Analysis of connotation for fishmeal as high-quality feed protein source
解构鱼粉作为优质饲料蛋白源的内涵

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Fishmeal is still a highly dependent high-quality protein source for aquaculture
鱼粉仍然是水产养殖主要依赖的优质蛋白源

SCIENCE

GLOBAL FOOD SUPPLY

China's aquaculture and the world's wild fisheries

Curbing demand for wild fish in aquafeeds is critical

9 JANUARY 2015 • VOL 347 ISSUE 6218 133

Fishmeal manufacturing season canceled in Peru!
秘鲁鱼粉产季取消！

Original UCN UCN International Sea Products Information at 00:15 on June 10, 2023

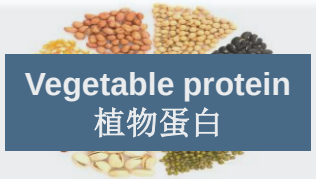
原创 UCN UCN国际海产资讯 2023-06-10 00:15

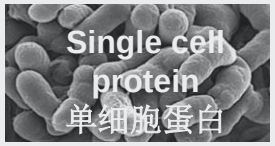
Fishmeal price soars by nearly 40% to hit a new high, soybean meal price rises to 4500 Yuan/ton, feed enterprises increase price under pressure
鱼粉价格暴涨近四成创历史新高，豆粕涨至4500元/吨，料企承压全面上调价格

www.feedtrade.com.cn, published in Yunnan at 12:22 on July 28, 2023

饲料行业信息网 2023-07-28 12:22发表于云南

VS

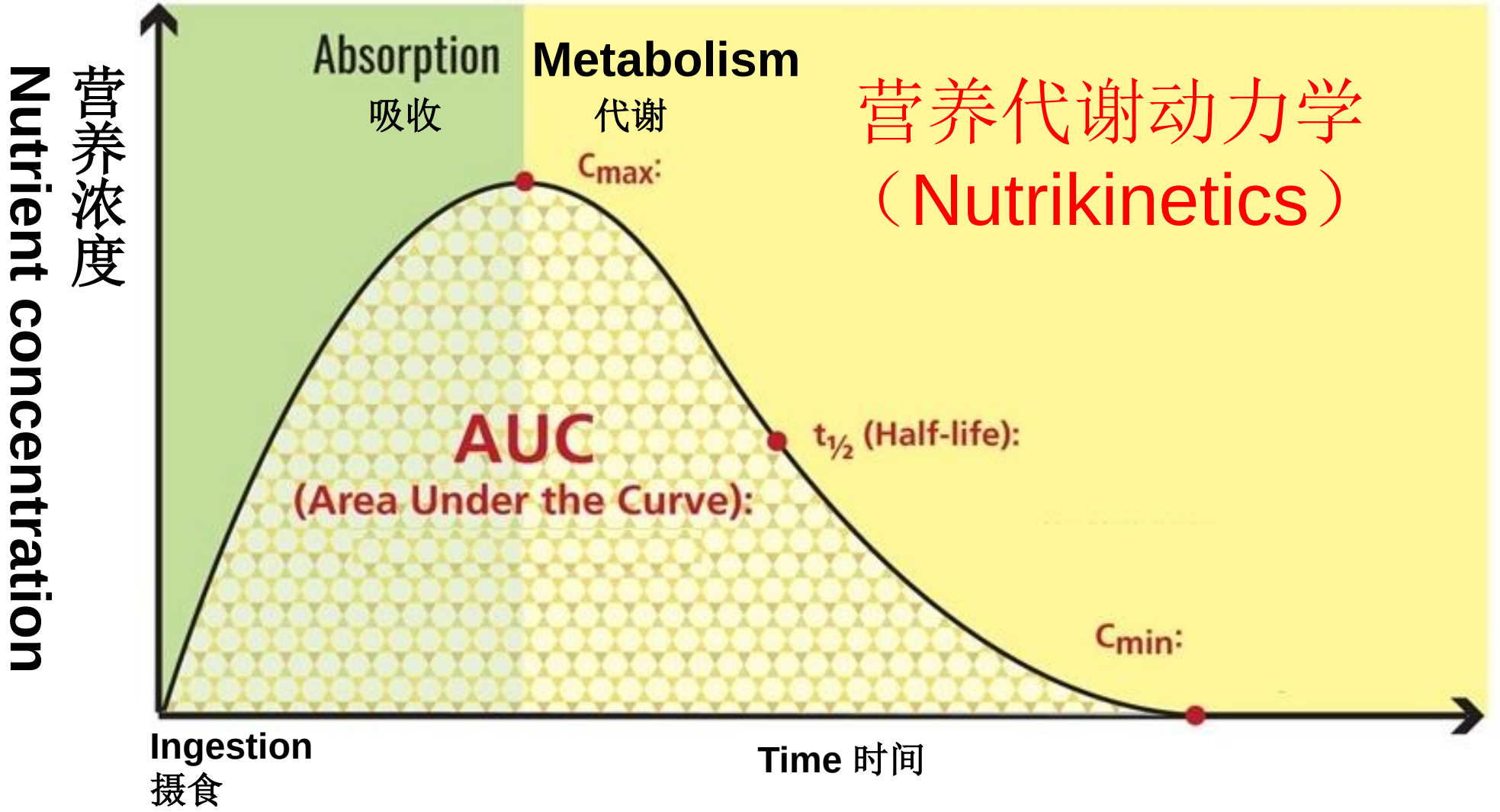




Feeding attraction activities 诱食性	Digestibility coefficient 消化率	Growth rate 生长速度	Feed conversion efficiency 饲料转化效率
Good 好	High 高	Fast 快	High 高
VS			
Poor 差	Low 低	Slow 慢	Low 低

Nutrikinetics: time-space quantitative analysis of nutrient absorption and metabolism after ingestion

营养代谢动力学：摄食后营养消化吸收与代谢过程的时空定量分析



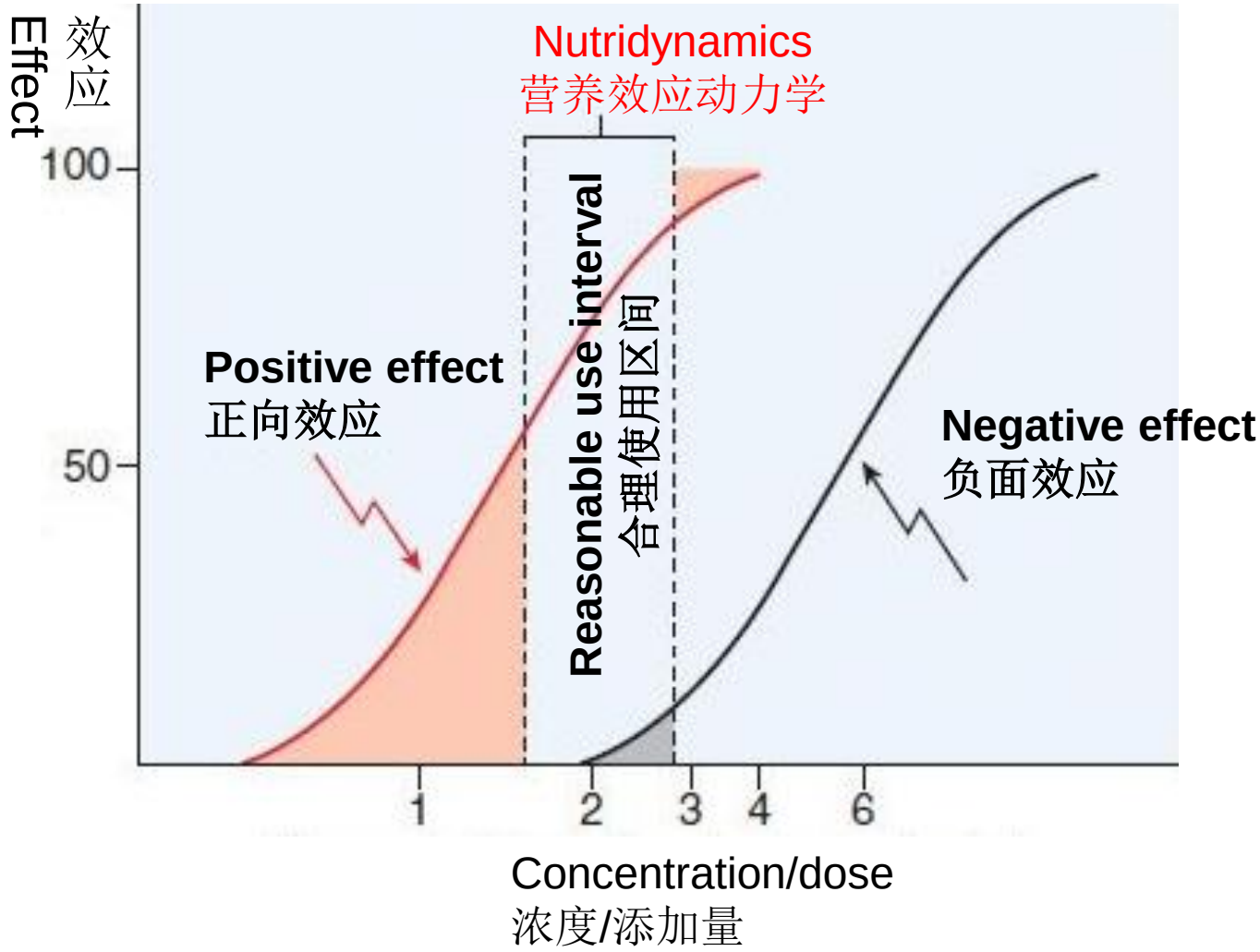
Nutridynamics:concentration-effect relationship and reasonable use interval of nutrient active substance or raw material

