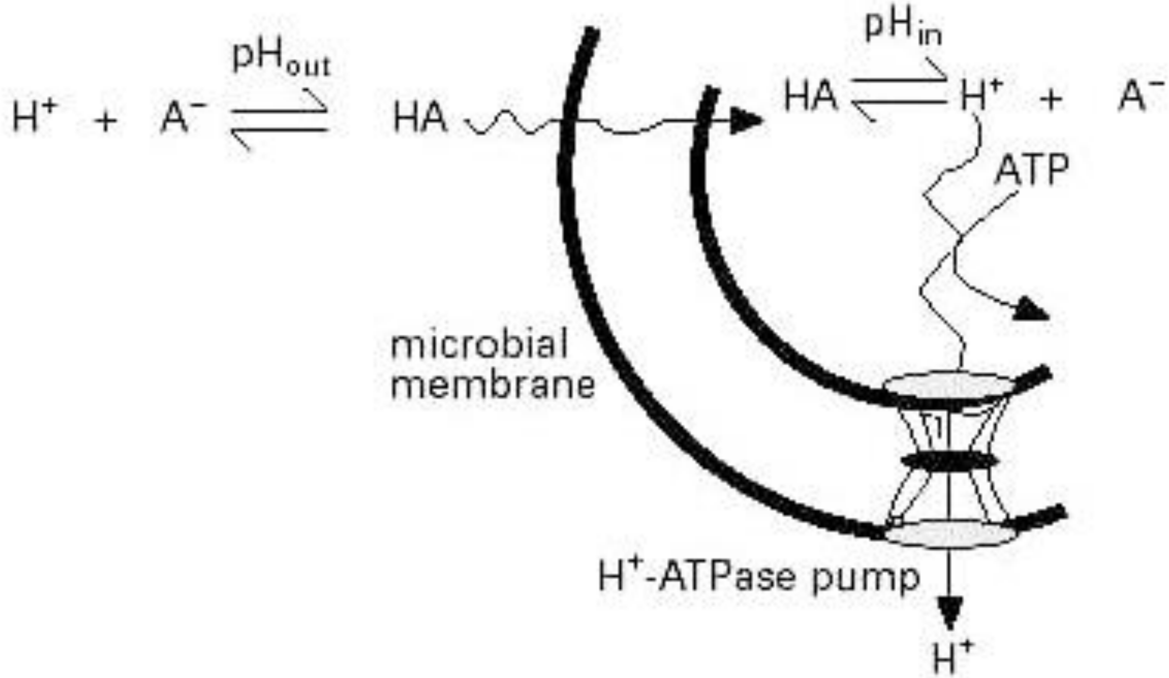


OA mode of action

Mode of action of organic acids on pH sensitive bacteria



OA mode of action



OA mode of action

ANION ACCUMULATION → BECOMES TOXIC

ANION ACCUMULATION → AT LEAST IN PART AN OSMOTIC STRESS

The anionic (A^-) part of the acid remains trapped inside the bacteria, because it diffuses freely through the cell wall only in its non-dissociated form. This accumulation of anions becomes toxic to the bacteria (Russell, 1992) as it inhibits metabolic reactions (Krebs *et al.*, 1983), reducing the synthesis of macromolecules (Cherrington *et al.*, 1991), and disrupts internal membranes (Freese *et al.*, 1973). Non-pH sensitive bacteria (such as lactic acid bacteria) can tolerate a larger differential between the internal and the external pH, if the internal pH becomes low enough, organic acids re-appear in a non-dissociated form and exit the bacteria by the same route as they entered. Gram-positive bacteria may also have a high concentration of intracellular potassium, which provides a counter cation for the acid anions (Russell and Diez-Gonzalez, 1998).

