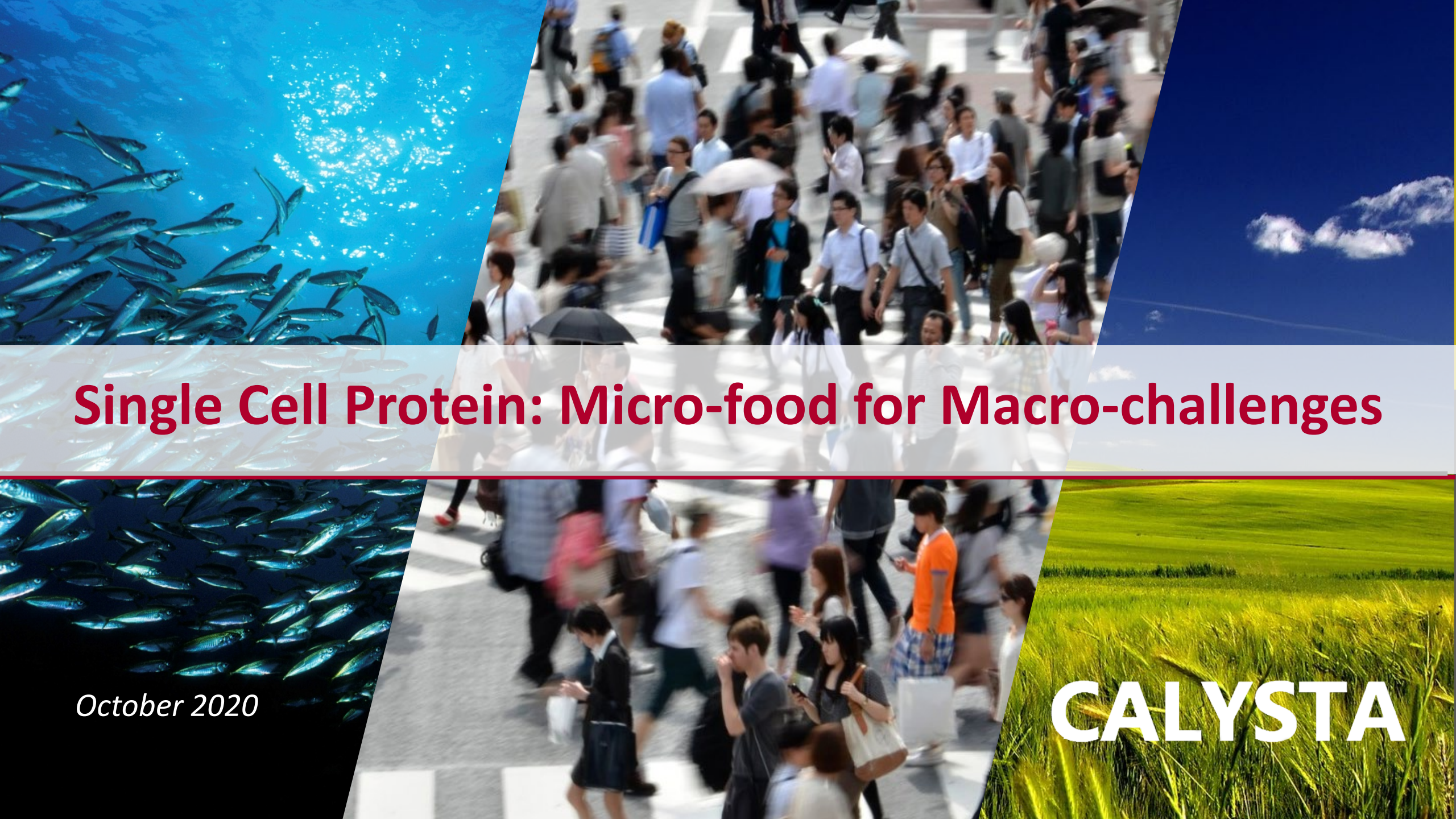


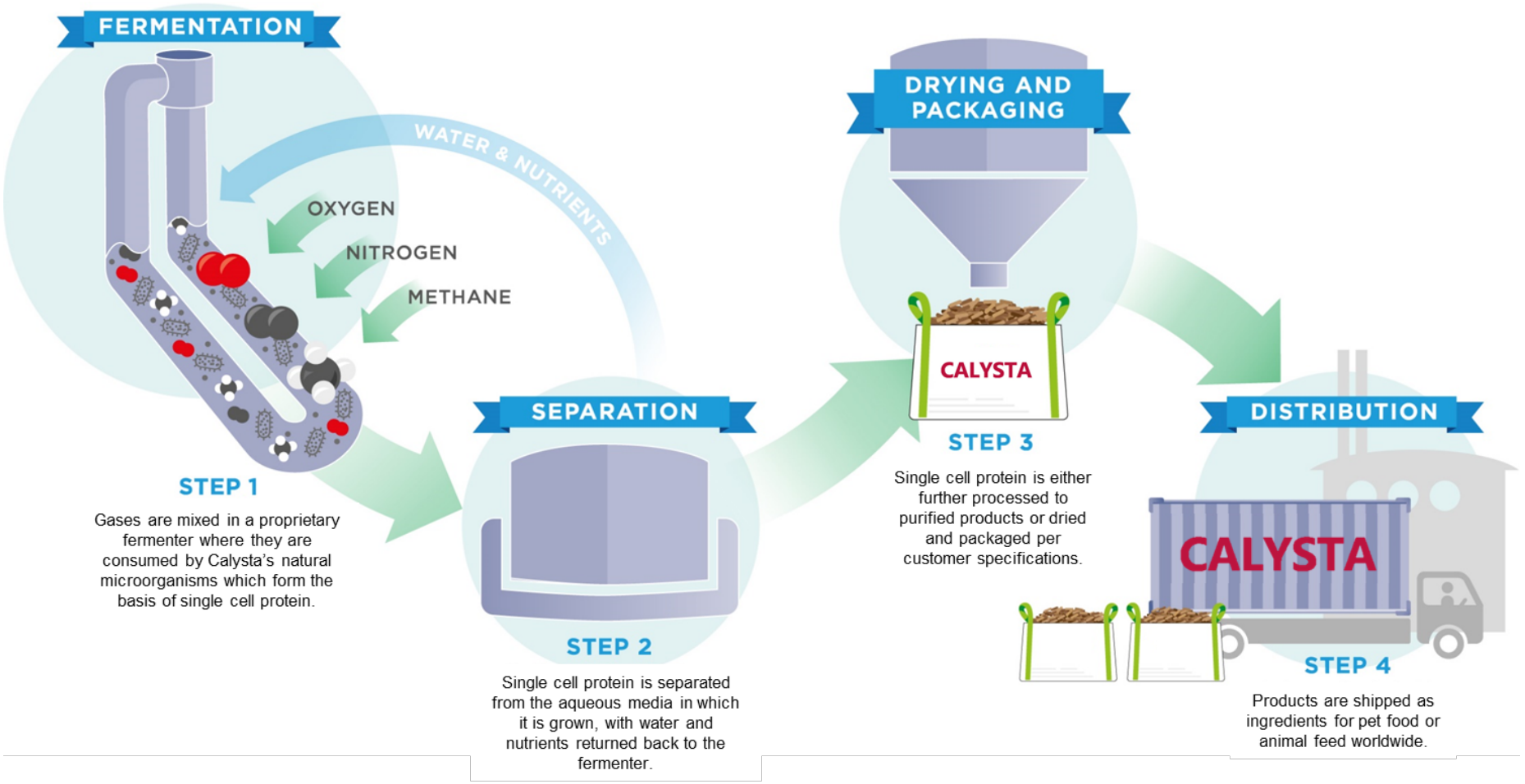
Single Cell Protein: Micro-food for Macro-challenges

October 2020

CALYSTA

FeedKind protein is a single cell protein produced by fermenting natural gas, an abundant source of energy