营养效应动力学：营养活性物质或原料的浓度-效应关系及合理使用区间

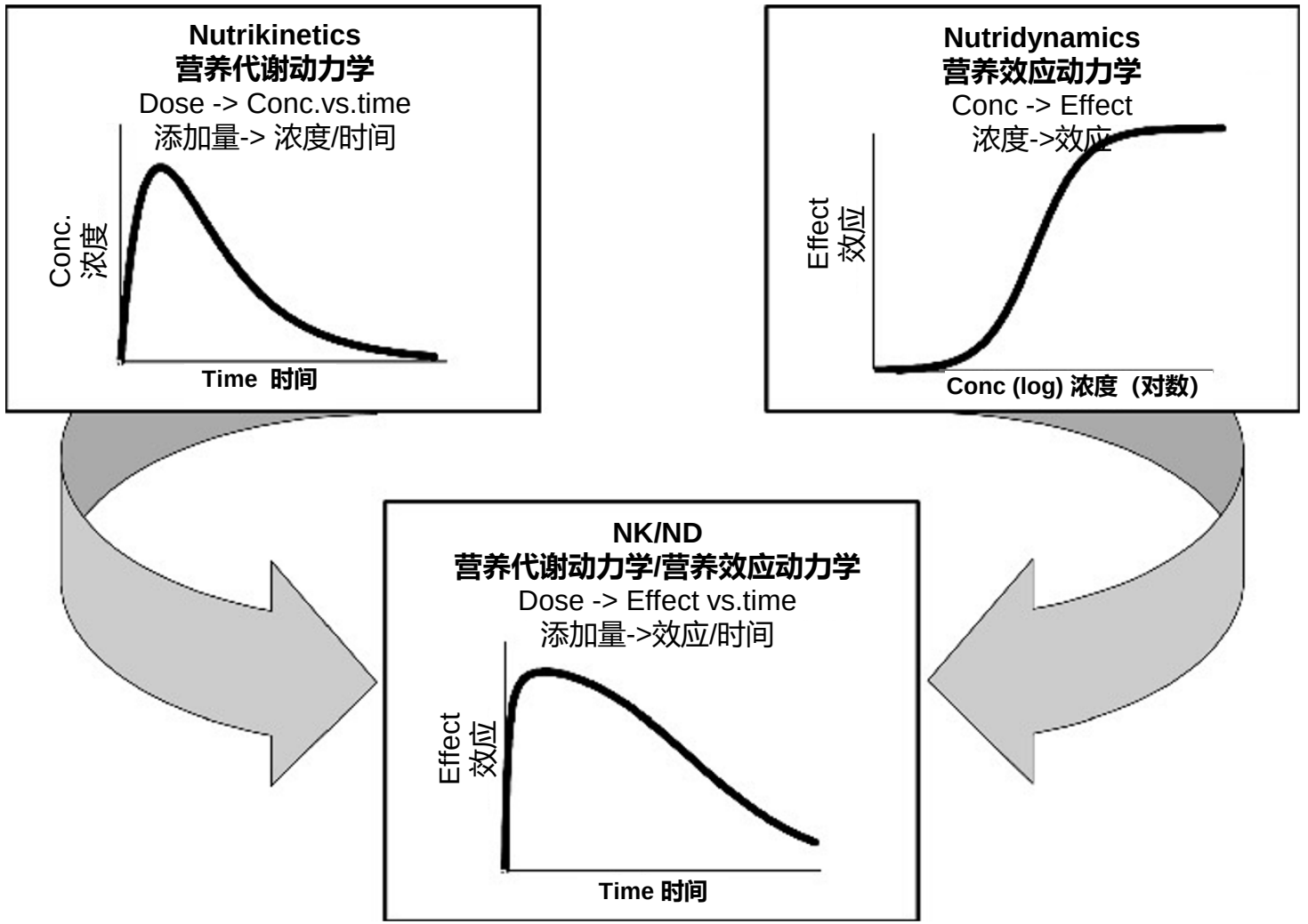
Nutrient effect

营养效应

- Macroscopic effect: growth, health, quality;
- 宏观效应：生长、健康、品质；
- Sensing effect: nutrient sensing signal and conduction;
- 感知效应：营养感知信号及传导；
- Metabolic effect:body protein synthesis and intermediary metabolism process, immune response, etc.
- 代谢效应：体蛋白合成及中间代谢过程，免疫应答等



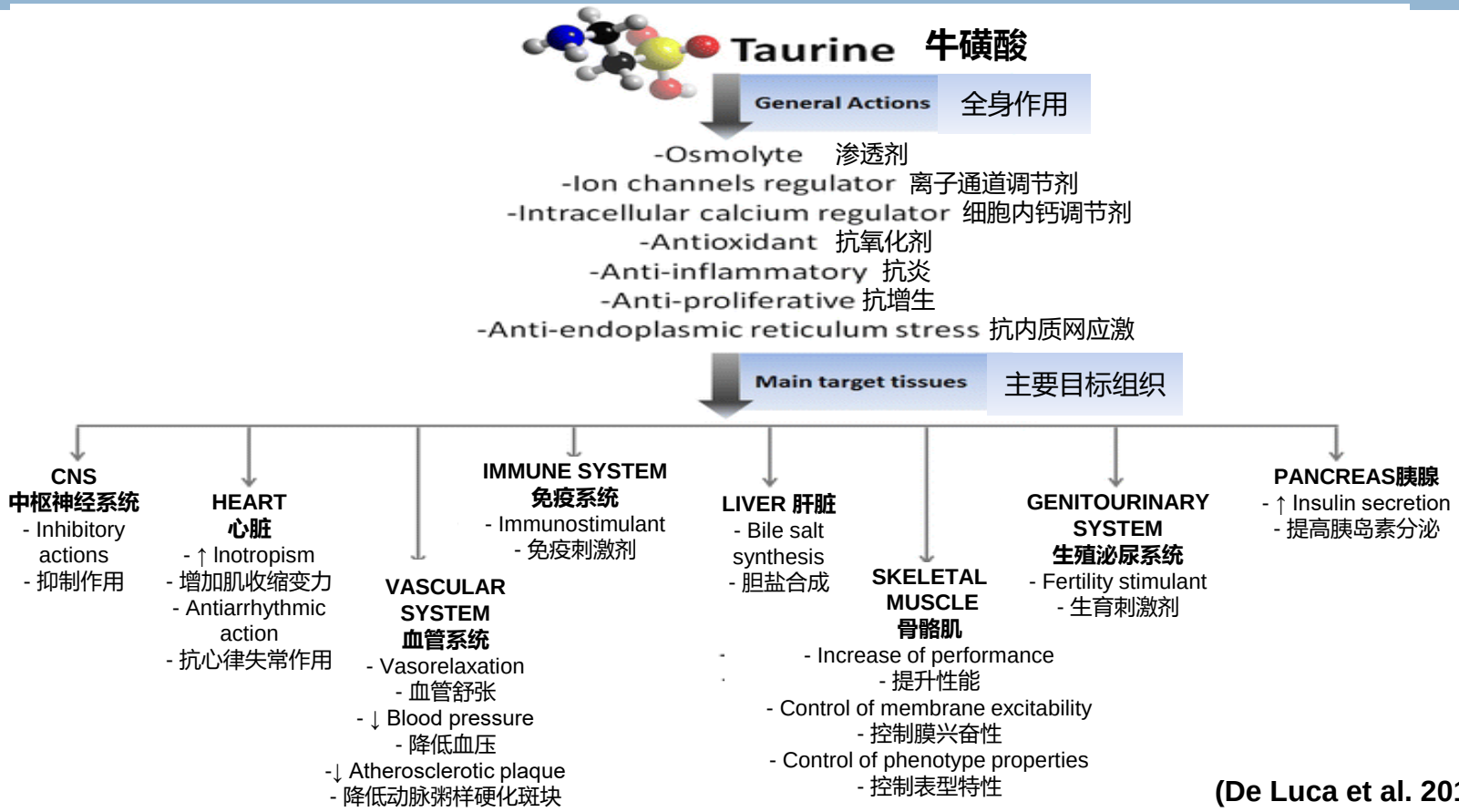
Accurate quantitative analysis of realization of nutrikinetics and nutridynamics vs.nutrition utilization and output
营养代谢与效应动力学实现对于营养利用与产出的准确定量分析



Module 1: composition
模块1:组成成分

Protein material 蛋白原料	Crude protein content (%) 粗蛋白含量 (%)	Crude fat content (%) 粗脂肪含量 (%)	Ash content (%) 灰分 (%)	Energy (KJ/Kg) 能量 (KJ/Kg)	Apparent digestibility of protein (%) 蛋白表观消化率（%）	Apparent digestibility of energy (%) 能量表观消化率（%）
Fishmeal 鱼粉	75.46	8.85	14.98	17.42	88.74	96.95
Chicken meal 鸡肉粉	72.82	13.31	12.41	18.50	75.56	67.98
Blood meal 血粉	99.32	0.60	3.77	19.42	83.34	71.35
Meat and bone meal 肉骨粉	59.66	9.50	30.80	13.67	73.12	62.90
Soybean meal 豆粕	53.27	2.55	6.63	16.04	64.47	48.12
Peanut meal 花生粕	54.97	1.70	6.42	15.91	71.25	51.34
Corn gluten meal 玉米蛋白粉	60.94	4.16	1.80	19.32	45.00	34.76
Vital wheat gluten 谷朊粉	88.33	1.60	0.99	19.44	85.75	86.82

Rich taurine in fishmeal is very important for growth and health
鱼粉富含的牛磺酸对于生长健康非常重要



(De Luca et al. 2015)

Protein source 蛋白源	Fishmeal 鱼粉	Meat and bone meal 肉骨粉	Yeast 酵母	Vegetable protein 植物蛋白
Taurine content (mg/kg) 牛磺酸含量(mg/kg)	3562	405	124	n.d

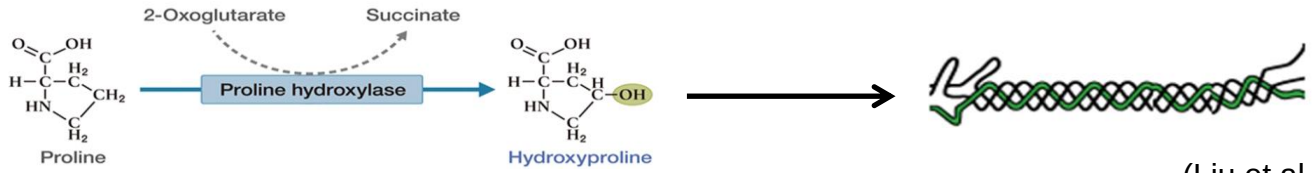
(Spitze et al. 2003)

Rich hydroxyproline in fishmeal is very important for fish growth
鱼粉中富含的羟脯氨酸对于鱼类生长非常重要

Fishmeal substitution reduces the content of hydroxyproline in fish body. The hydroxyproline supplementation can significantly improve the utilization efficiency of vegetable protein