OA mode of action

undissociated dissociated

$$H\text{-}COOH \leftrightarrows H^+ + H\text{-}COO^-$$

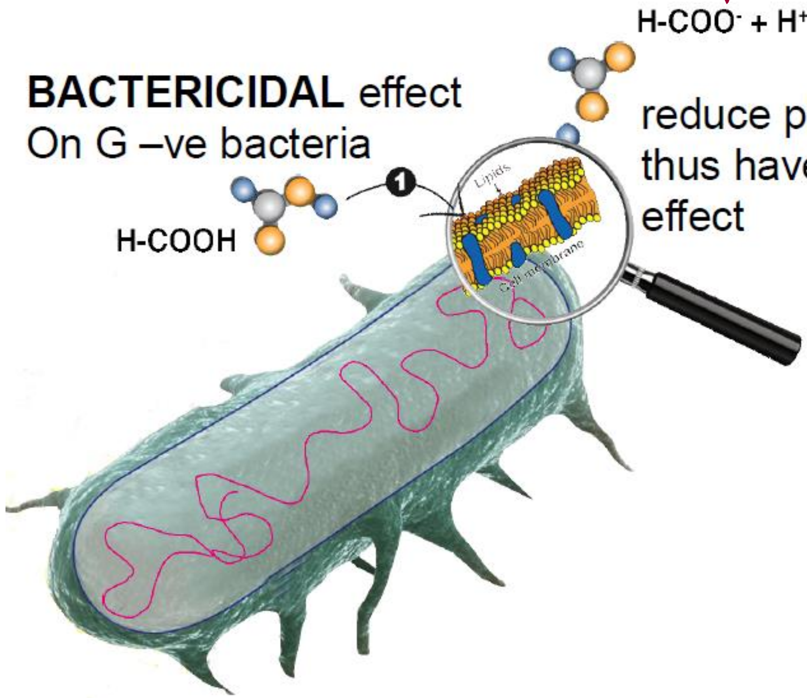
pH ↓ - protein and mineral digestion ↑

- growth of pathogenic bacteria ↓
- **eubiosis** ↑

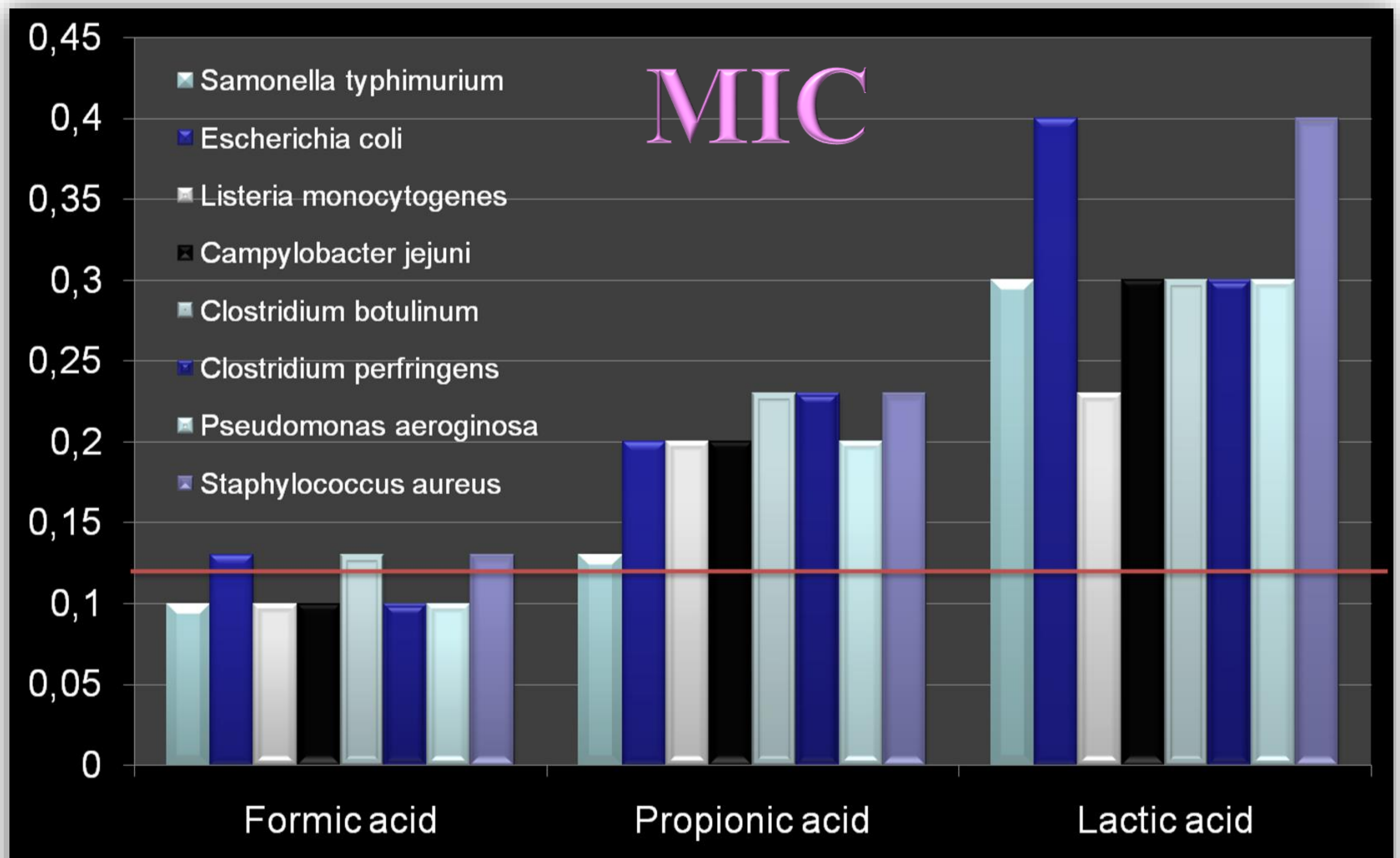
Antimicrobial

BACTERICIDAL effect
On G –ve bacteria

reduce pH in Surrounding, thus have **BACTREOSTATIC** effect



OA related factors



Antimicrobial effect of formic, propionic and lactic acid against different bacteria (Strauss and Hayler, 2001)

MW:46 74 90

OA related factors

An **acid dissociation constant**, K_a, (also known as **acidity constant**, or **acid-ionization constant**) is a quantitative measure of the strength of an acid in solution. It is the equilibrium constant for a chemical reaction known as dissociation in the context of acid-base reactions. The larger the K_a value, the more dissociation of the molecules in solution and thus the stronger the acid.

The equilibrium of acid dissociation can be written symbolically as:

$$\mathrm{HA} \rightleftharpoons \mathrm{A}^- + \mathrm{H}^+$$

where HA is a generic acid that dissociates by splitting into A^-, known as the conjugate base of the acid, and the hydrogen ion or proton, H^+, which, in the case of aqueous solutions, exists as the hydronium ion—in other words, a solvated proton. In the example shown in the figure, HA represents acetic acid, and A^- represents the acetate ion, the conjugate base. The chemical species HA, A^- and H^+ are said to be in equilibrium when their concentrations do not change with the passing of time. The dissociation constant is usually written as a quotient of the equilibrium concentrations (in mol/L), denoted by [HA], $[A^-]$ and $[H^+]$:

$$K_\mathrm{a} = \frac{[\mathrm{A}^-][\mathrm{H}^+]}{[\mathrm{HA}]}$$

Due to the many orders of magnitude spanned by K_a values, a logarithmic measure of the acid dissociation constant is more commonly used in practice. The logarithmic constant, pK_a, which is equal to $-\log_{10} K_a$, is sometimes also (but incorrectly) referred to as an acid dissociation constant:

$$\mathrm{p}K_\mathrm{a} = -\log_{10} K_\mathrm{a}$$

The larger the value of pK_a, the smaller the extent of dissociation at any given pH (see Henderson–Hasselbalch equation)—that is, the weaker the acid. A weak acid has a pK_a value in the approximate range −2 to 12 in water. Acids with a pK_a value of less than about −2 are said to be strong acids; a strong acid is almost completely dissociated in aqueous solution, to the extent that the concentration of the undissociated acid becomes undetectable. pK_a values for strong acids can, however, be estimated by theoretical means or by extrapolating from measurements in non-aqueous solvents in which the dissociation constant is smaller, such as acetonitrile and dimethylsulfoxide.

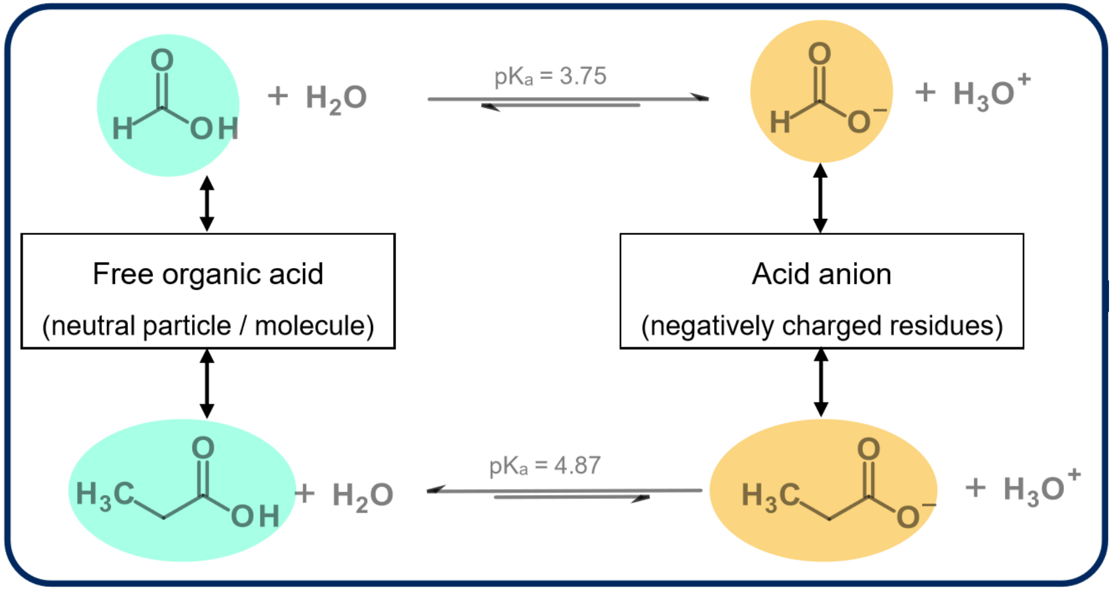
OA related factors

Formulas, physical and chemical characteristics of organic acids used as dietary acidifiers

