In vitro rumen fermentation of black soldier fly larvae reared on different sources of food waste

Dr Kristy DiGiacomo
Prof Brian Leury
Claire Leach
Paula Giraldo

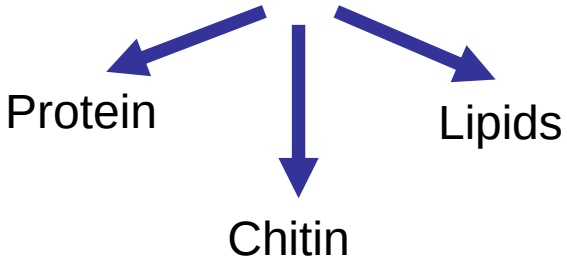
Food waste

- ~1/3 of worldwide food production is wasted each year
  - ~1.3 billion tonnes
  - The highest rate of wastage comes from fruits & vegies
- Global costs ~$940 billion

Data Source: FAO

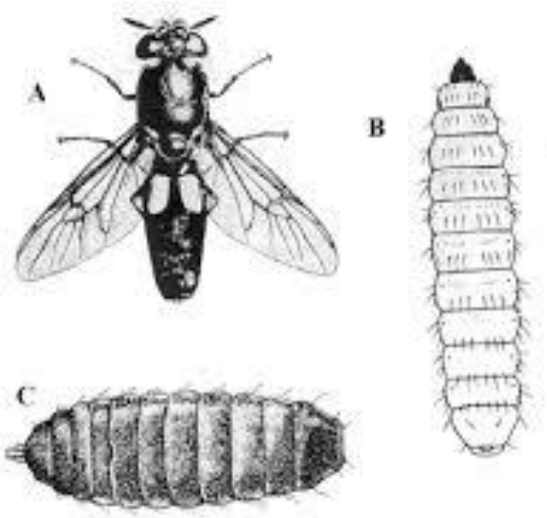
Black soldier flies (*Hermetia illucens*)

- Occur worldwide in tropical & temperate regions
- Pathogen free
  - Do not vector or disseminate diseases
  - FCR's are superior to crickets & mealworms
- 1 hectare of land produces ~ 300 x the volume of insect protein compared to soybean/canola crops



Black soldier fly larvae

- Commonly investigated as feed for aquaculture, poultry & pork production
- Limited research in ruminants
- Larvae rearing substrate influences resultant composition



Black soldier fly. A, Adult female. B, Larva. C, Puparium.

Amino acid composition - comparison

	BSF larvae	Soybean meal	Fish meal
Alanine	24	15	63
Arginine	17	26	64
Aspartic acid	34	40	85
Cysteine	4	5	9
Glutamic acid	43	63	128
Glycine	19	16	99
Histidine	12	10	20
Isoleucine	16	17	37
Leucine	25	27	65
Lysine	24	22	69
Methionine	6	5	26
Phenylalanine	15	18	33
Proline	20	18	53
Serine	14	19	48
Threonine	14	15	39
Tryptophan	4	5	9
Tyrosine	18	13	26
Valine	21	17	45
Total	321	351	918

Does the rearing feed source alter the nutrient content and *in vitro* fermentation pattern of Black Soldier Fly Larvae?