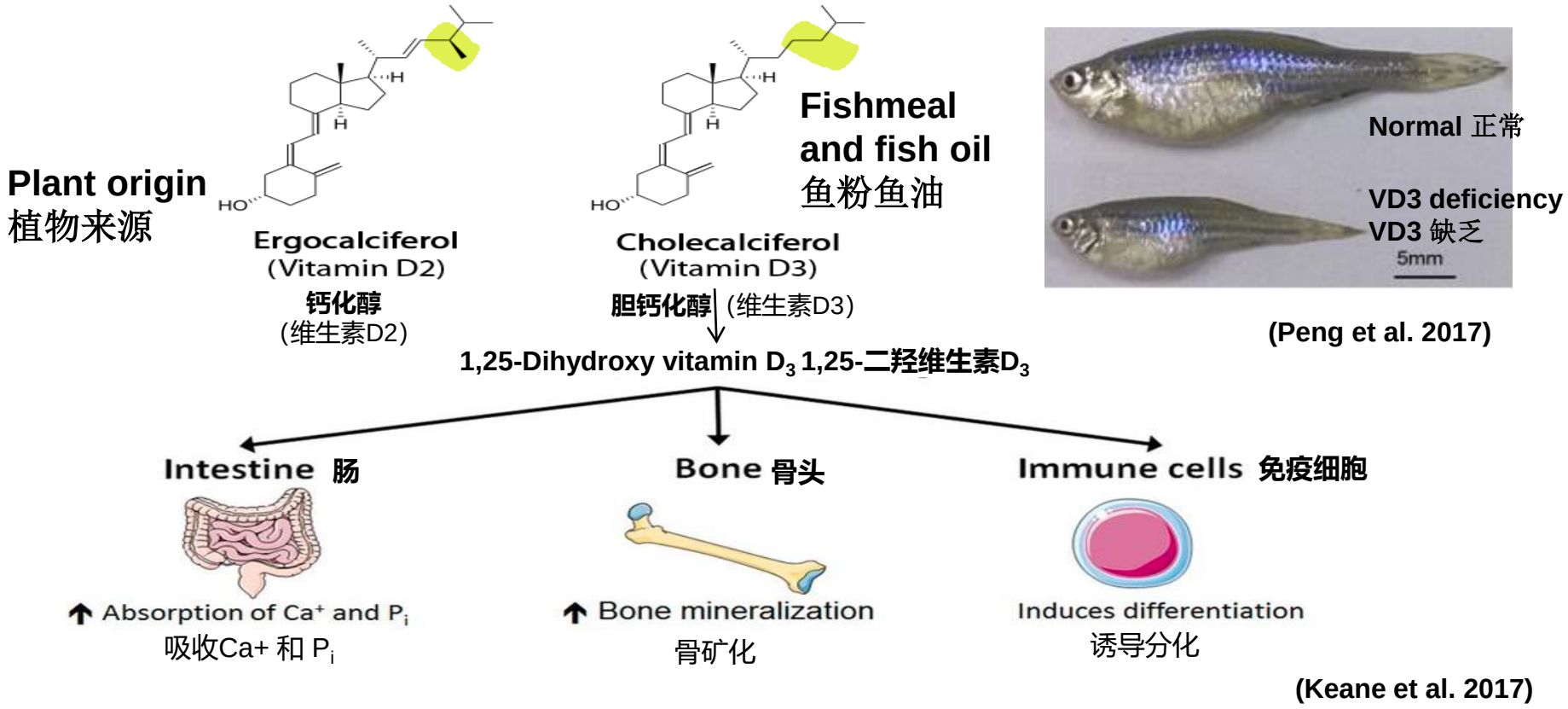
鱼粉替代造成鱼体羟脯氨酸含量下降，补充羟脯氨酸可以显著提高植物蛋白利用效率

Protein source of turbot 大菱鲆蛋白来源	Specific growth rate 特定生长率	Hydroxyproline content of plasma (μg/ml) 血浆羟脯氨酸含量（μg/ml）	Hydroxyproline content of muscle (μg/ml) 肌肉羟脯氨酸含量（g/kg）	Collagen content of muscle (%) 肌肉胶原蛋白含量(%)
All fishmeal 全鱼粉饲料	2.70 ±0.05^{a}	50.36±2.78^{b}	0.403±0.023^{b}	0.322±0.019^{b}
40% fishmeal + 60% vegetable protein **40% 鱼粉+ 60%植物蛋白**	2.45 ±0.08^{b}	40.53±2.00^{c}	0.281±0.031^{c}	0.225±0.025^{c}
40% fishmeal + 60% vegetable protein+ 0.6% Hyp **40% 鱼粉+ 60%植物蛋白+ 0.6% Hyp**	2.64 ±0.05^{a}	70.40 ±2.63^{a}	0.713 ±0.081^{a}	0.571 ±0.065^{a}



(Liu et al. *Aquaculture* 2014)

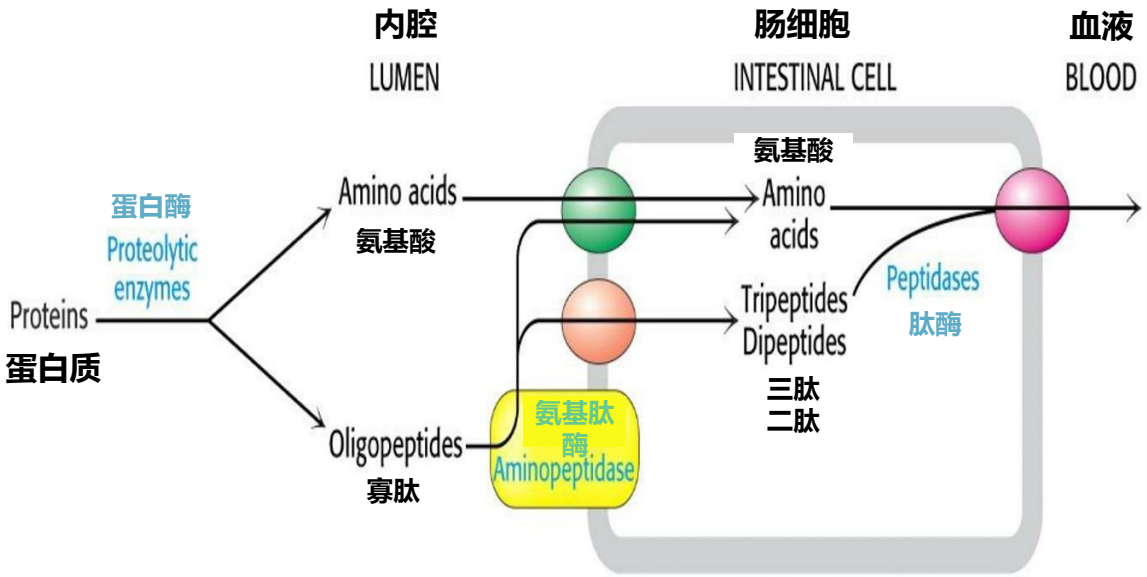
VD_3 in fishmeal and fish oil is very important for fish growth and health
鱼粉鱼油中的VD_3 对于鱼类生长健康非常重要



(Peng et al. 2017)

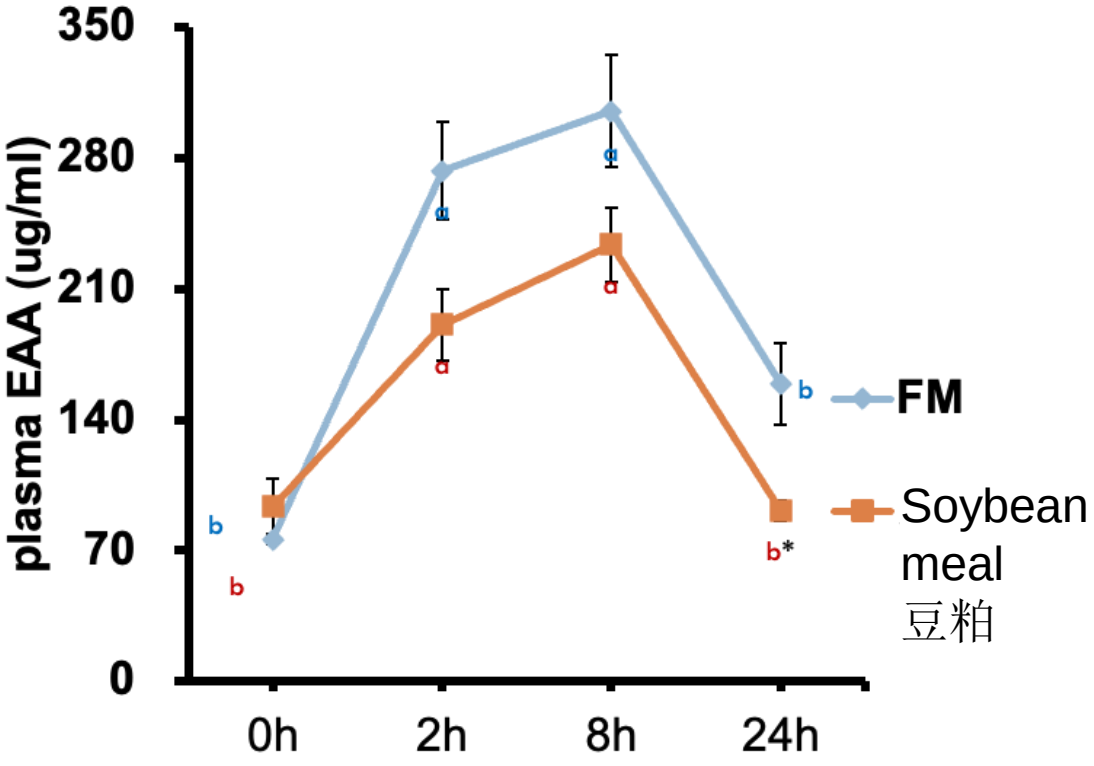
(Keane et al. 2017)

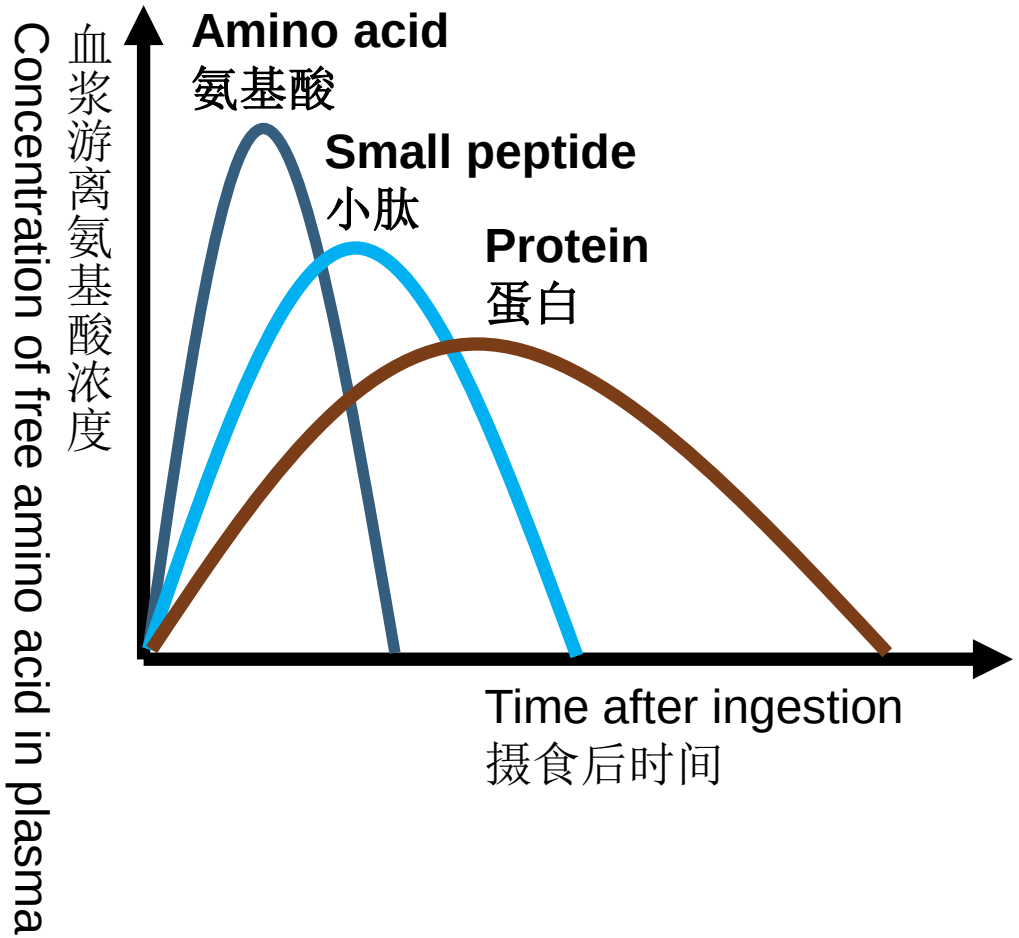
Proportion of protein, small peptide and amino acid
蛋白质、小肽与氨基酸的比例



	Protein (%dry weight) 蛋白（%干重）	Acid soluble protein (%) 酸溶蛋白 (%)	<10K Da (protein %) <10K Da (蛋白%)
Fishmeal 鱼粉	72.6	10.29	2.91
Chicken meal 鸡肉粉	73.7	13.06	3.99
Soybean meal 豆粕	51.8	2.04	6.84