Acid	Formula	MM g/mol	Density g/mL	Form	$pK_{a\,I}$	$pK_{a\,II}$	$pK_{a\,III}$
Formic	$HCOOH$	46.03	1.220	liquid	3.75		
Acetic	CH_3COOH	60.05	1.049	liquid	4.76		
Propionic	CH_3CH_2COOH	74.08	0.993	liquid	4.88		
Butyric	$CH_3CH_2CH_2COOH$	88.12	0.958	liquid	4.82		
Lactic	$CH_3CH(OH)COOH$	90.08	1.206	liquid	3.83		
Fumaric	$COOHCH{:}CHCOOH$	116.07	1.635	solid	3.02	4.38	
Malic	$COOHCH_2CH(OH)COOH$	134.09	1.601	liquid	3.4	5.1	
Tartaric	$COOHCH(OH)CH(OH)COOH$	150.09	1.760	liquid	2.93	4.23	
Citric	$COOHCH_2C(OH)(COOH)CH_2COOH$	192.14	1.665	solid	3.13	4.76	6.40

MM, molecular mass expressed in grams

OA related factors



Formic acid is a stronger

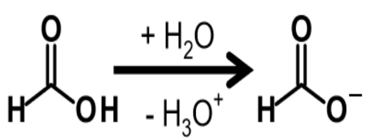
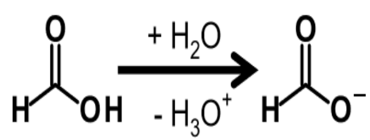
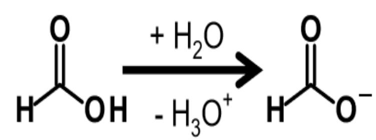
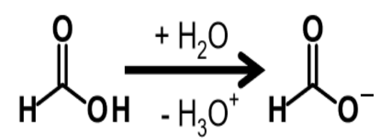
acid than propionic acid

K_a (formic) > K_a (propionic)

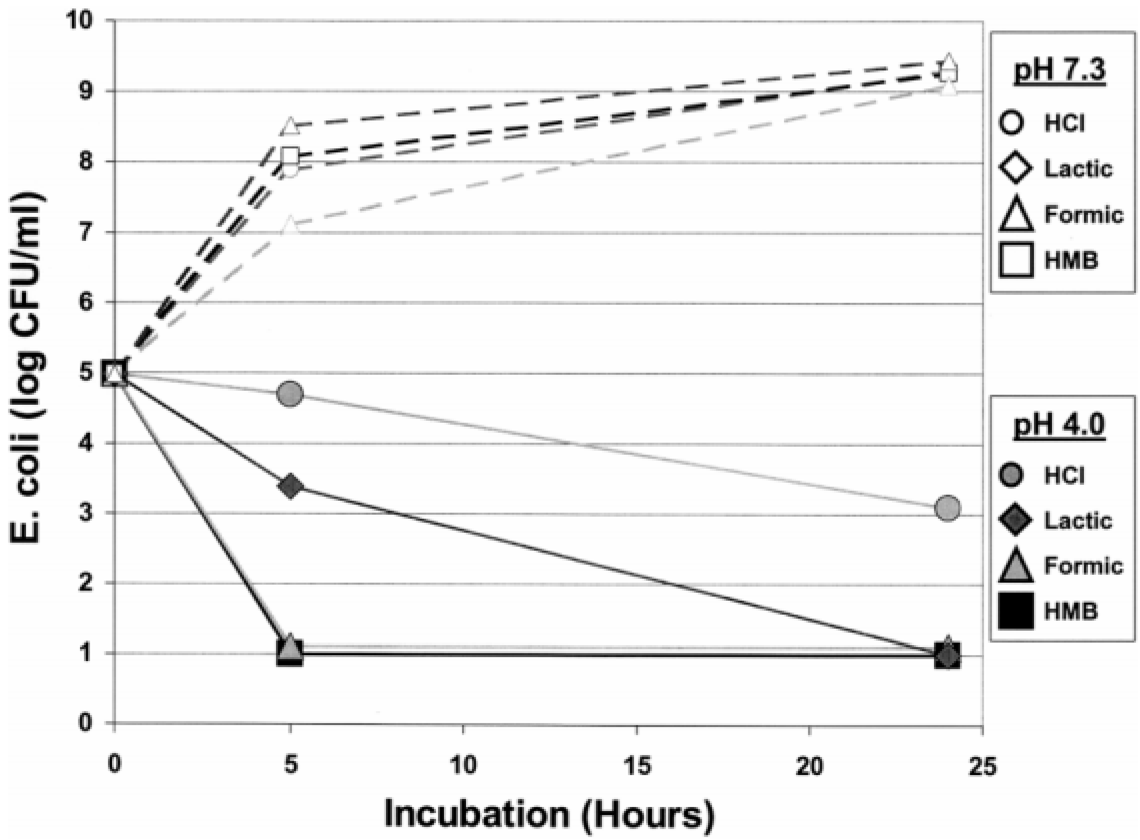
is equal to

pK_a (formic) < pK_a (propionic)

OA related factors

pH-value = 5.0	pH-value = 4.5	pH-value =4.0	pH-value = 3.5
 8% 92%	 15% 85%	 35% 65%	 75% undissociated (biologically active) 25%

OA related factors



Effect of pH on the antimicrobial activity of HCl, lactic acid, formic acid and 2-hydroxy-4-(methylthio)butanoic acid. An *E. coli* inoculum (10^6 CFU) was grown in trypticase soy broth (TSB)

OA related factors

Minimum inhibitory concentration (MIC) of undissociated and dissociated acid (micro mol)

Organism	Acid type	MIC_u	MIC_d
E. coli M 23	Lactic	8.32	-
Y. enterocolitica	lactic	5-10	-
E. coli	Propionic	70	800
Staphylococcus aureus	Propionic	19	830
Bacillus cereus	Propionic	17	380
E. coli	Sorbic	1	100
E. coli	Sorbic	1	350
Staphylococcus aureus	Sorbic	0.6	400
Bacillus cereus	Sorbic	1.2	110
Listeria innocua	Lactic (Na lactate)	4.9	1 250

OA related factors

The MIC values for acetic, butyric, lactic and caprylic acid in E. coli are less than 4 g/l, but this same bacterium is approximately 10 times more resistant to malic acid, tartaric acid and citric acid (Hsiao & Siebert, 1999).
This observation indicates that factors such as:

- Chain length
- Side chain composition
- pKa values and hydrophobicity
- Microorganisms defense strategies

OA related factors

The **buffering capacity** of poultry feeds particularly of protein and mineral sources is high. Buffering capacity or **B-value** in a feed is often expressed as meq of 1.0 M HCl required to acidify 1 kg of material (feed or feed ingredient) to pH 3-5.
Usually, the amount of 0.1 M HCl required to reduce the pH to 5 of 10 g feed in 90 ml distilled water is represented as buffering capacity.