Methods: *In vitro* fermentation

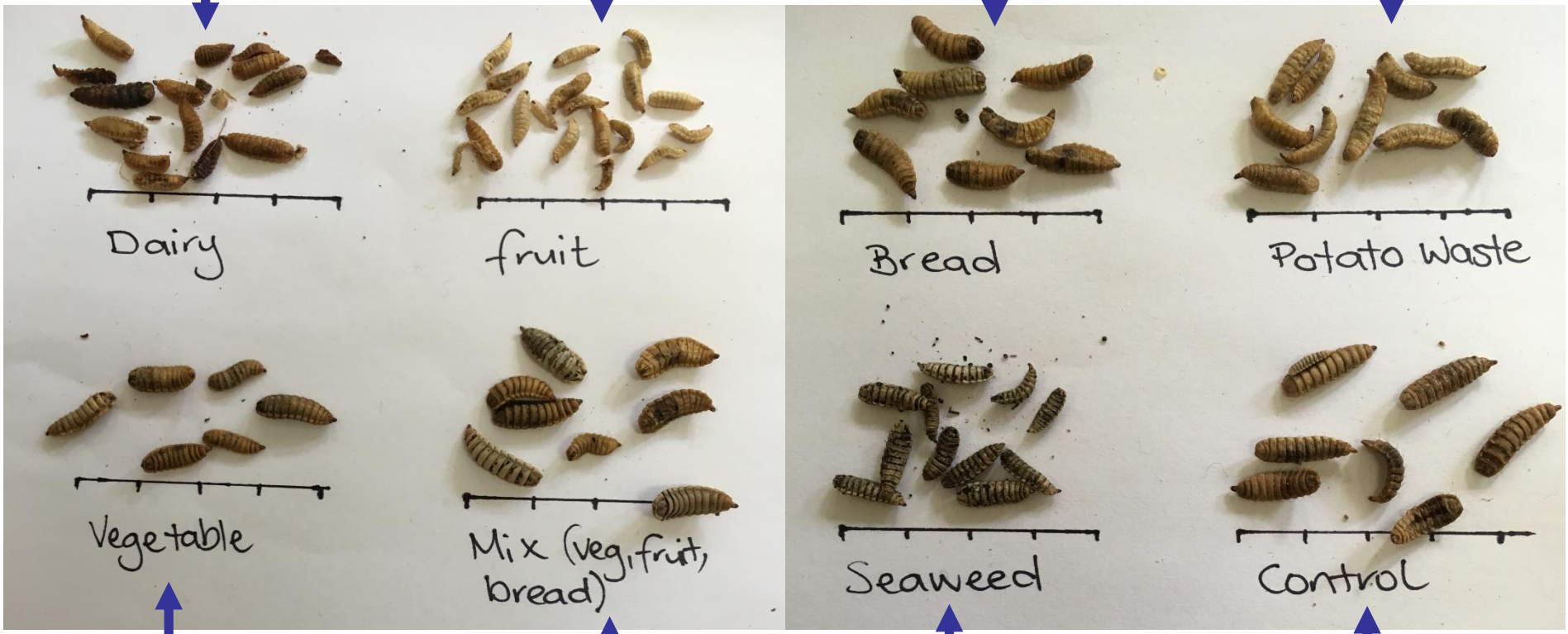
- Larvae reared on various pre-consumer waste products
- Ankom *in vitro* gas production system
  - Screening of larvae n = 8 flasks per treatment & inclusion rate
- Gas production monitored every 5min for 48h
  - modelled using a Gompertz equation to determine the rate (slope, β), maximum volume of gas production (max, C) & point at which max is reached (M)
  - Final pH measured