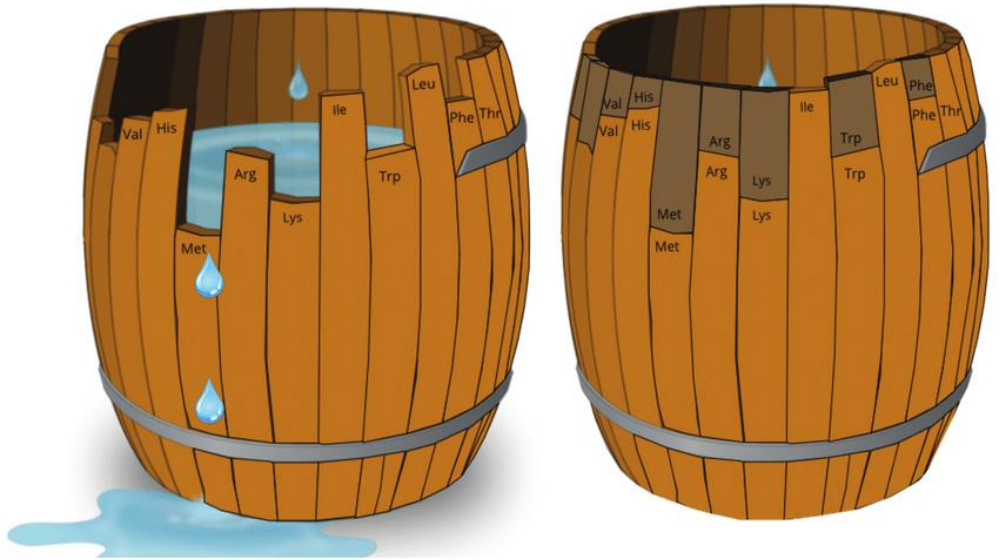
Module 2: Dynamics of free amino acid after ingestion
模块2:餐后游离氨基酸动力学





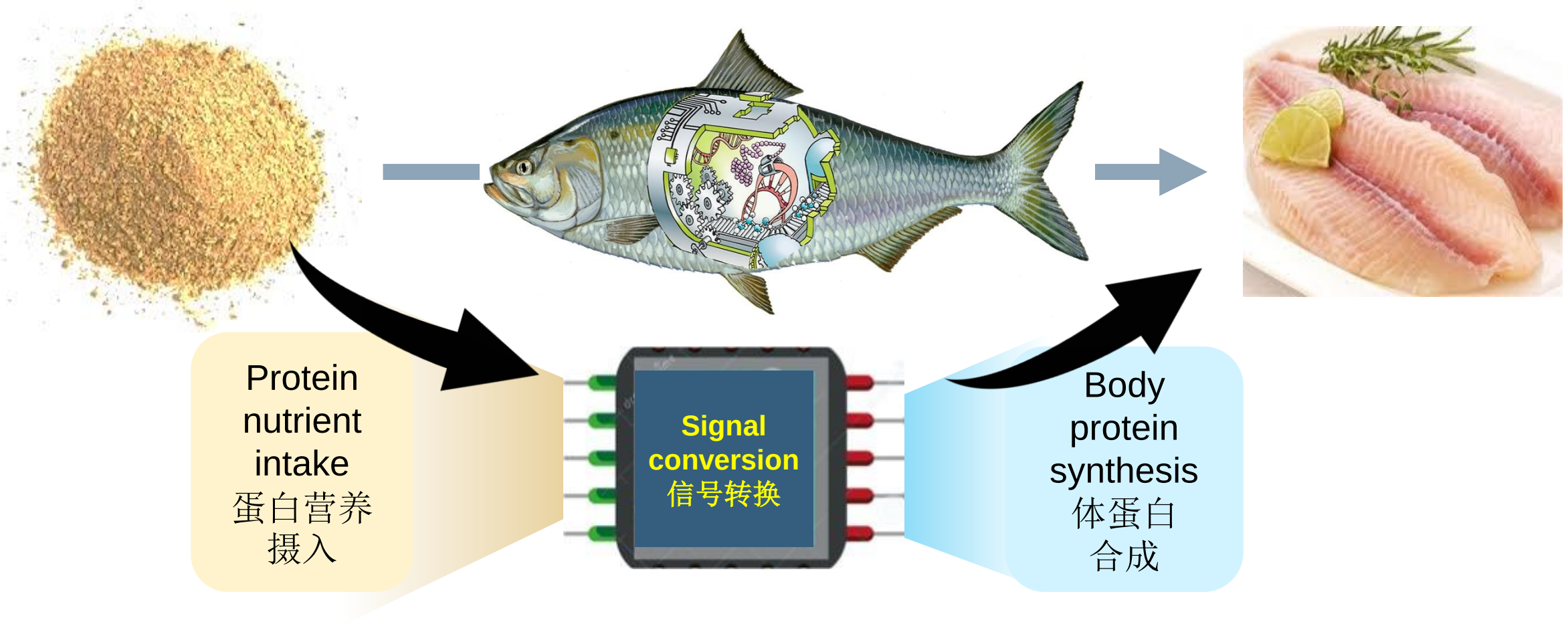
Amino acid balance
氨基酸平衡

- **Is the amino acid pattern of fishmeal the optimal pattern?**
  鱼粉的氨基酸模式是最优的氨基酸模式吗？