CALYSTA



ADISSEO
A Bluestar Company

bp

Cargill™

The Coming Wave of Protein Ingredient Demand

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- Changing consumer preferences and growing middle class will drive demand for protein ingredients far more than population growth
- Shifting tastes from omnivorous to carnivorous fish will accelerate slow moving demographic trends
- Growth in Demand = [Δ FCR] x [Δ Marine Inclusion]

- It's true that fish need nutrients and not ingredients, but this highlights a clear gap in nutrient dense ingredients with favorable amino acid profiles

Figure 1: Grass carp, Ctenopharyngodon idella (source: Liu and He, 1992)

1.0 x

FCR	1.2
Fishmeal inclusion	5%
Fishmeal per tonne	**60 kgs**

8.3 x

FCR	2.0
Fishmeal inclusion	25%
Fishmeal per tonne	**500 kgs**

Shifting 5% of Chinese carp demand to marine species will require another 440,000 tonnes of high protein ingredients

What Is the Industry Looking for in an Alternative Protein?

CALYSTA

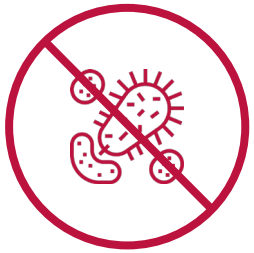
Natural & Sustainable Process

High Density Protein
All Essential Amino Acids

Consistent Quality
Traceable

Robust and Scalable Supply Chain

Animal-free



Non-GMO

No Pesticides
or Antibiotics

No Known Allergens nor Anti-Nutritional Factors

Dramatically Reduced Land and Water Use Requirements, as Well as Lower GHG Profile than Traditional Protein Ingredients

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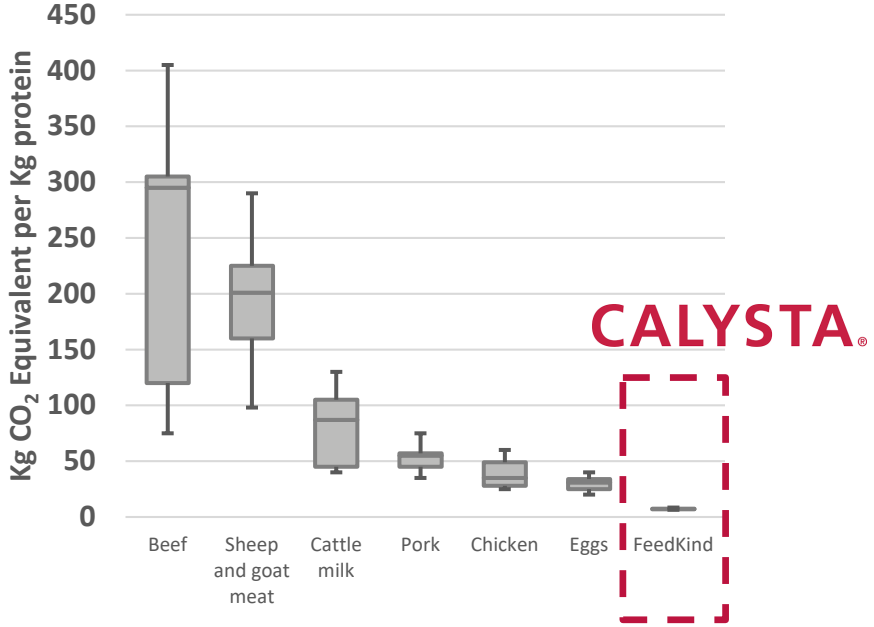
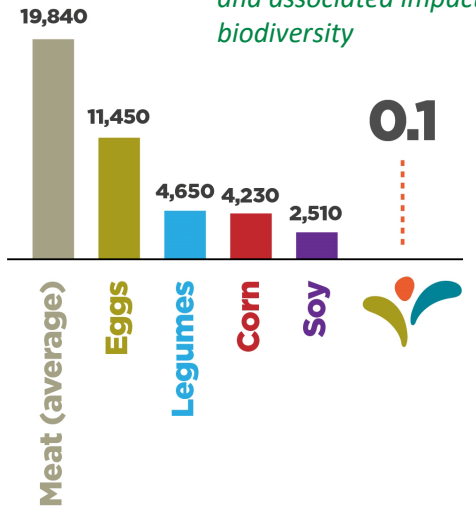
GHG Intensity of Different Protein Sources

