Supplementation of Beverages, Salad Dressing and Yogurt with Pulse Ingredients

Summary of Report

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- Objectives:
  - functional properties of pea protein, chickpea flour, lentil flour, pea fiber
  - fruit juices with pulse fractions
  - yogurt and probiotic cultures
  - salad dressing

1. Functional properties of pea protein, chickpea flour, lentil flour, pea fiber

Proximate analysis of pulse fractions

Sample	Protein% (w/w)		Moisture% (w/w)		Fat % (w/w)		Ash% (w/w)	
	Average	SD	Average	SD	Average	SD	Average	SD
Pea protein	79.97	0.13	3.18	0.07	0.53	0.86	4.79	0.42
Chick pea flour	23.52	0.09	9.99	0.01	7.39	12.77	3.16	0.36
Lentil flour	24.83	0.12	9.45	0.14	0.06	0.10	2.68	0.27
Pea fibre	7.21	0.17	5.29	0.04	0.38	0.14	1.95	0.29

Were the chickpea and lentil flours whole flours?

Functional properties of pulse flours

Sample	Water Holding Capacity (ml/g)		Fat Absorption Capacity % (w/w)		Emulsifying Properties		Foam Expansion (FE %)	
	Average	SD	Average	SD	EAI (m^2/g) (Average of emulsifying activity index)	ESI (min) (Average of emulsifying stability index)	Average	SD
Pea protein	3.1302	0.000	79.709	4.857	13.3755	32.7530	514.973	49.507
Chickpea flour	0.8373	0.002	87.694	5.181	11.9363	25.7969	1348.2	114.941
Lentil flour	0.8838	0.000	76.708	2.714	12.9838	26.1138	478.261	7.629
Pea fibre	2.7316	0.000	116.282	3.677	--------	----------	---------	----------

- Soy protein concentrate and soy protein isolate WHC range from 3.9-4.3ml/g
- Pea protein (~80% protein) isolate similar WHC to soy
- Soy protein concentrate and soy protein isolate fat absorption capacity 218-251%, much greater than pulse fractions
- Foam expansion of soy protein isolates ~400-550
- Pea protein concentrate and lentil flour isoelectric point: ~3.5-4.5
- Chickpea flour isoelectric point ~2.5-4.5

- Solubility of chickpea flour and lentil flour was higher than for pea protein concentrate (maybe due to denaturation of proteins during processing treatments to concentrate pea protein)
    - **Further studies required**

Conclusions on functional properties of pulse ingredients

- Differences in the functional properties of the pulse fractions
- Likely due to diff. protein contents
- Although lentil and chickpea similar protein contents, have diff. functional properties
    - Ongoing research on amino acids profile, protein structure and the effect of other components present in the matrices will help to explain differences

2. Fruit juice supplementation with pulse fractions

Moisture sugar and ash content of the control apple juice

Sample	Moisture%(g/g)		Total sugar %(g/ml)		Reducing sugar %(g/ml)		Ash%(g/g)	
	Average	SD	Average	SD	Average	SD	Average	SD
Apple Juice	88.72	0.03	11.05	0.04	9.39	0.36	0.26	0.05

pH in supplemented apple juice and control apple juice samples

Sample	pH
Blank	3.53
Apple juice + pectin only	3.5
Apple juice + 2% soy protein concentrate	3.92
Apple juice + 1% pea protein	3.72
Apple juice +2% pea protein	3.98
Apple juice +3% pea protein	4.11
Apple juice +4% pea protein	4.21
Apple juice+1% chickpea flour	3.6
Apple juice +2% chickpea flour	3.67
Apple juice +3% chickpea	3.75
Apple juice +4% chickpea flour	3.82
Apple juice +1% lentil flour	3.6

Apple juice +2% lentil flour	3.66
Apple juice +3% lentil flour	3.72
Apple juice +4% lentil flour	3.79

- Greatest pH increases due to addition of pea protein, lentil flour and chickpea flour comparable effect on pH
- Soy protein concentrate (2%) comparable to pea protein (2%) wrt pH changes

Percentage of pulp and turbidity of the pulse-supplemented apple juice and control samples

Sample	**% Pulp**		**% Turbidity**	
	Average	**SD**	**Average**	**SD**
Blank	0.91	0.04	1785.85	20.59
Apple juice + pectin only	0.81	0.06	1458.91	3.50
Apple juice + 2% soy protein concentrate	7.62	0.01	12961.04	332.50
Apple juice + 1% pea protein	4.80	0.08	12274.47	55.44
Apple juice +2% pea protein	7.91	0.05	15670.02	99.48
Apple juice +3% pea protein	10.75	0.05	15900.76	309.62
Apple juice +4% pea protein	12.21	0.06	12530.21	193.73
Apple juice+1% chickpea flour	6.55	0.04	5590.67	63.17
Apple juice +2% chickpea flour	12.65	0.15	1648.60	14.86
Apple juice +3% chickpea flour	13.47	0.74	712.24	83.07
Apple juice +4% chickpea flour	18.14	0.09	801.87	13.32
Apple juice +1% lentil flour	9.49	0.66	7971.23	37.21
Apple juice +2% lentil flour	13.52	0.18	7392.69	34.66
Apple juice +3% lentil flour	16.31	0.45	4885.11	74.80
Apple juice +4% lentil flour	23.28	1.54	6576.81	366.59