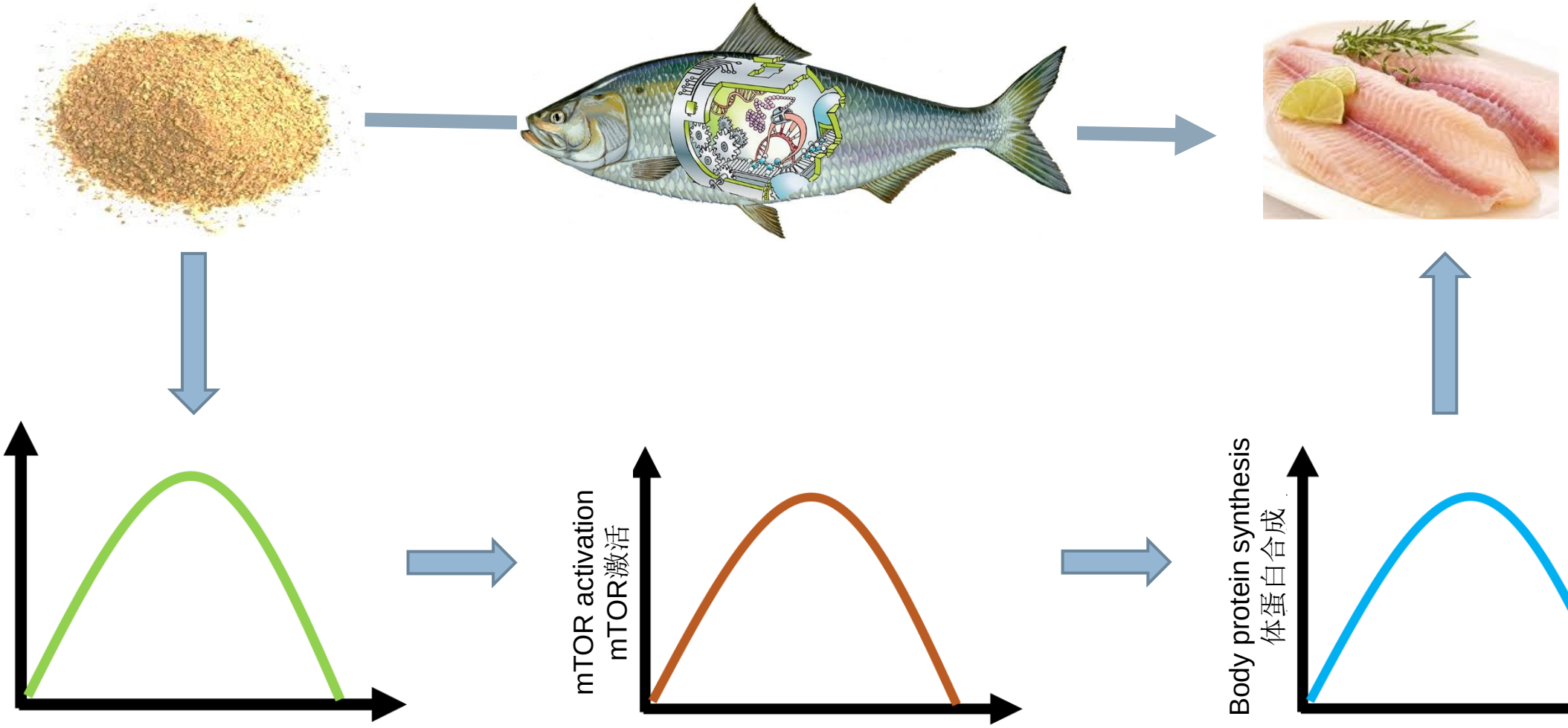


What to balance?
平衡什么？

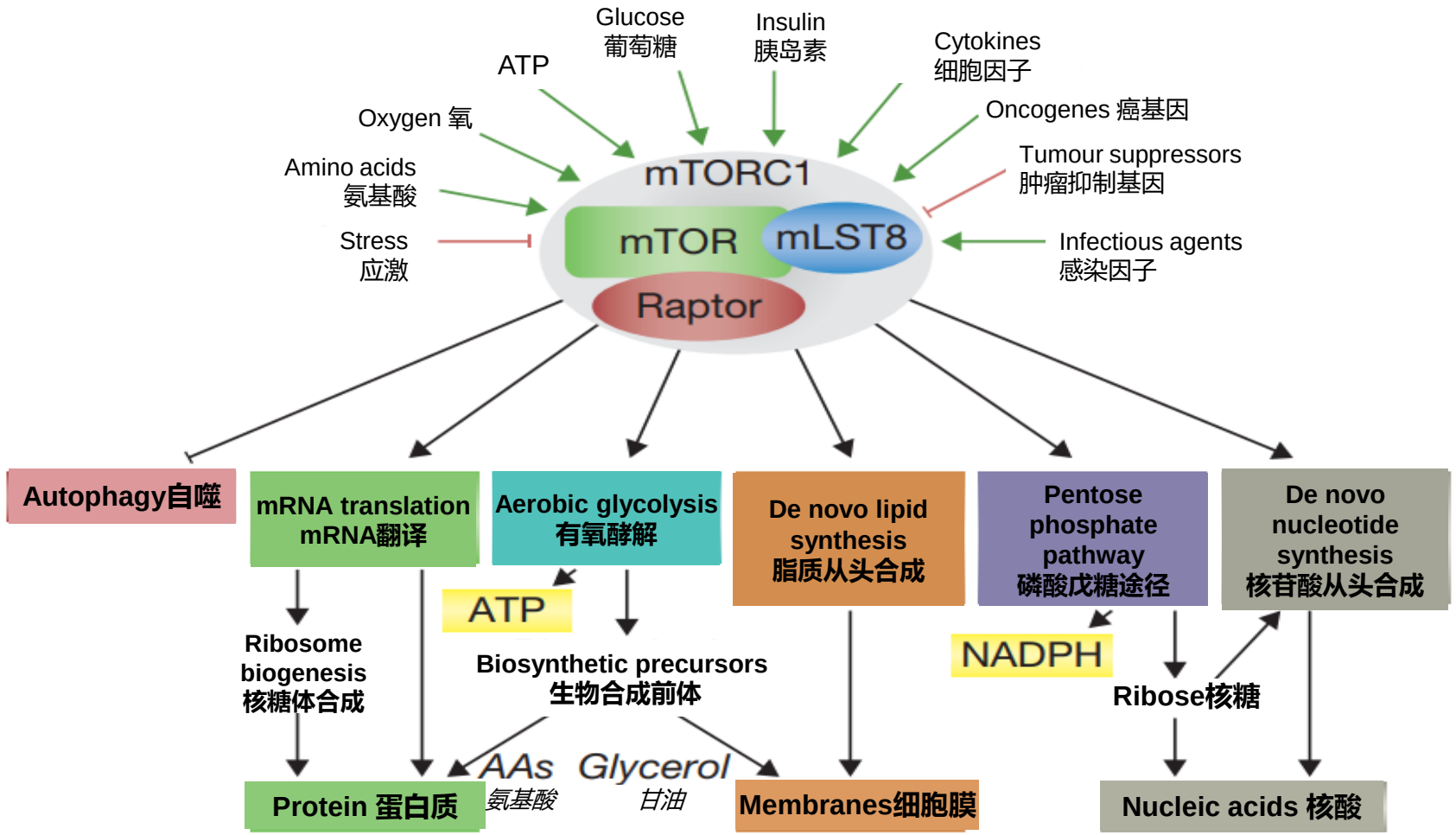
Module 3: nutrient sensing
模块3: 营养感知



mTOR is a key control node for protein utilization of aquatic animal feed
mTOR是水产动物饲料蛋白利用的关键调控节点

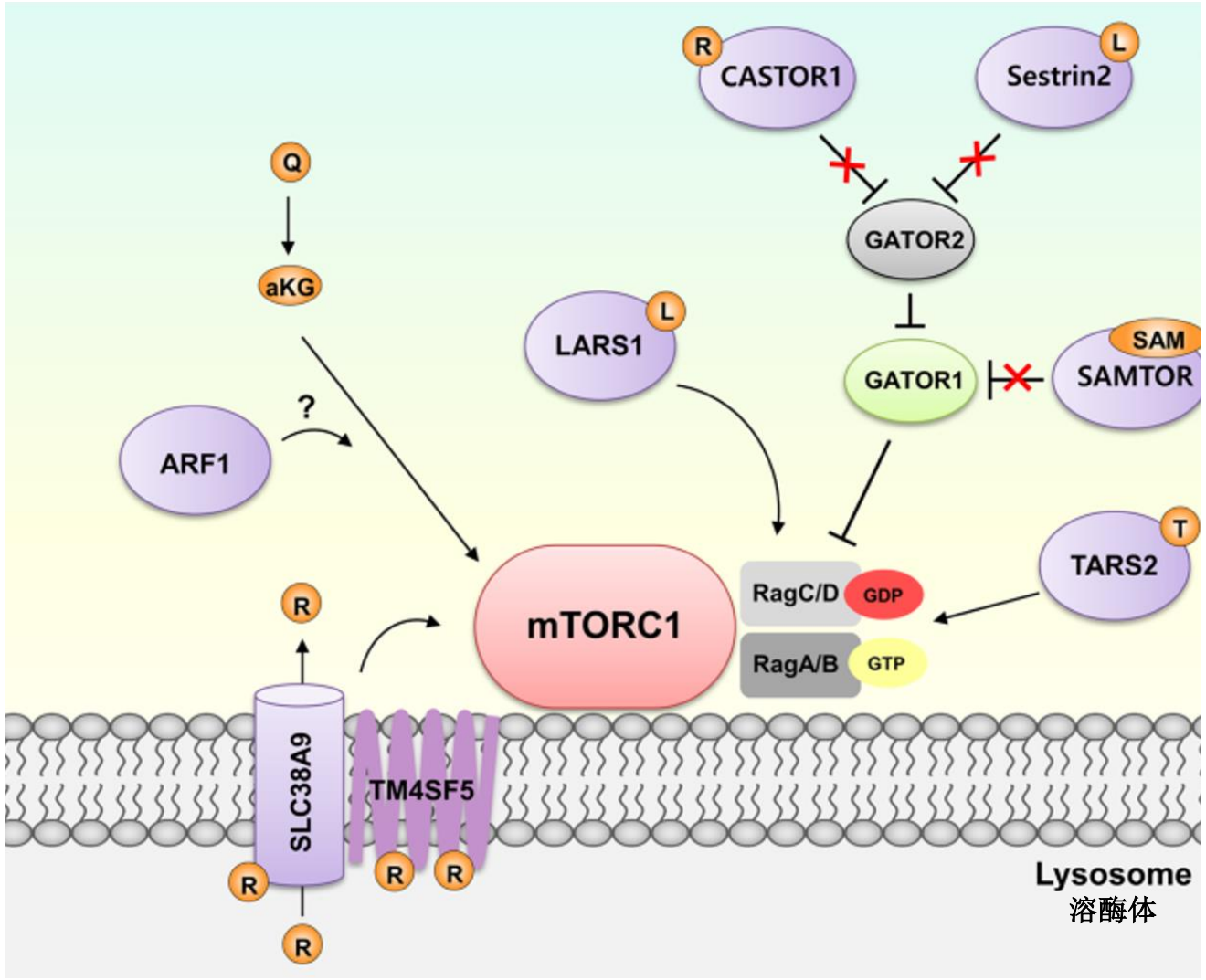


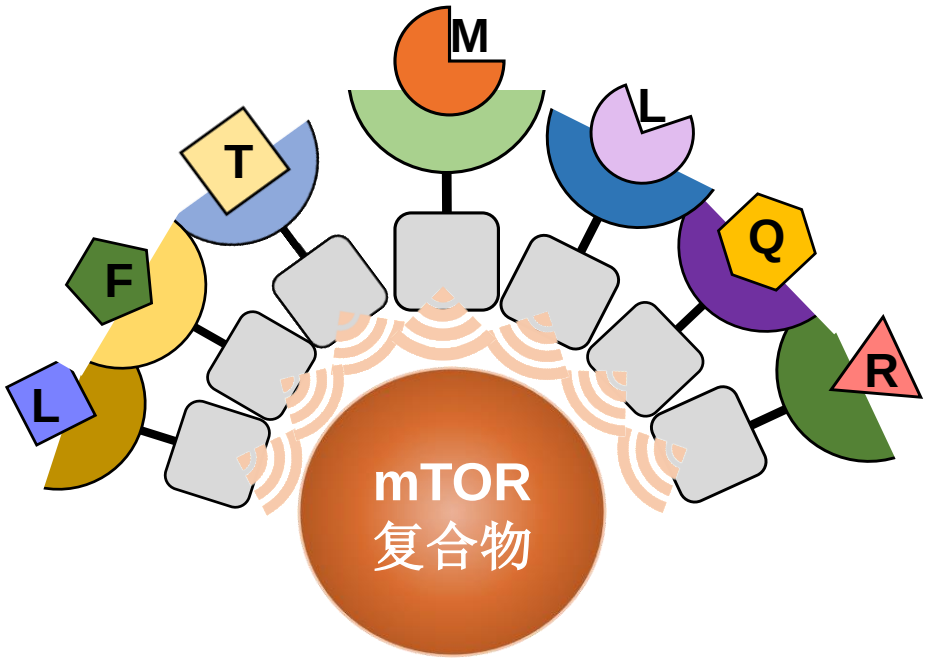
mTOR is an intersection of external environment and metabolic regulation
mTOR是关联外界环境、调控代谢的交汇点



Many amino acid sensors combine different amino acid and conduct them to mTOR system for regulating synthesis and metabolism