OA related factors

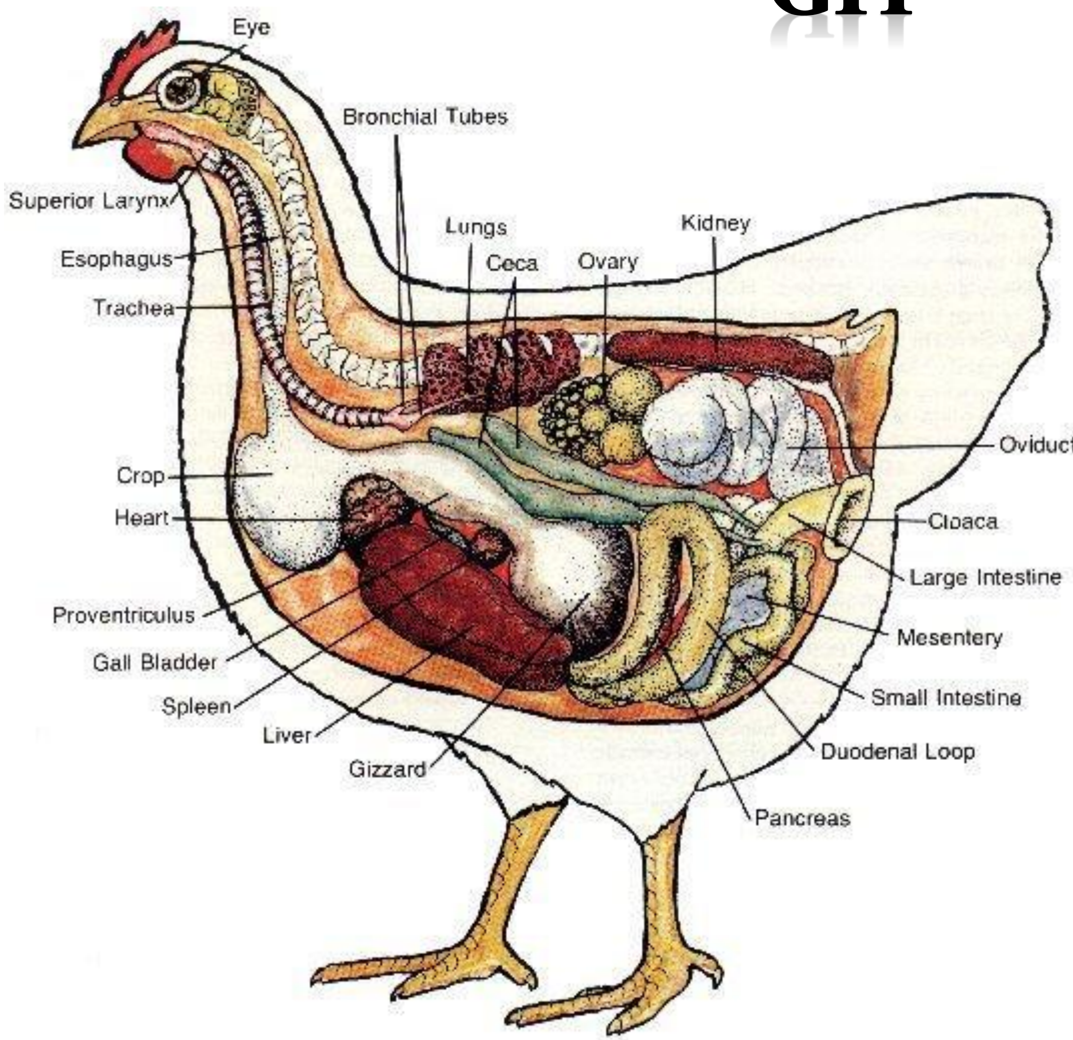
Buffer capacity of some feed ingredients

Ingredients	meq/kg
Corn	135-172
Wheat	180-240
Sunflower meal	850-900
Soybean meal	1000-1200
Di Calcium Phosphate	8000-10000
Calcium Carbonate	19000-21000

LIMITATIONS

- ✓ Impossible to significantly modify the pH value of GIT of animals because homeostasis
- ✓ Homeostasis is combined with buffer capacity of feed
- ✓ Some bacteria *spp* can develop acid resistance when exposed to low pH values for long periods
- ✓ Lowering the pH to extreme values is not practical because acids are corrosive
- ✓ Decrease passage rate
- ✓ Destructive for vitamins
- ✓ Dangerous for both humans and animals
- ✓ Damage to milling and handling equipment
- ✓ Losses during pelleting

GIT


Eye
Bronchial Tubes
Superior Larynx
Esophagus
Trachea
Lungs
Ceca
Ovary
Kidney
Oviduct
Crop
Heart
Cloaca
Large Intestine
Proventriculus
Gall Bladder
Spleen
Liver
Gizzard
Mesentery
Small Intestine
Duodenal Loop
Pancreas

GIT

GIT

Mean Retention Time (min) of Solid Phase Markers in Various Segments of the Digestive System of Broilers and Leghorns

Gastrointestinal tract segment	Broilers	Leghorns
Crop	31	48
Proventriculus + gizzard	39	71
Duodenum	10	7
Jejunum	84	85
Ileum	97	84
Ceca	119	112
Rectum	56	51

GIT

Gastrointestinal Hormones in the Domestic Fowl

Hormone	Site of origin	Biological actions
Gastrin	Proventriculus	Stimulates gastric acid and pepsin secretion
Cholecystokinin	Duodenum, jejunum	Stimulates gall-bladder contraction and pancreatic enzyme secretion and gastric acid secretion; inhibits gastric emptying; potentiates secretin-induced stimulation of pancreatic electrolyte secretion
Secretin	Duodenum, jejunum	Stimulates bicarbonate secretion by pancreas
Vasoactive intestinal peptide	Duodenum, jejunum	May be a more potent stimulator of pancreatic electrolyte secretion than secretin; inhibits smooth muscle contraction
Pancreatic polypeptide	Pancreas, proventriculus, duodenum	Stimulates gastric acid and pepsin secretion
Gastrin-releasing peptide (bombesin)	Proventriculus	Stimulates pancreatic enzyme secretion; stimulates crop contraction
Somatostatin	Pancreas, gizzard, proventriculus, duodenum, ileum	Inhibits secretion of other gut hormones

GIT

Basal gastric secretion rates of the chicken compared to some mammals

		Chicken	Rat	Monkey	Man
Volume (HCl)	ml/h	**15.4** **8.8**	**1.3** **3.7**	**5** **2**	**60** **0.86**
Acid concentration	ml/kg BW/h	**93**	**66**	**60**	**36**
Acid output	mEq/L mEq/kg BW /h	**1.36** **0.78**	**0.09** **0.25**	**0.3** **0.12**	**2.16** **0.03**
Pepsin concentration	Pepsin units/ml	**247**	**600**	**365**	**1035**
Pepsin output	Pepsin units/h	**4256**	**780**	**1825**	**62 100**
	PU/kg BW/h	**2430**	**2230**	**730**	**862**