- Lower turbidity values are indicative of greater instability which suggests that higher levels of supplementation destabilized the juice.
    - So what are good values for turbidity? Apple juice with 2% chickpea flour is similar to the control juice

Visual stability factor (VSF) of supplemented apple juices and control samples (one day after production and 1-3 weeks later)

Sample	VSF (One day after production)	VSF (One week after production)	VSF (Two weeks after production)	VSF (Three weeks after production)
Blank	100	99.6	99.6	96
Apple juice + pectin only	100	99.7	99.6	96
Apple juice + 2% soy protein concentrate	93.3	87.2	87.2	87.2
Apple juice + 1% pea protein	99.6	96.6	97.2	97.2
Apple juice +2% pea protein	92	94	94	94
Apple juice +3% pea protein	92	85	84.8	84
Apple juice +4% pea protein	84	83.6	83.6	83.6
Apple juice+1% chickpea flour	96.4	92	88	87.2
Apple juice +2% chickpea flour	96.5	88	77.2	77.2
Apple juice +3% chickpea flour	94.8	88	72.6	72.4
Apple juice +4% chickpea flour	94.8	14.1	14.13	14
Apple juice +1% lentil flour	96.4	88	88	84.13
Apple juice +2% lentil flour	96.4	88	80.4	80.6
Apple juice +3% lentil flour	96.4	72.6	64	64
Apple juice +4% lentil flour	94.4	72.6	60	60

- Visual stability of apple juice containing 1-2% pea protein was comparable to the blank and apple juice containing pectin
- 1-2% pea protein had a higher visual stability factor than when 2% soy protein concentrate was added

Colour

- L values same range for supplemented samples and control (22.31-42.34)

    - Exception apple juice w/ 3% chickpea L=7.07
- Addition of pulse fractions changed the colour of the juices
    - Pea protein greater effect compared to the chickpea/lentil flours

Protein in sediment

- Sediments of all supplemented samples had higher protein content than the control
- Protein content in sediment increased with increased level of supplementation
    - Except for the chickpea flours

Sensory Analysis

- Apple juice supplemented with 1% pulse fraction was found to be acceptable (flavour, mouth feel, overall acceptability)

Orange Juice

pH

- Orange juice supplemented with pulse fractions slightly increased the pH
    - Pea fibre had little effect on pH

Visual stability factor

- Lower for all supplemented juices relative to the blank sample

Conclusion: Fruit Juice supplementation

- Pulse supplementation in fruit juices decreased cloud stability during storage
- Visual stability factor in all supplemented juice decreased with increasing levels of supplementation
- Increasing the content of pulse fraction lowered the stability of the beverage system and prevented the formation of a stable homogenous system
- Supplementation changed the colour of the juice samples
- Higher the supplementation, the higher the pH value
    - Pea fiber exception in orange juice

3. Yogurt Supplementation with Pulse Fractions

- Buffering capacity: Amount of 1M HCl required to acidify 200ml of all supplemented skim milk samples and control samples from pH 6.4 to4

Sample	Titrable HCl (mL)	
	Average	SD
Supplemented sample with pea protein	7.77	0.11
Supplemented sample with chickpea flour	7.4	0.00
Supplemented sample with lentil flour	7.35	0.43
Supplemented sample with pea fiber	6.66	0.27

Supplemented sample with soy protein concentrate	7.65	0.21
Supplemented sample with soy flour	7.69	0.05
Supplemented sample with milk powder	8.27	0.16
Non-supplemented control sample (media only)	6.91	0.41

Conclusions: Yogurt and probiotic supplementation

- Pulse ingredients had little/ no inhibitory effect on acidification trend of yogurt cultures prepared with culture A or B
- Samples supplemented with pulse fractions tended to lower the pH more rapidly in comparison with the non-supplemented control and milk powder samples
- Different supplements had different effects on the acidification trend
    - No prevention of microbial growth was observed
- Greatest benefits to acidification trend of probiotic cultures were noted with pea fibre, chickpea flour, soy protein concentrate, pea protein and lentil flour

4. Salad dressing supplementation with pulse fractions

sensory evaluation

- All the salad dressing samples supplemented with pea protein, chickpea flour, lentil flour and pea fibre were found to be acceptable for both the Honey Lemon and Creamy Asian style formulations for flavour, mouthfeel and overall acceptance
- For honey lemon control average score was 3.77 while for samples supplemented with pea protein scored an average of 4.27 on overall acceptability
    - All other pulse fractions scored lower than the blank (more favourable for overall acceptability)
- For Creamy Asian Style dressing the averaged results for overall acceptability were slightly higher (less favourable) than the control

Conclusions: Salad dressing studies

- Supplementation of salad dressing with pulse fractions yielded acceptable sensory scores
- There were different scores for the different dressing which may impact which pulse fraction or which flavour of dressing could be used to make an optimized product

Overall conclusions and Future Work

- Probiotic yogurt and salad dressing use was found to be the most promising
- Pulse ingredients did not inhibit microorganism growth and increased the acidification rate of microbes and may be beneficial as a substrate

- PhD will further pursue the yogurt/probiotic product

Yogurt

- Selection of appropriate pulse ingredients (to be characterized in detail)
- Fortified yogurt and fermented products containing probiotics with selected pulse ingredients will be prepared
    - Analysis of physicochemical, rheological, sensory
    - Analysis of bioactive compounds/antinutritive properties