多种氨基酸感受器结合不同氨基酸并传导到mTOR系统调节合成代谢



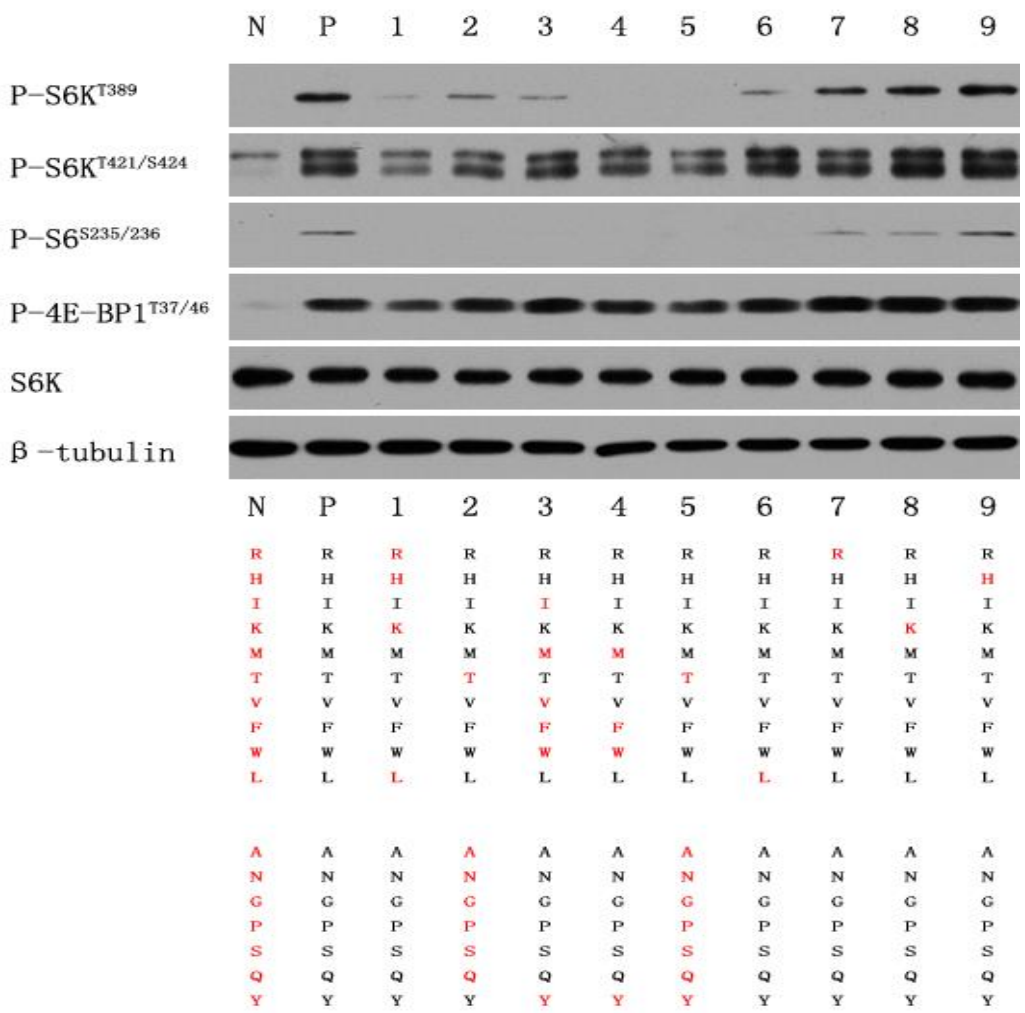


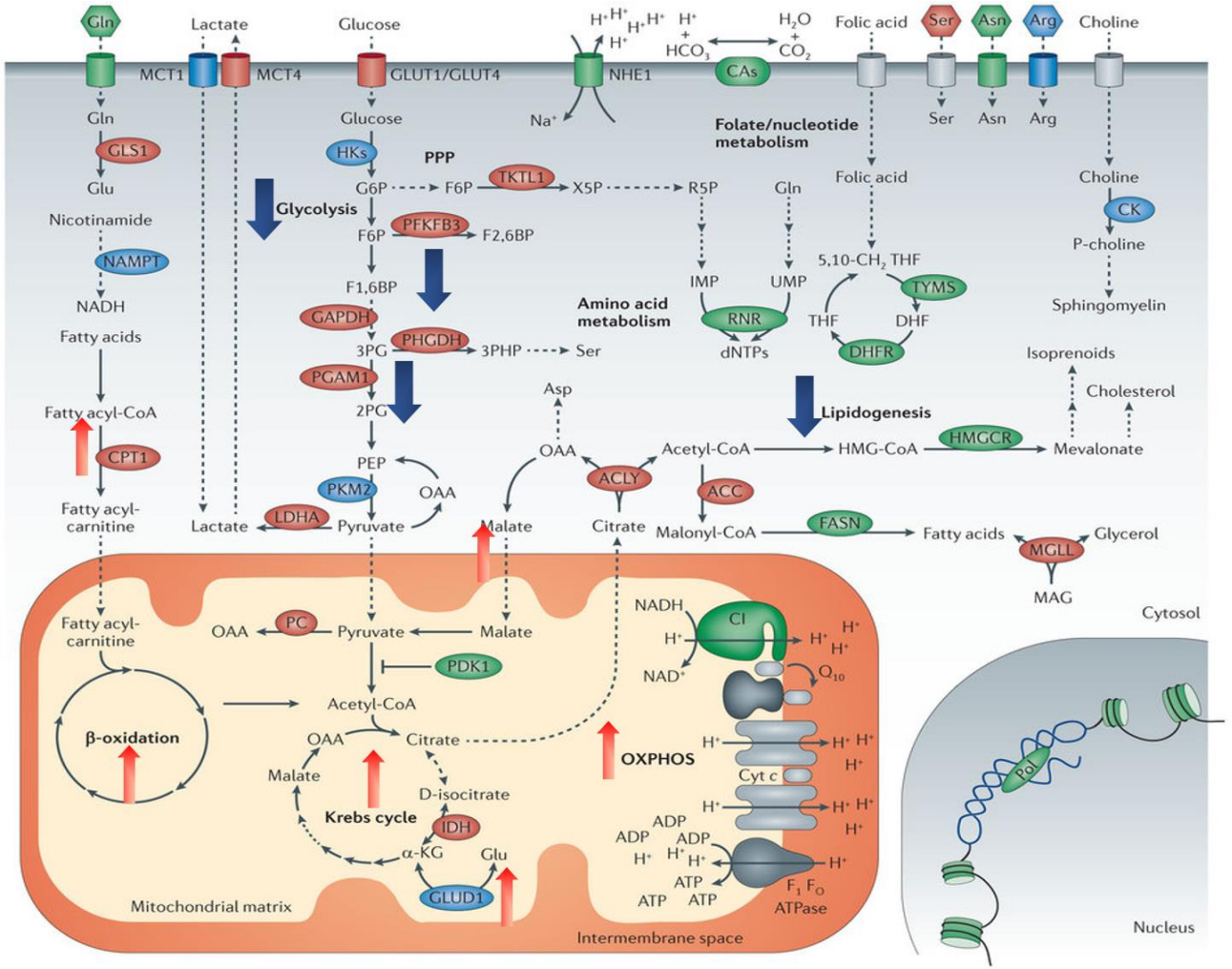
Synthesis and metabolism

合成代谢

Any change in amino acid pattern/balance will affect nutrient sensing and metabolism

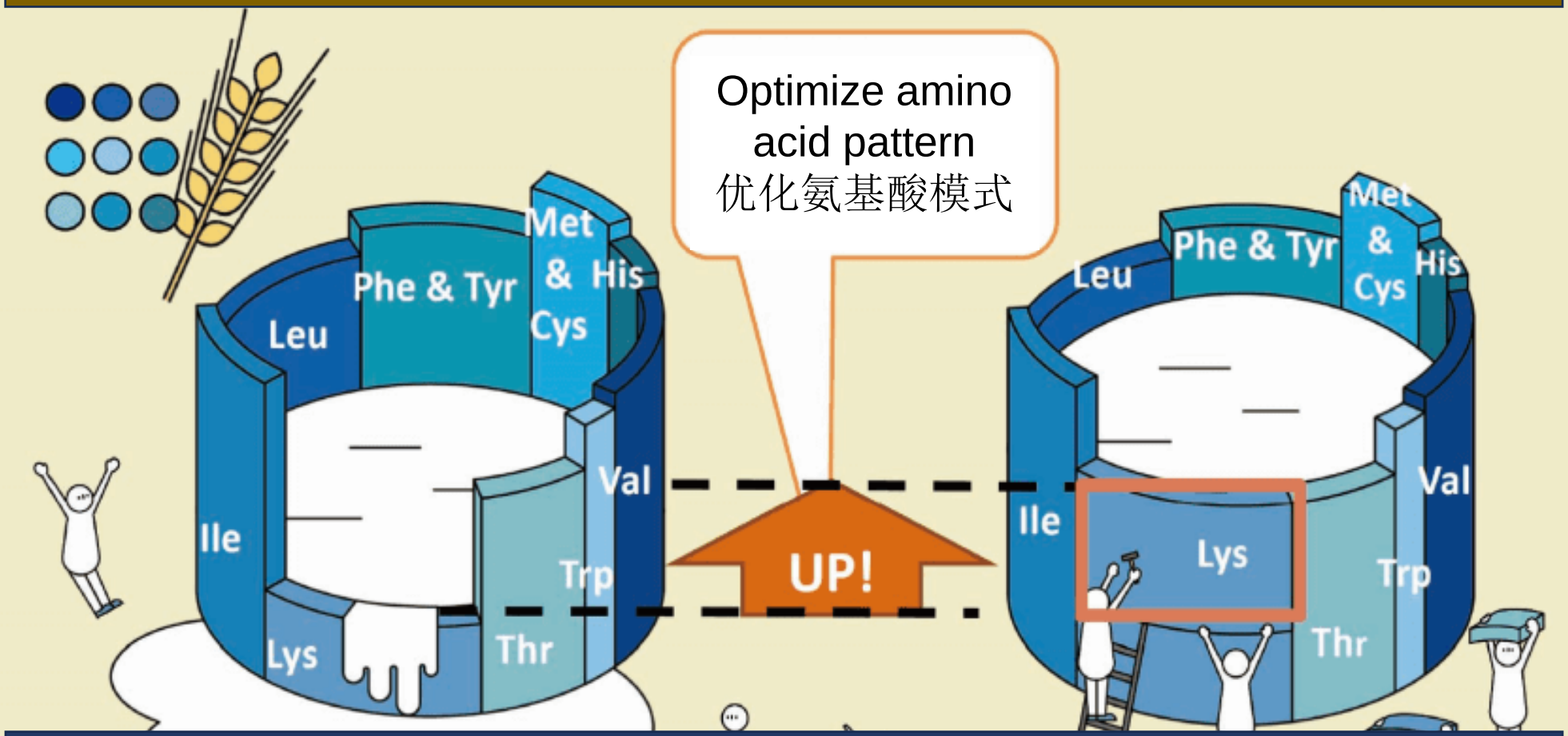
任何氨基酸模式/平衡的变化会影响营养感知与代谢





Traditional knowledge
传统认识

Essential amino acid to be balanced
必需氨基酸需要平衡



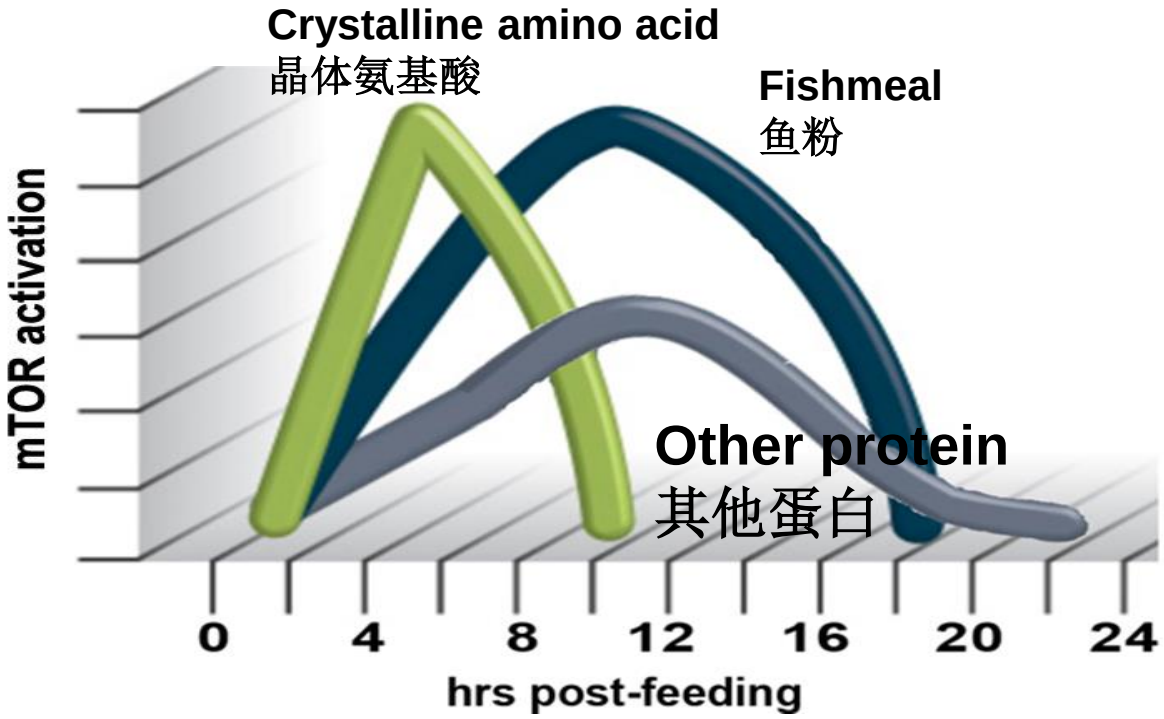
Updating knowledge
更新认识

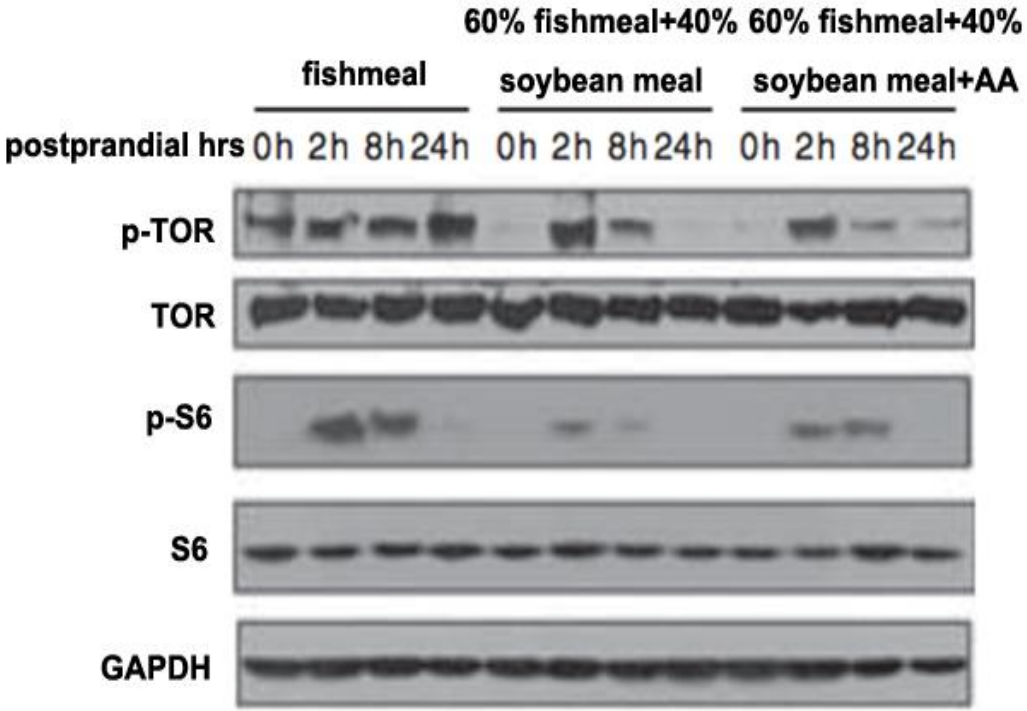
All amino acid to be balanced
全氨基酸需要平衡

The reduction of mTOR activation after fishmeal substitution is underlying cause for poor animal growth and feed ratio