Greek yogurt, grated tasty cheese, full cream milk powder

Apples, pears, banana, honey dew melon & watermelon

White bread, wholemeal bread, hot cross buns

Potato skins, flesh and oils from processing factory



Zucchini, broccoli, celery, cos lettuce, iceberg lettuce, capsicums & carrots

750g of each food type

Seaweed collected from local beach

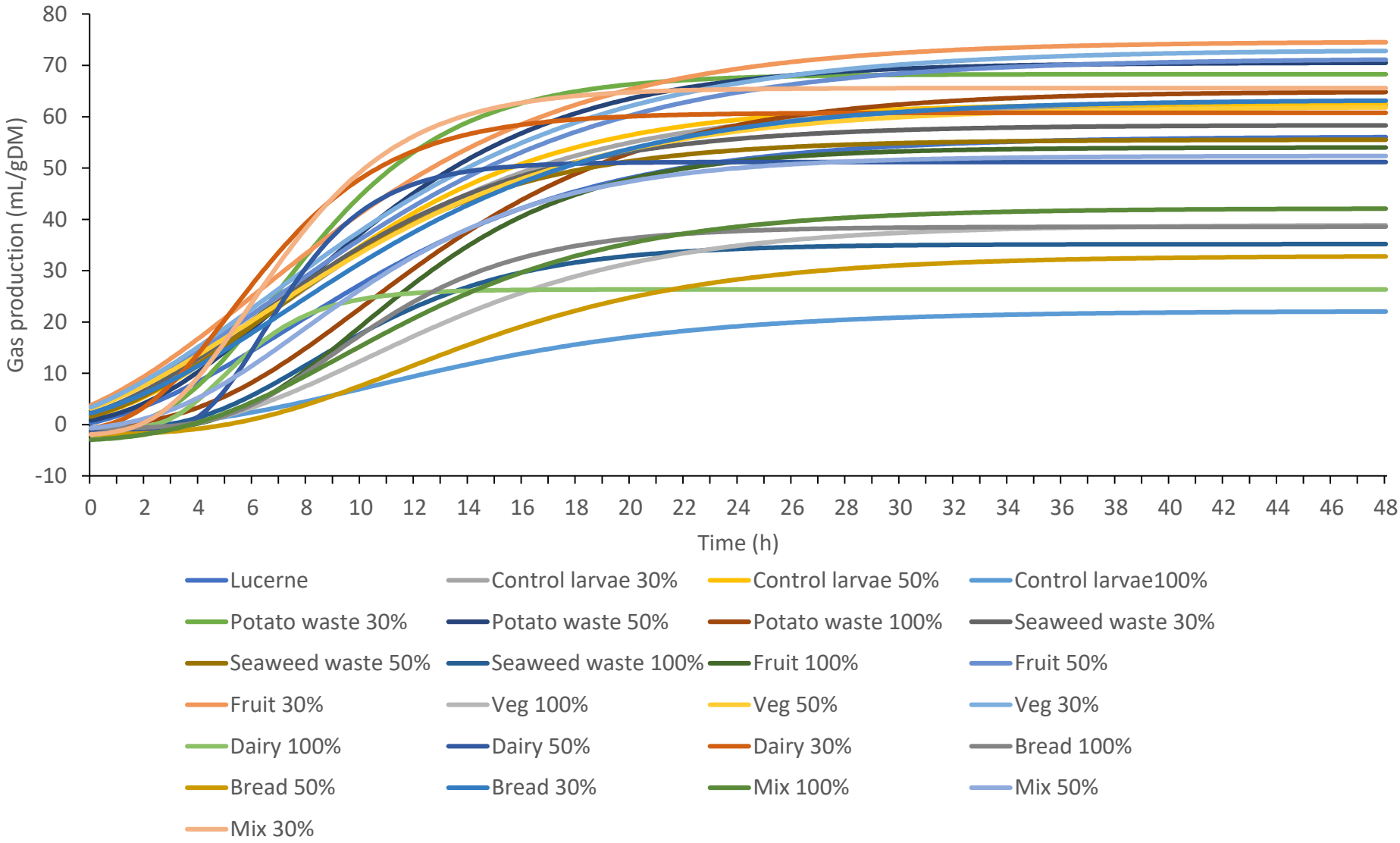
Pelleted diet (gainsville)

Larvae nutrient composition

		Control	Seaweed	Potato	Bread	Vegetable	Dairy	Fruit	Mix
Dry Matter	(%)	78.6	91.4	92.7	91.6	92.7	90.1	91.1	93.6
Protein	(% DM)	48.9	45.3	49.2	38.2	54.9	44.6	48.1	46.5
ME	(kcal/100g DM)	387	297	379	510	378	502	385	476
Fat	(% DM)	21.4	12.9	19.2	40.6	18.9	40.0	22.2	35.8
Ash	(% DM)	10.7	26.1	11.4	5.8	9.4	7.7	10.2	7.0
Crude Fibre	(% DM)	6.9	6.8	6.9	5.7	9.2	5.8	10.8	8.2

