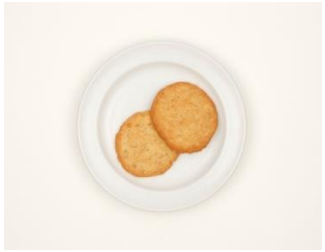
Department of Food and Nutritional Sciences

University of Reading









Whey Protein Fortification of Food for Older People

Dr Lisa Methven

nda PROGRAMME
E·S·R·C ECONOMIC & SOCIAL RESEARCH COUNCIL
University of Reading
Newcastle University
SCHOOL OF DESIGN THE GLASGOW SCHOOL OF ART
foodie

Malnutrition (undernutrition): the magnitude of the problem

University of Reading

+ In 2007, 239 patients died **of** malnutrition in hospitals– this figure is only 0.5% of those who died **with** malnutrition (Lishman 2009)
+ Malnutrition costs the health care services > **£7.3 Billion per year** – half of which is spent on older people
- 40% of older people are at risk of malnutrition whilst in hospital (BAPEN 2003)
- Those aged >80 years in hospital have 5 times the risk of those <50 years (BAPEN 2003)

foodie

Malnutrition: physical & psychological consequences

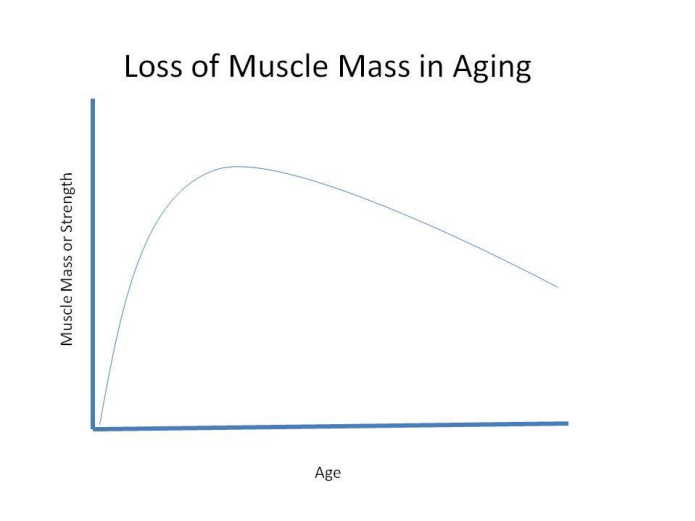
University of Reading

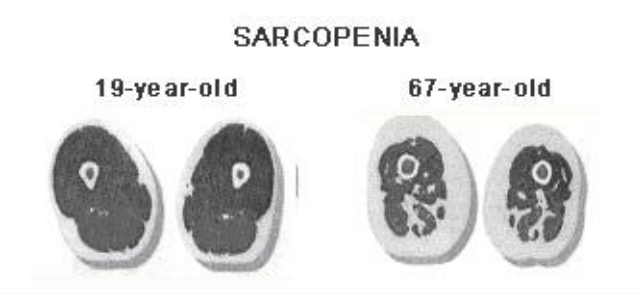
- Impairs immune function
  - Increasing susceptibility to infection and sepsis
- Wound healing
  - Increases the risk of pressure ulcers and delays wound healing
- Muscle wasting
  - Impairing respiratory and cardiac function, increased risk of pneumonia and cardiac failure
  - Reduced mobility, increasing risk of thromboembolism and pressure ulcers and delays return to full mobility
  - Sarcopenia
- Alters gastrointestinal structure and function
- Causes apathy and fatigue - loss of morale & will to recover