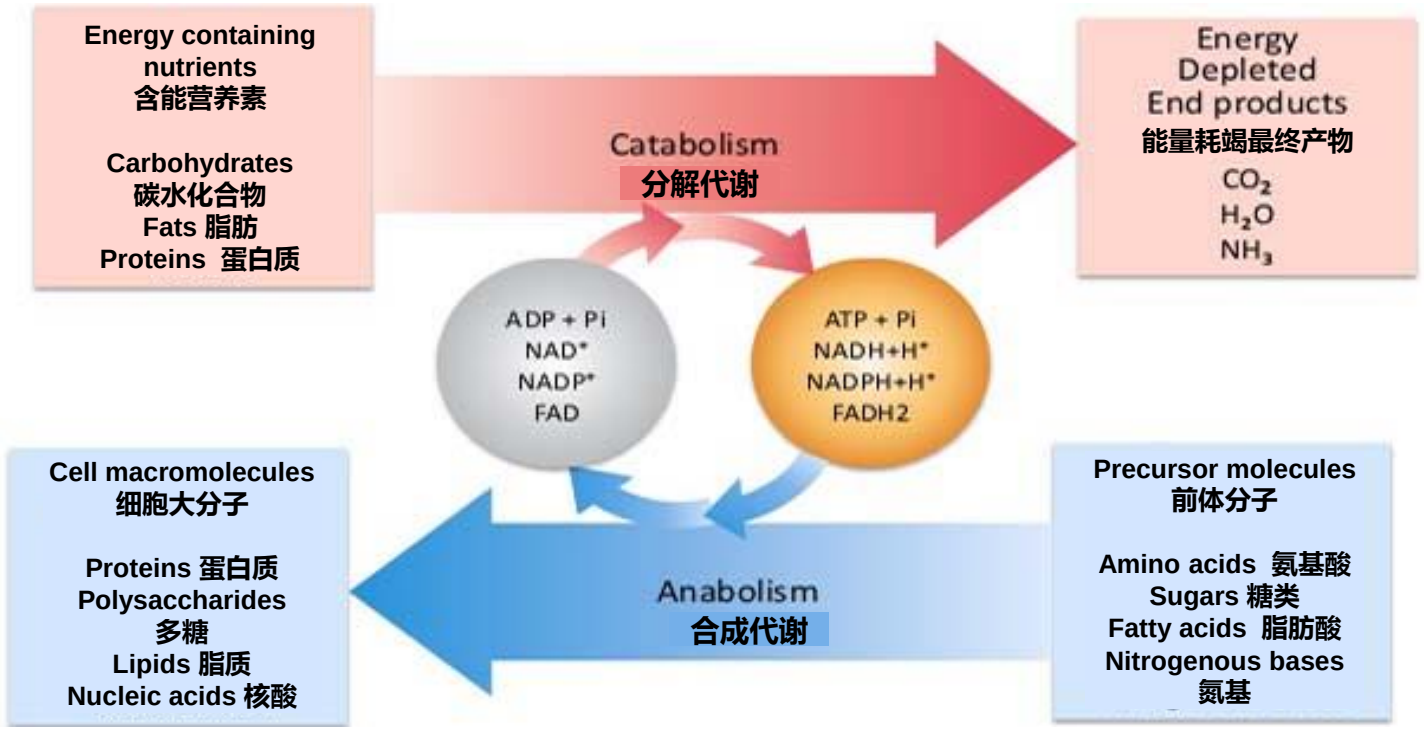
鱼粉替代后造成的 mTOR激活下降是动物生长和料比不佳的内在原因

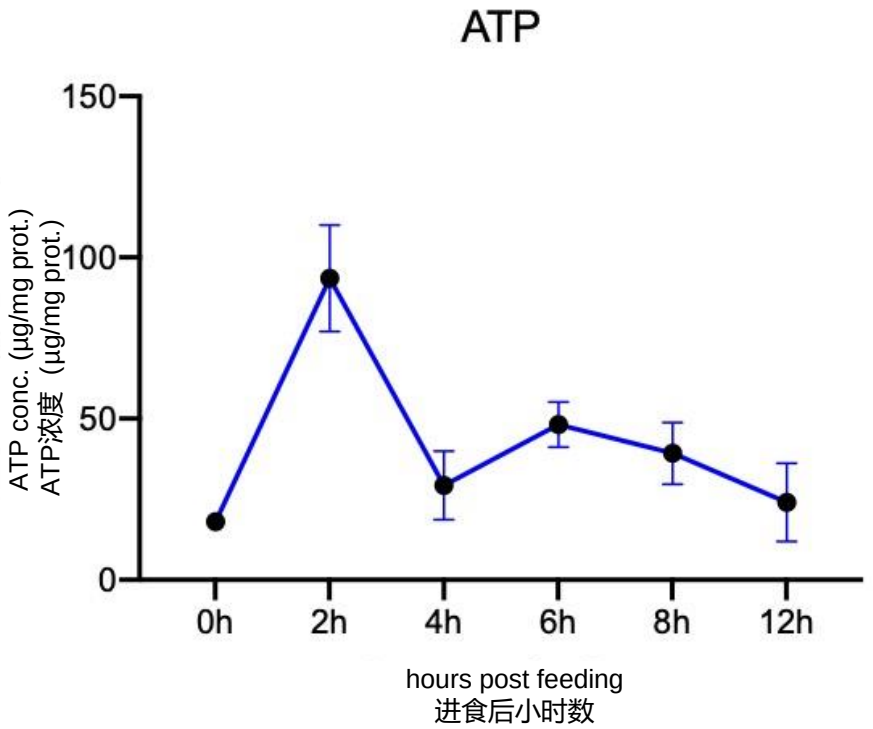
Fishmeal substitution 鱼粉替代 → Inadequate mTOR activation mTOR激活不足 → Inadequate body protein synthesis 体蛋白合成不足 → Growth reduction 生长下降