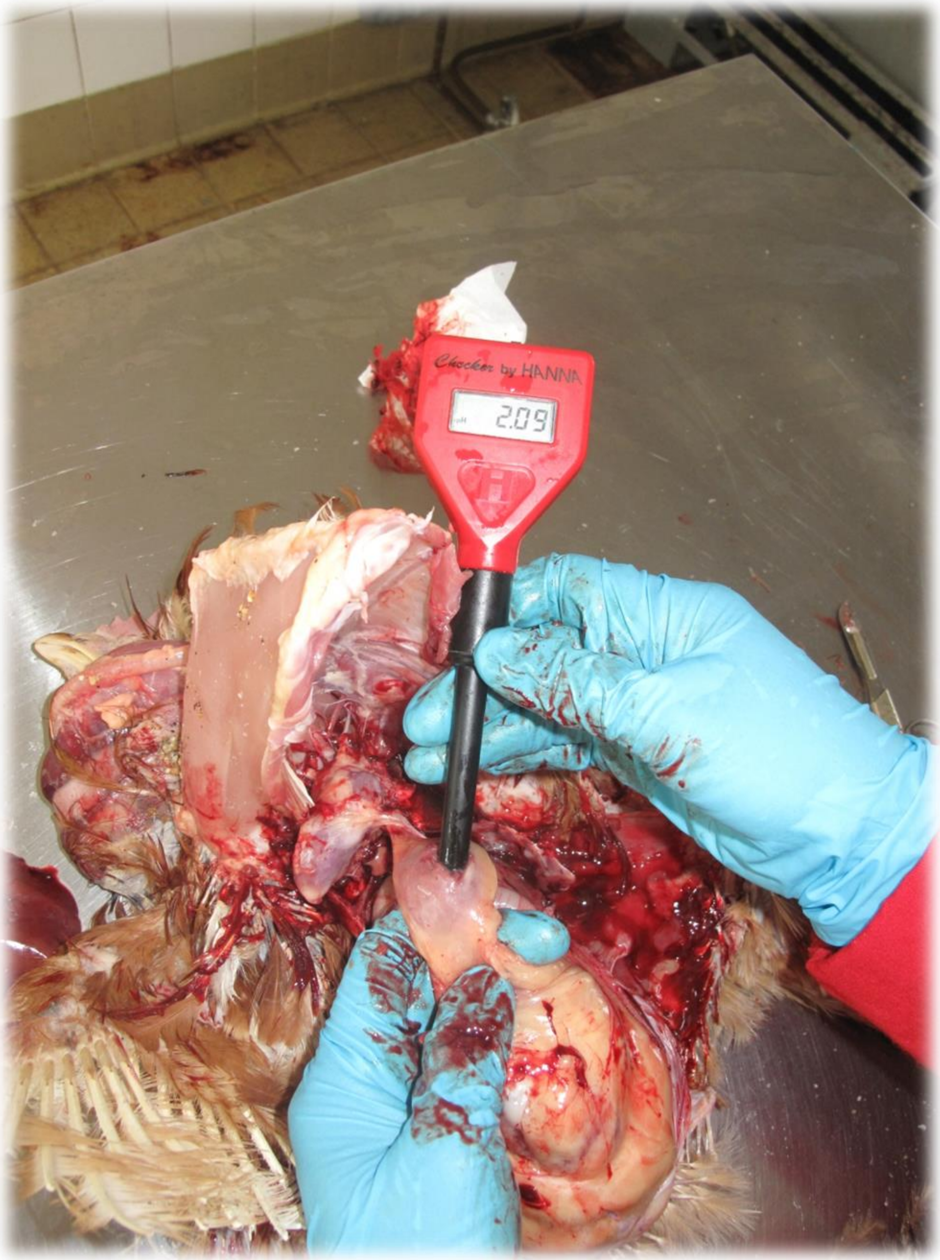
GIT

pH and mean duration of transit time of mash feed in different compartments of the broiler gut after ad libitum feeding during 6 weeks.

GIT compartment	Duration of transit time (min.)	pH
Crop	50	5.5
Proventriculus & gizzard	90	2.5 – 3.5
Duodenum	5-8	5 - 6
Jejunum	20-30	6.5 - 7
Ileum	50-70	7 – 7.5
Rectum	25	8

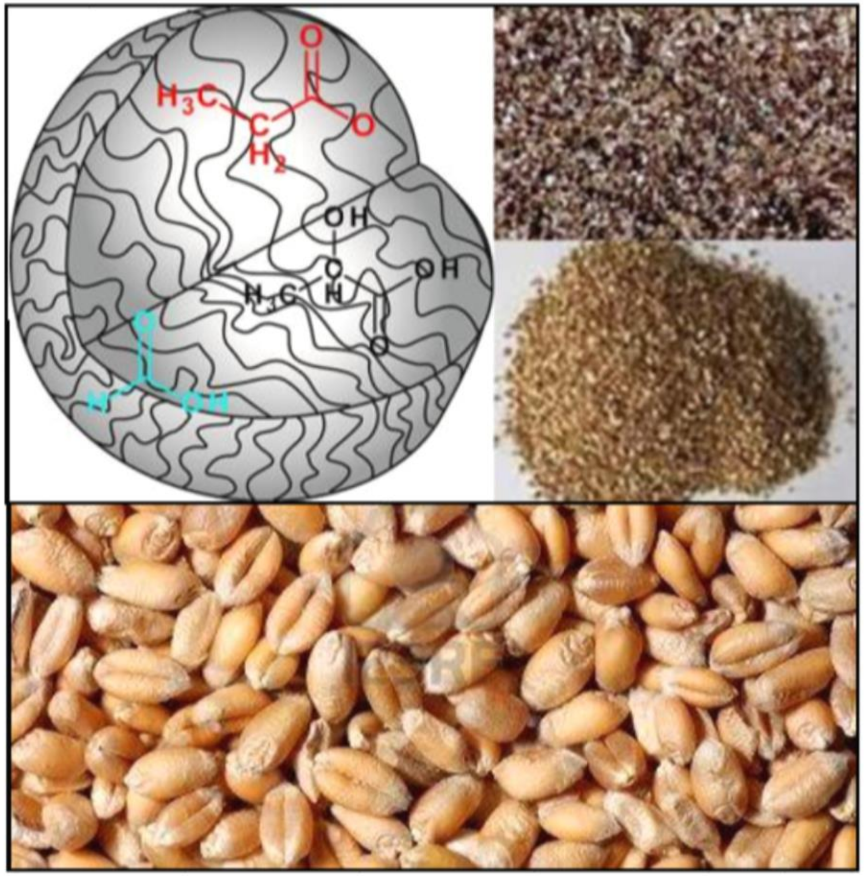
GIT

GIT



GIT

OA carrier eg vermiculite (protection)

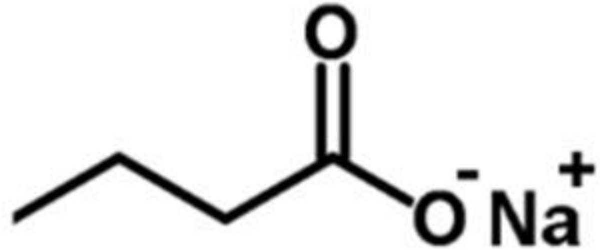


50% Adsorbent
(clay, silica, vermiculite,…)

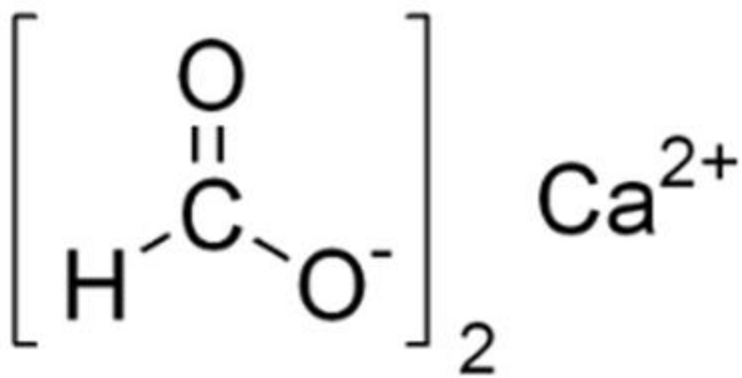
50% Acid blend

OA salt (protection)