Agriculture and associated land-use change such as deforestation accounted for nearly 25% of global greenhouse gas (GHG) emissions in 2010



Land Required to Produce Protein Equivalent to a 100,000 mtpa FeedKind Plant

Agriculture has already cleared or converted 70% of grassland, 50% of the savanna, 45% of the temperate deciduous forest, and 27% of tropical forests, yet continues to expand and is the dominant driver of deforestation and associated impacts on biodiversity



(Shown in km²)

FeedKind protein uses 90% less blue water than equivalent soy protein or wheat production; agriculture accounts for 70% of all fresh water withdrawn from rivers, lakes, and aquifers, and for 80-90% of freshwater consumption by human activities

Source: FAO Global Livestock Environmental Assessment Model (GLEAM), DuPont Solae, USDA, FAO/WHO/UNICEF Protein Advisory Group and The Carbon Trust's "Assessment of environmental impact of FeedKind protein" (2016), World Resources Report "Creating a Sustainable Food Future" (July 2019)

Methanotroph (*Methylococcus capsulatus*, Bath) bacteria meal as an alternative protein source for Japanese yellowtail, *Seriola quinqueradiata*

CALYSTA

- Partnership with Kindai University in Japan
- 2 separate trials to determine efficacy of FeedKind in Seriola feeds and appropriate inclusion levels
- Additional treatments to assess impact of attractants and physical processing of FeedKind
- Favorable results showing FeedKind can be included at up to 17% of total feed

Table 3
Feed formula and proximate composition of diets used in Trial 2.

	C	FK20	FK25	FK30	FK25J	FKB25	EFK
Ingredients							
Fish meal[a]	68.0	54.4	51.0	47.6	51.0	51.0	48.0
FK 5/35[b]		13.6	17.0	20.4			17.0
FK jet mill 5/35[b]					17.0		
FK 5/19[b]						17.0	
Enzyme-treated fish meal[c]							3.0
Fish oil[d]	8.5	9.7	10.0	10.2	10.0	9.9	10.0
Wheat flour	11.5	7.8	7.3	6.9	7.3	7.4	7.1
Wheat flour (low grade)	5.0	3.0	3.0	3.0	3.0	3.0	3.0
β-Tapioca starch	5.0	3.0	3.0	3.0	3.0	3.0	3.0
Vitamin & mineral premix[e]	1.3	1.8	1.9	2.1	1.9	1.9	2.1
Taurine	0.0	0.3	0.3	0.3	0.3	0.3	0.3
Cellulose	0.2	6.0	6.0	6.0	6.0	6.0	6.0
Chromic oxide (Cr_2O_3)	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Proximate composition (%, dry matter basis)							
Crude protein	54.7	53.4	52.9	53.2	53.3	53.0	53.3
Crude fat	14.1	15.9	16.4	15.9	15.8	15.5	15.7
Crude ash	12.8	11.3	11.0	10.8	11.1	11.2	11.1
Phosphorus (g/kg diet)	21.4	18.2	18.0	17.8	17.6	18.9	18.4

[a] Feed Pro, Quito, Equador (crude protein, ca. 67%).
[b] Calysta, Inc., CA, USA (crude protein, ca. 71%).
[c] Profish S.A., Santiago, Chile (crude protein, ca. 70%).
[d] Ueda Oils & Fats Mfg. Co. Ltd., Tokyo, Japan.
[e] Halver (1957).

Opportunities for Future Collaboration

CALYSTA

- We actively pursue collaborations with academic partners for research of mutual interest
- Primary research of interest is functional benefits of FeedKind to gut and immune health in shrimp and finfish
- We are currently involved in projects with professors at U of Stirling, U of Glasgow, Kasetsart University in Bangkok, and Ocean University in Qingdao (among others!)

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