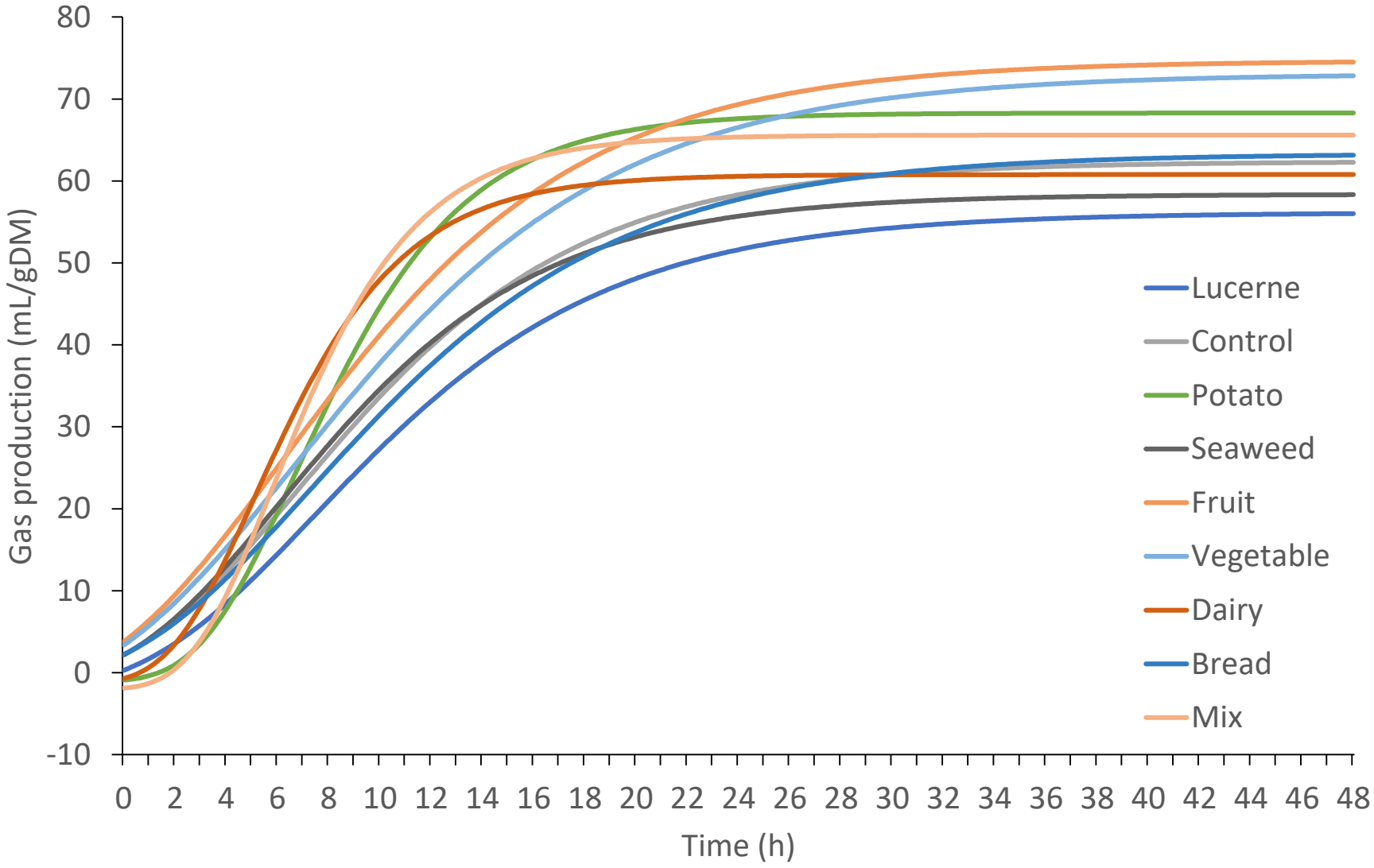
THE UNIVERSITY OF MELBOURNE

In vitro gas production

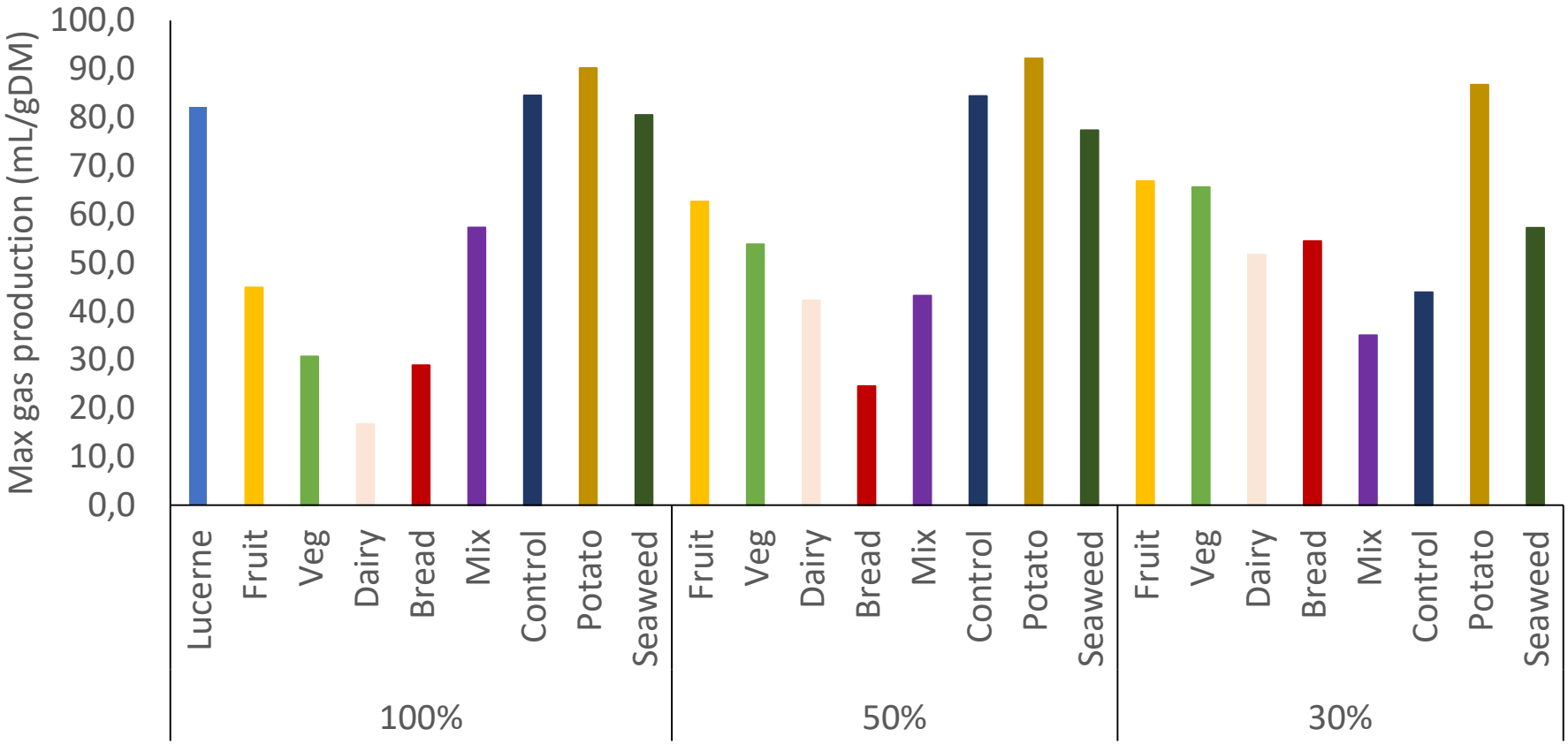


THE UNIVERSITY OF MELBOURNE

Gas production (30% inclusion)



Gas production results



P-Values	Rate (B)	Time at max (M)	Max (C)	pH
Treatment	0.01	<0.001	<0.001	<0.001
Inclusion level	0.56	<0.001	<0.001	<0.001
Trt x Inc	0.8	<0.001	0.04	0.19
SED	0.11	1.22	10	0.07

Discussion

- Larvae fermentation rate varied by larvae rearing diet
  - Likely driven by high fat content of larvae
- pH ↑ proportionally as the larvae inclusion ↑
- Bread & dairy treatments produced a reduced max gas than other treatments

- BSF larvae will have a different nutritional value for ruminants depending on the larvae rearing substrate

Next steps

- Defatted larvae
- Further inclusion rates
- Comparisons with other protein meals & forages

Thank You!

kristyd@unimelb.edu.au