Sodium butyrate

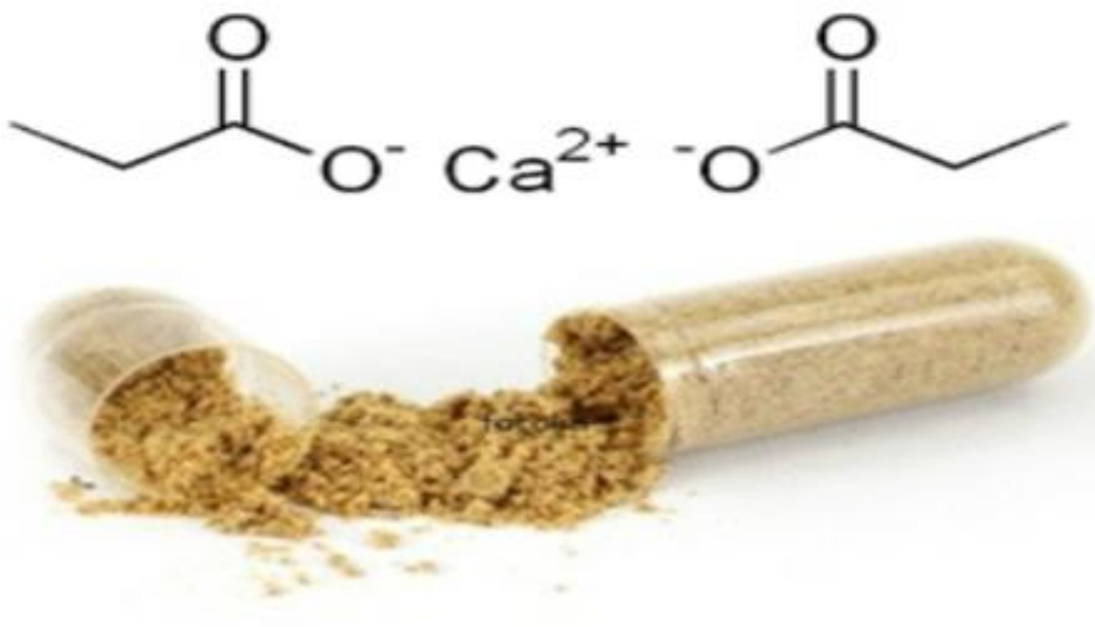


Calcium formate



OA encapsulated (protection)