H foodie

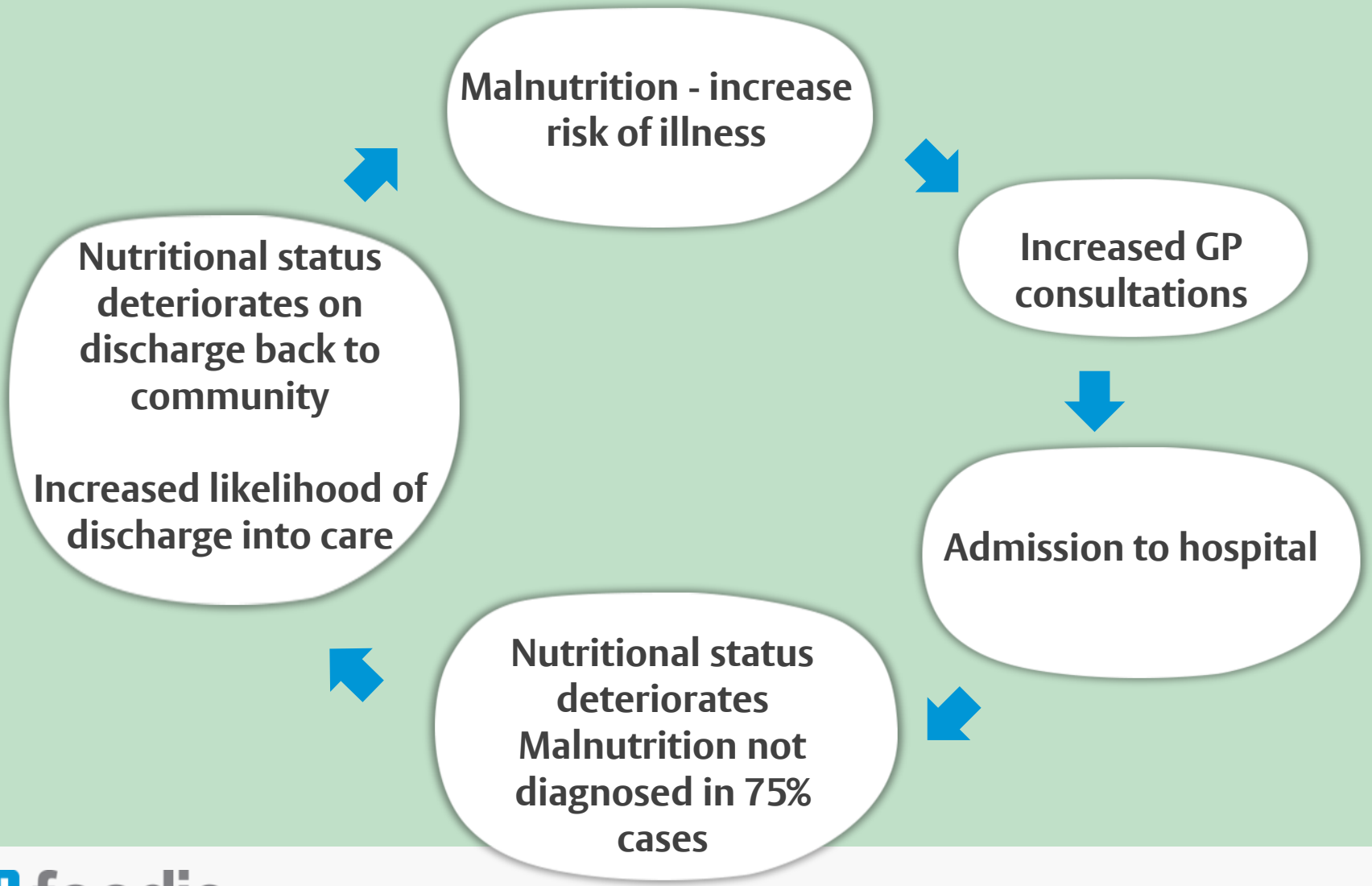
Sarcopenia

- Loss of muscle mass & function
- Muscle atrophy (decreased size) & muscle fibres replaced by fat
- Impaired response of muscle protein synthesis from nutritional intake
- Muscle disuse a contributory factor





Malnutrition carousel of multiple admissions



foodie

More than just 'hospital food': Factors contributing to malnutrition in older patients

University of Reading

swallowing difficulties

reduced manual dexterity

reduced taste perception

illness and nausea

need for a nutrient dense diet

unfamiliar surroundings

increased nutrient requirements

reduced appetite

foodie

Overview

1. Why fortify with Whey Protein ?
2. What can be achieved ?
4. What are the problems of high levels of inclusion ?

Recommended daily intakes for older adults

Micronutrient	Government daily guidelines [a]
Energy (kcal)	1955
Protein (g)	50
Fat (g)	<74.5
Saturated fat(g)	<23.5
Potassium (mg)	> 3500 (except renal disease < 274)
Magnesium (mg)	> 300
Iron (mg)	> 9
Zinc (mg)	> 9.5
Vit D (µg)	> 10
Riboflavin (B2) (mg)	> 1.3
Vit B6 (mg)	nr (1.3) [c]
Folate (B9) (µg)	> 200
Vit C (mg)	nr (40) [c]

Mean intake in one UK hospital 1379 kcal & 44g protein

Barton et al (2000) *Clin Nutr*; 19:445-449

References :

[a]FSA (2006) guidelines for nutrients for food provided to older people in residential care

[b]Micronutrients : range of 1/3rd to 1/2 of daily RNI per supplemented mini meal.