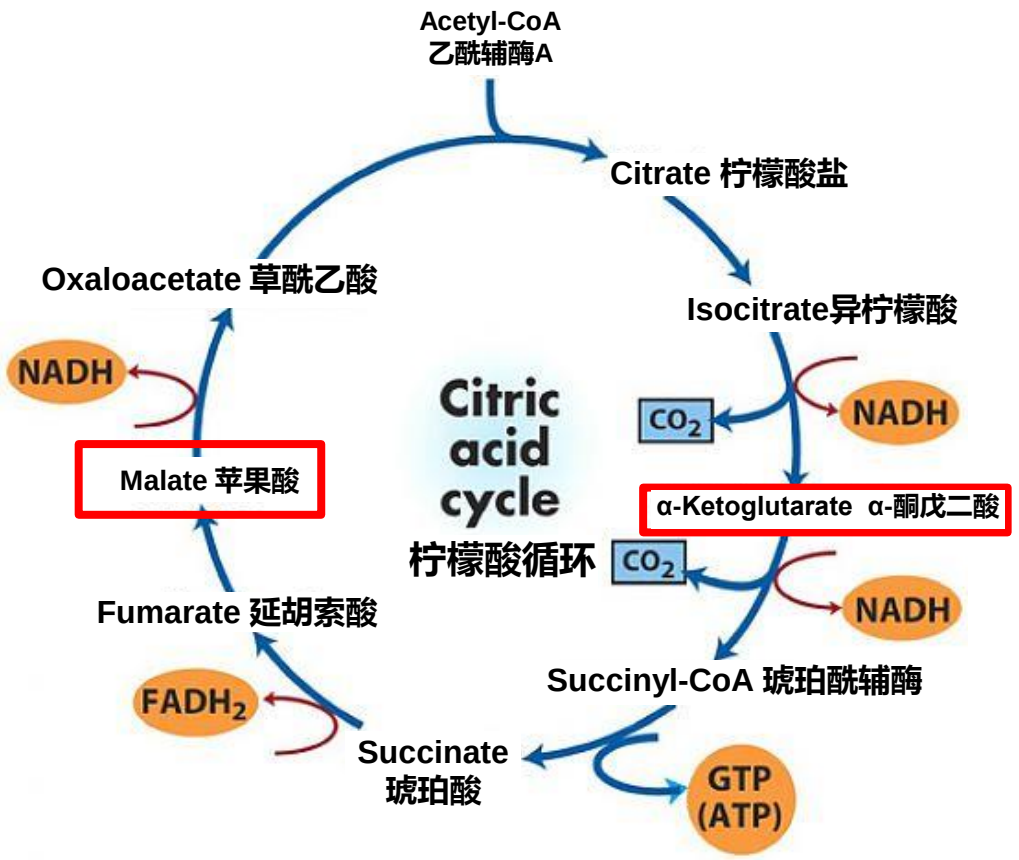


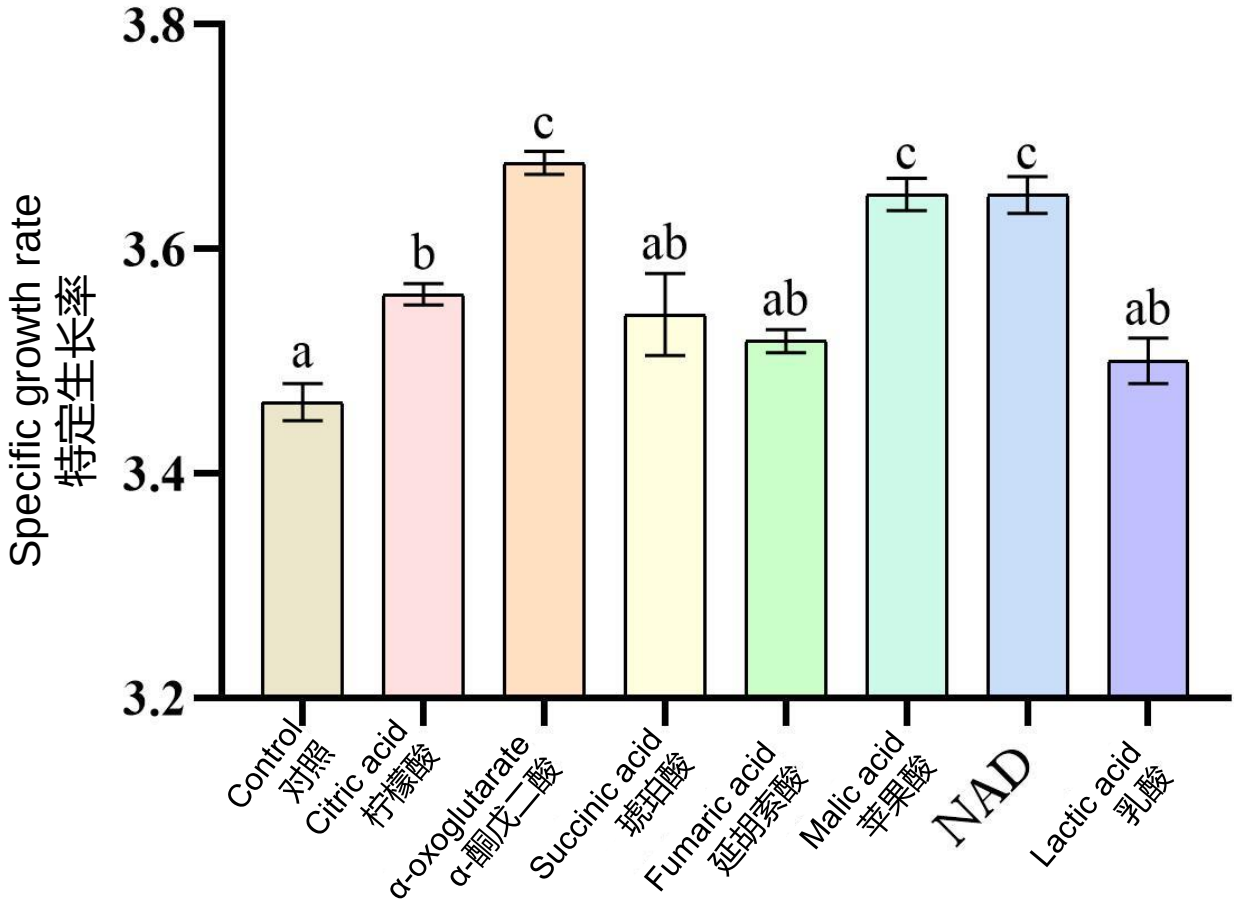
Module 4: energy is a key material basis for driving synthesis and metabolism
模块4:能量是驱动合成代谢的重要物质基础

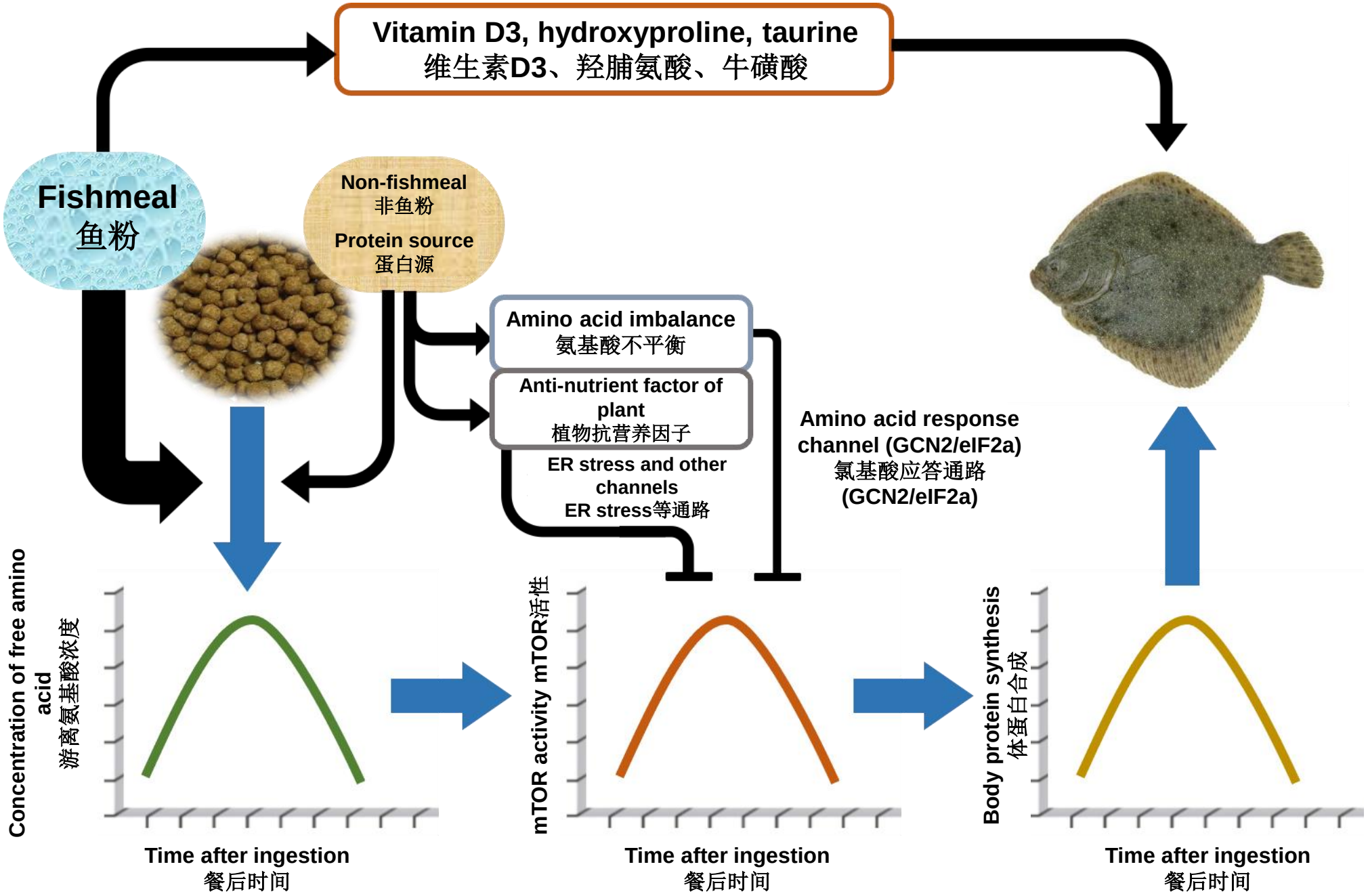


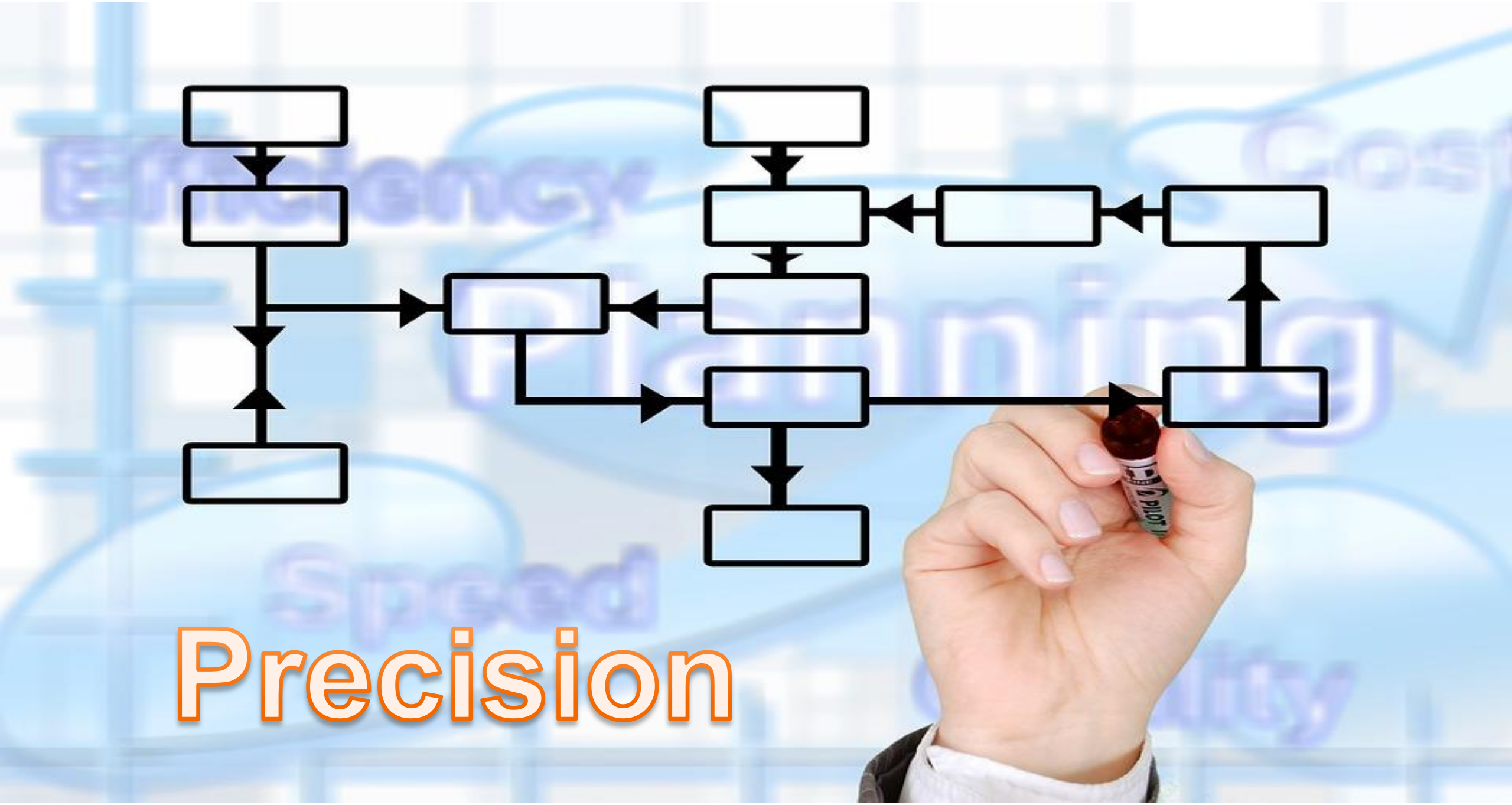


Energy supply after ingestion is very important for protein synthesis and growth
摄食后能量供应对于蛋白合成与生长非常重要






Vitamin D3, hydroxyproline, taurine
维生素D3、羟脯氨酸、牛磺酸
Fishmeal
鱼粉
Non-fishmeal
非鱼粉
Protein source
蛋白源
Amino acid imbalance
氨基酸不平衡
Anti-nutrient factor of plant
植物抗营养因子
ER stress and other channels
ER stress等通路
Amino acid response channel (GCN2/eIF2a)
氯基酸应答通路
(GCN2/eIF2a)
Concentration of free amino acid
游离氨基酸浓度
Time after ingestion
餐后时间
mTOR activity mTOR活性
Time after ingestion
餐后时间
Body protein synthesis
体蛋白合成
Time after ingestion
餐后时间


Precision