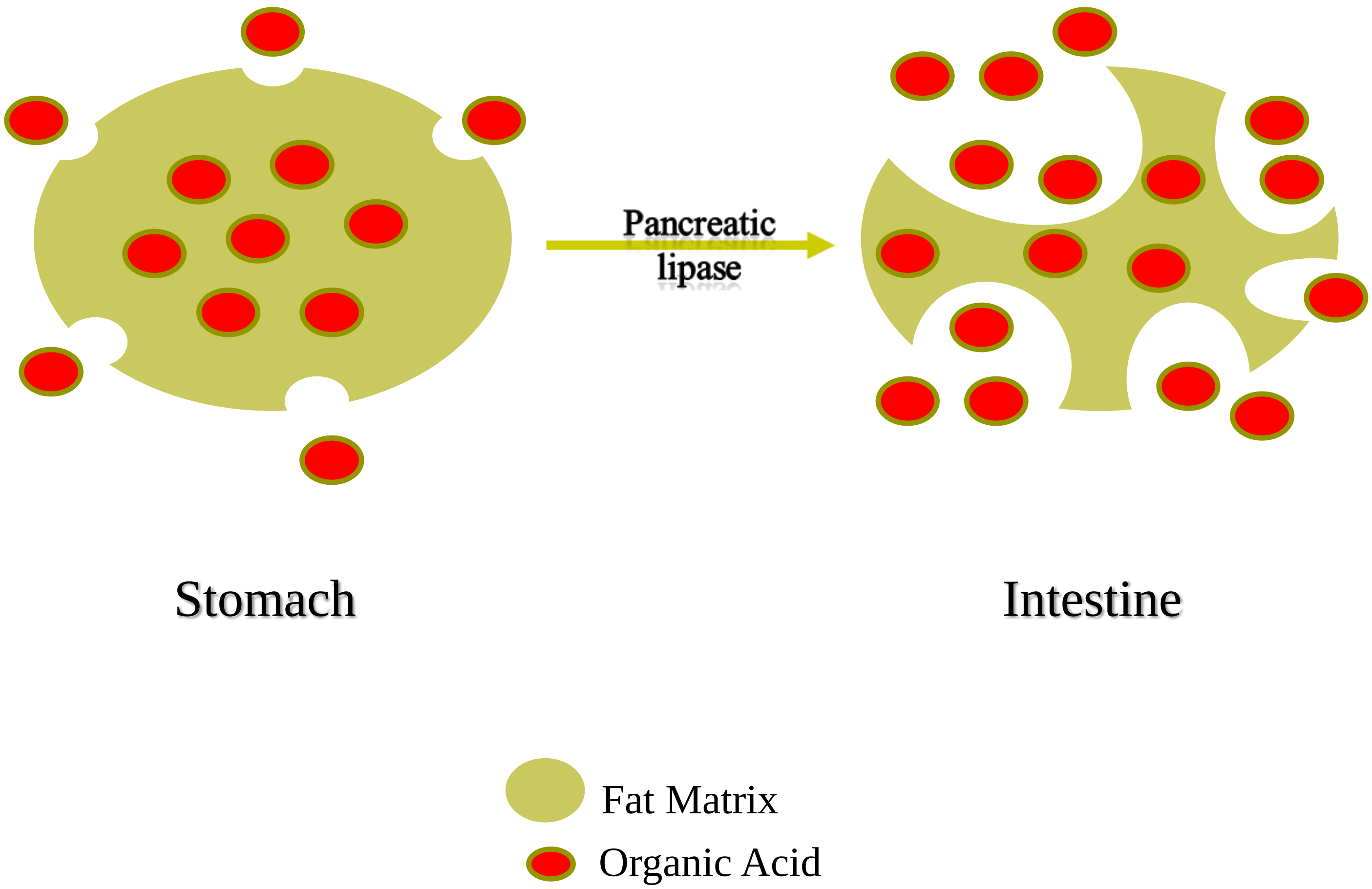
calcium propionate



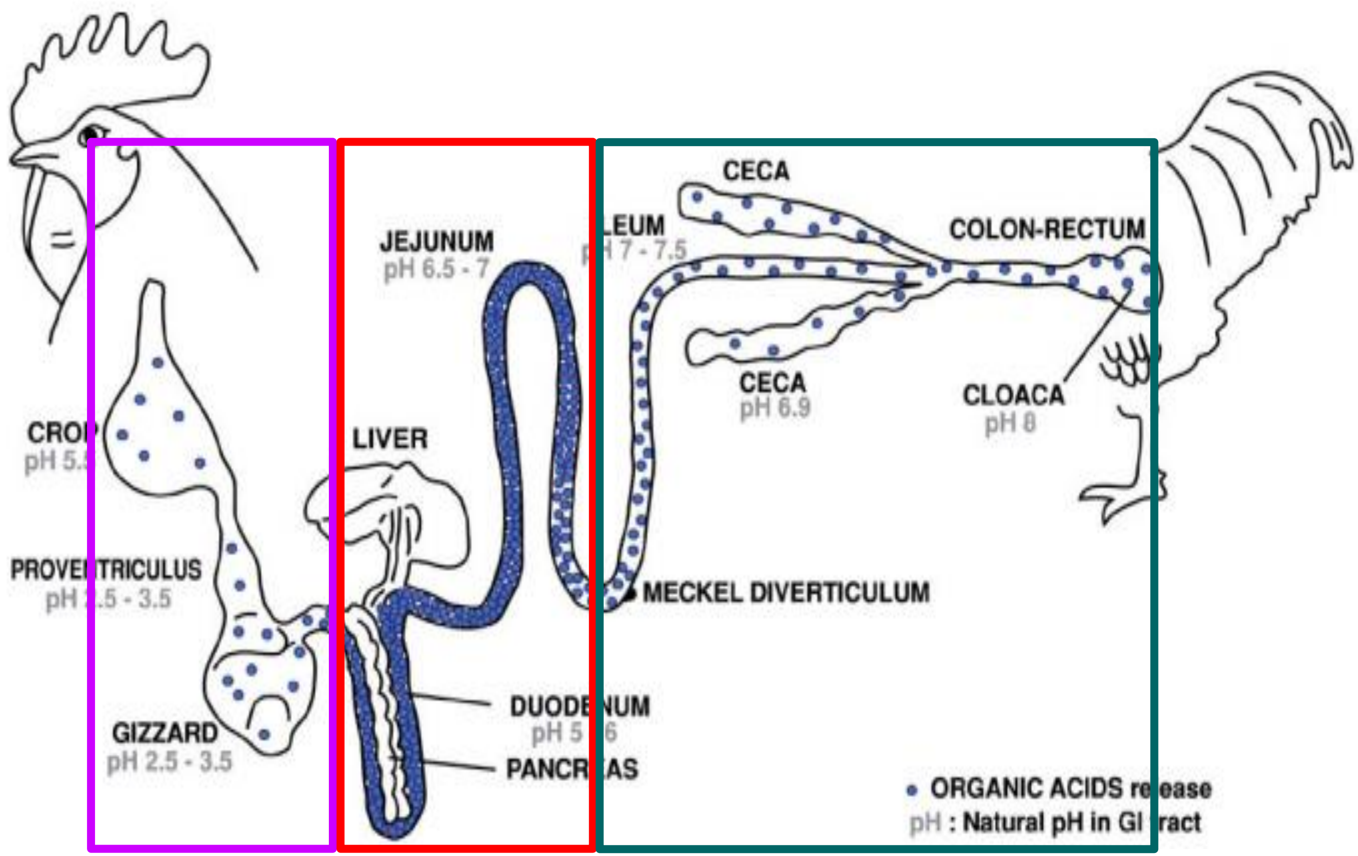
OA combine with fat (protection)

OA + TG → (Pancreatic lipase) release **OA** at lower intestine

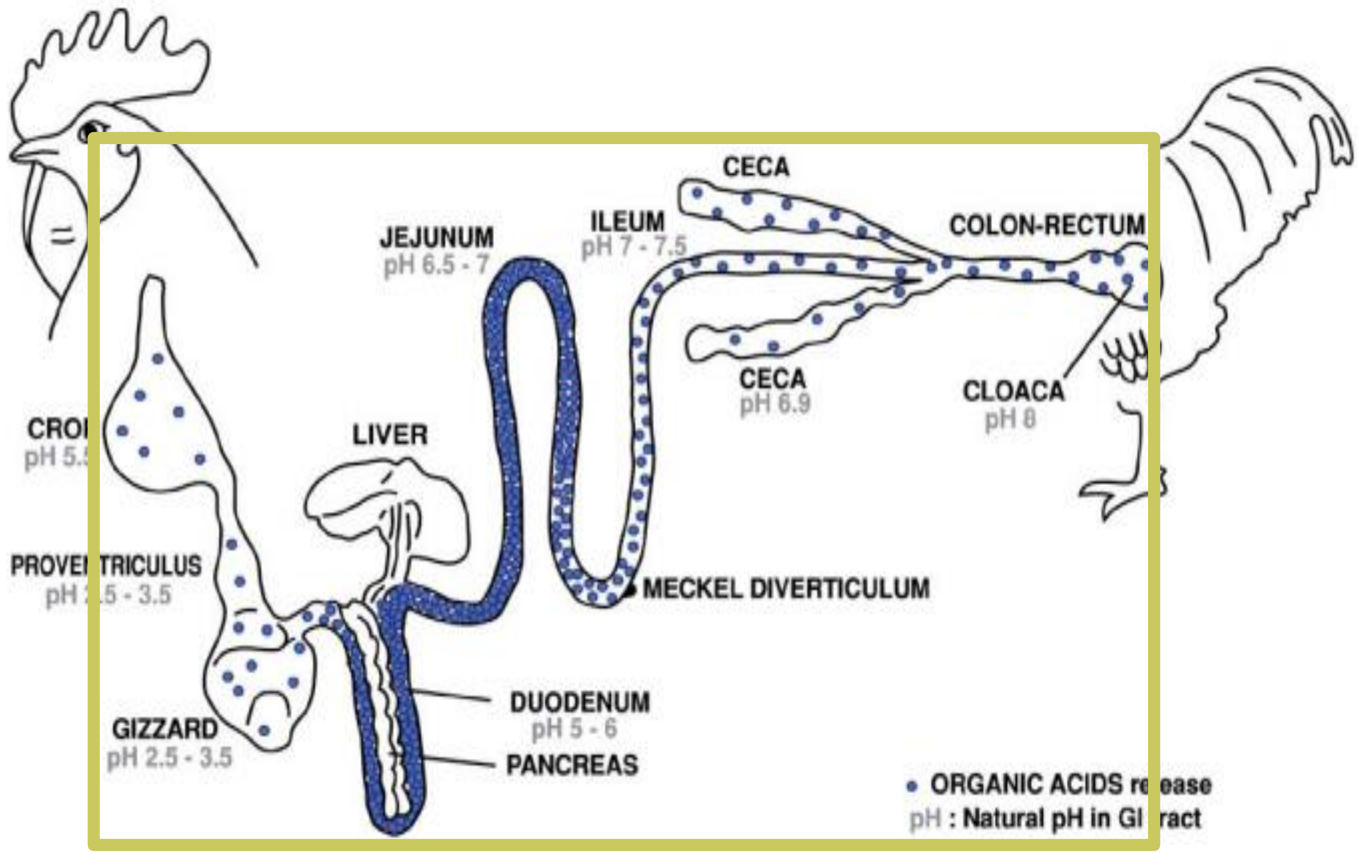
OA coated with fat (protection)



pattern of protected OA release



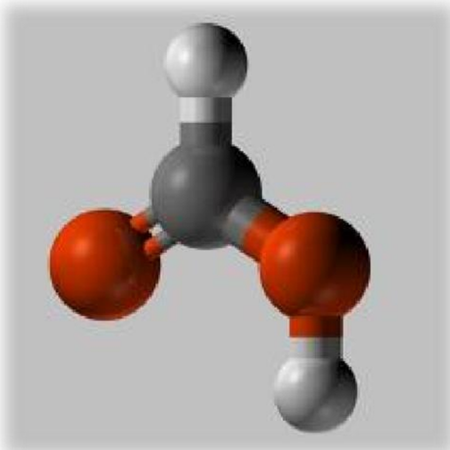
Ideal pattern of OA release



OA innovation in chemical (protection)

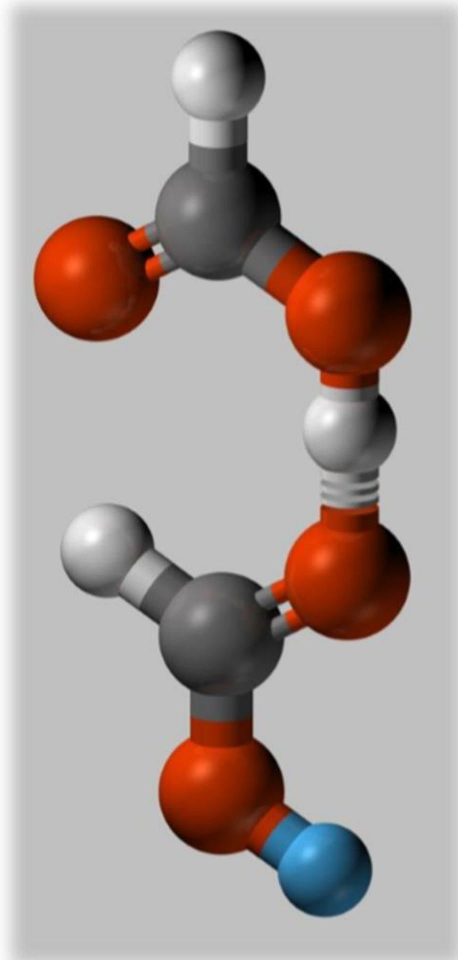
- ✓ Effective
- ✓ Low dosage
- ✓ Non-corrosive
- ✓ Safe
- ✓ Slow release
- ✓ Total protection

OA innovation in chemical (protection)



Liquid
Corrosive
Hazardous
Fast action

Powder
Non-corrosive
Safe
Slow release

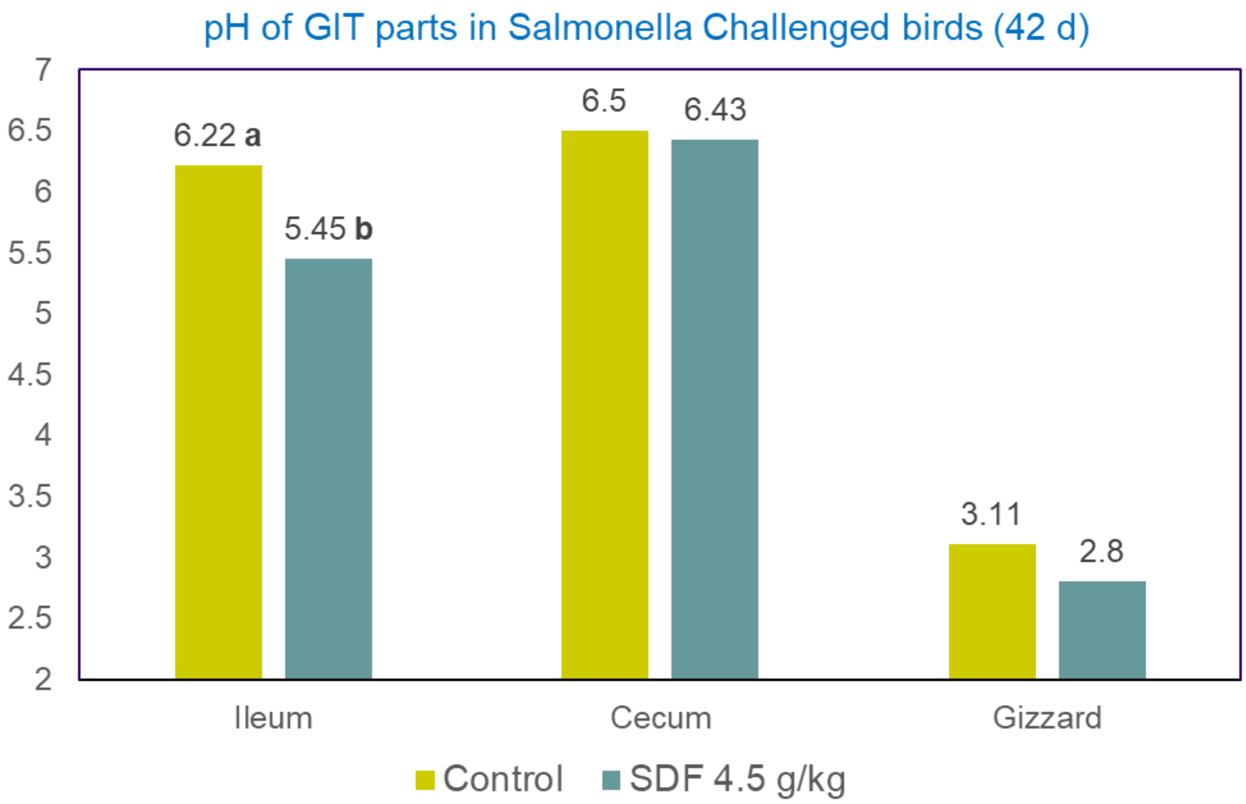


Formic acid (40%)

Format (40%)

Na (20%)

Collaboration of Razi University and University of Tehran



Maintaining a healthy gut requires up to **25%** of the daily protein and **20%** of the dietary energy supplied with the feed.

دریافت جایزه تحقیق در تغذیه طیور توسط دکتر مایکل بدفورد

توسط مدیر / یکشنبه, ۱۴ مرداد ۱۳۹۷ / نوشته شده در اخبار سایت

دکتر مایکل بدفورد، جایزه تحقیق در تغذیه طیور انجمن علمی مرغداری (PSA) را در جلسه سالانه این انجمن که هفته گذشته در تگزاس برگزار شد، دریافت نمود. دکتر بدفورد مدیر تحقیقاتی AB Visat در انگلستان، توسعه نوعی افزودنی خوراکی را رهبری کرد که به انقلابی در مقابل اثرات ضدتغذیه ای فیتات منجر شد. به کارگیری این افزودنی خوراکی سبب جذب بهتر فسفر، انرژی و پروتئین خوراک توسط حیوان میشود، بازده تولید را افزایش و آلودگی محیط را کاهش می دهد.

دکتر بدفورد و همکارانش سالانه حدود ۹۰ پروژه تحقیقاتی را به ثمر می رسانند. ایشان بیش از ۳۰۰ تالیف داشته اند، مطالب هفت ژورنال را ارزیابی می کنند و با بیش از ۱۰۰ محقق و متخصص تغذیه ارتباط دارند و کار می کنند. دکتر بدفورد دارای دکترای تغذیه و بیوشیمی و دو فوق دکترا در زیست شناسی مولکولی و تغذیه طیور از دانشگاه گوئلف کانادا هستند.