[b]Macronutrients : 1/6th of DRV per mini meal.

[c]nr = no recommendation specified; but highlighted as low intake and/or deficient in older adults in two studies: (Bates et al 1999, *Br J Nutr* 82(1), 7-15; Russell & Suter 1993, *Am J Clin Nutr* 58(1), 4-14)

Can protein increase Muscle mass in Older Adults ?.....*evidence against*

University of Reading

- n=80 : WPC 40g/d or placebo, 6 m; resistance training (RT)
  - Lean Mass ↑ 1.3% / 0.6%; Muscle cross sectional area ↑ 4.6% / 2.9%
  - Muscle strength ↑ 16-50% both groups
  - **Overall WPC no added benefit to RT**

  (Chale et al (2013) : *J. gerontology* 68:682-690)
- n=65 : protein 30g/d or placebo, 6 m; resistance training (RT)
  - Physical performance ↑
  - **No change in muscle mass**

  (Tieland et al (2012) : *J Am Med Dir Assoc* 13:720-726)
- n=60 : protein 15g/d or placebo, 6 m; resistance training (RT)
  - RT ↑ muscle mass & strength
  - **No further benefit from protein**

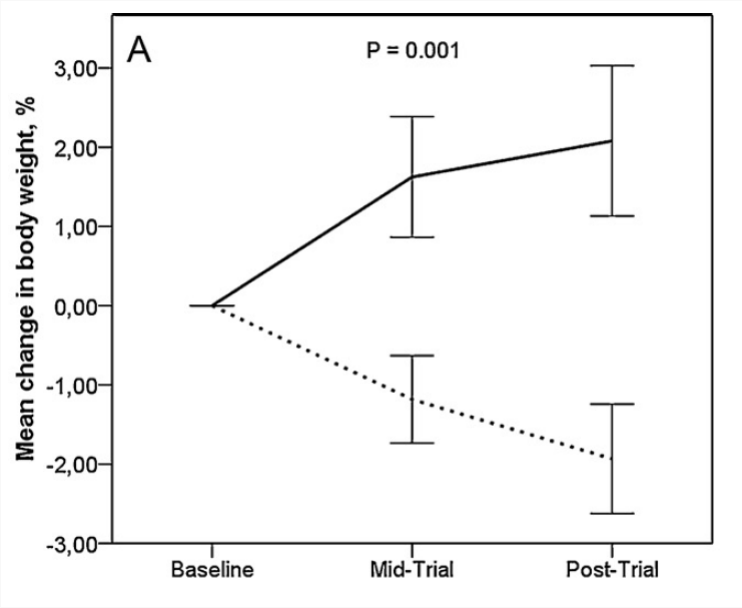
  (Leenders et al (2013) : Med & Sci in Sports & Excersise 45:542-552

Can protein increase Muscle mass in Older Adults ?.....*evidence for*

University of Reading

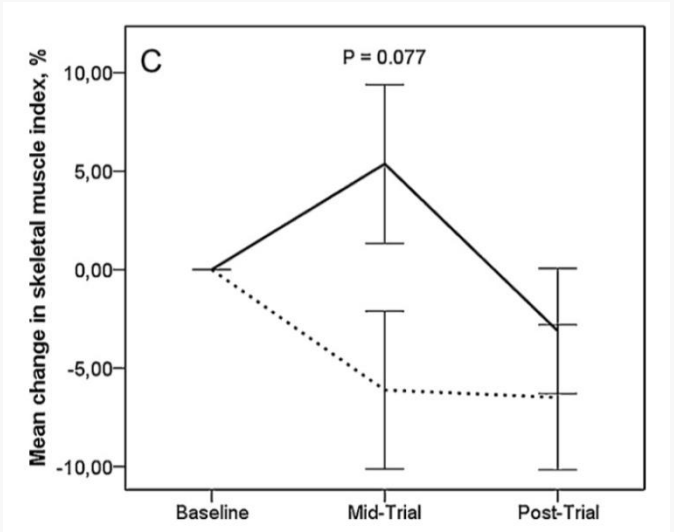
- n=33 males: acute consumption of labelled WP: 10, 20 or 35g
  - **35g protein led to ↑ aa absorption & protein synthesis**

(Pennings et al (2012) *Am J Physiol-Endocrinol Metab* 302:E992-E999).



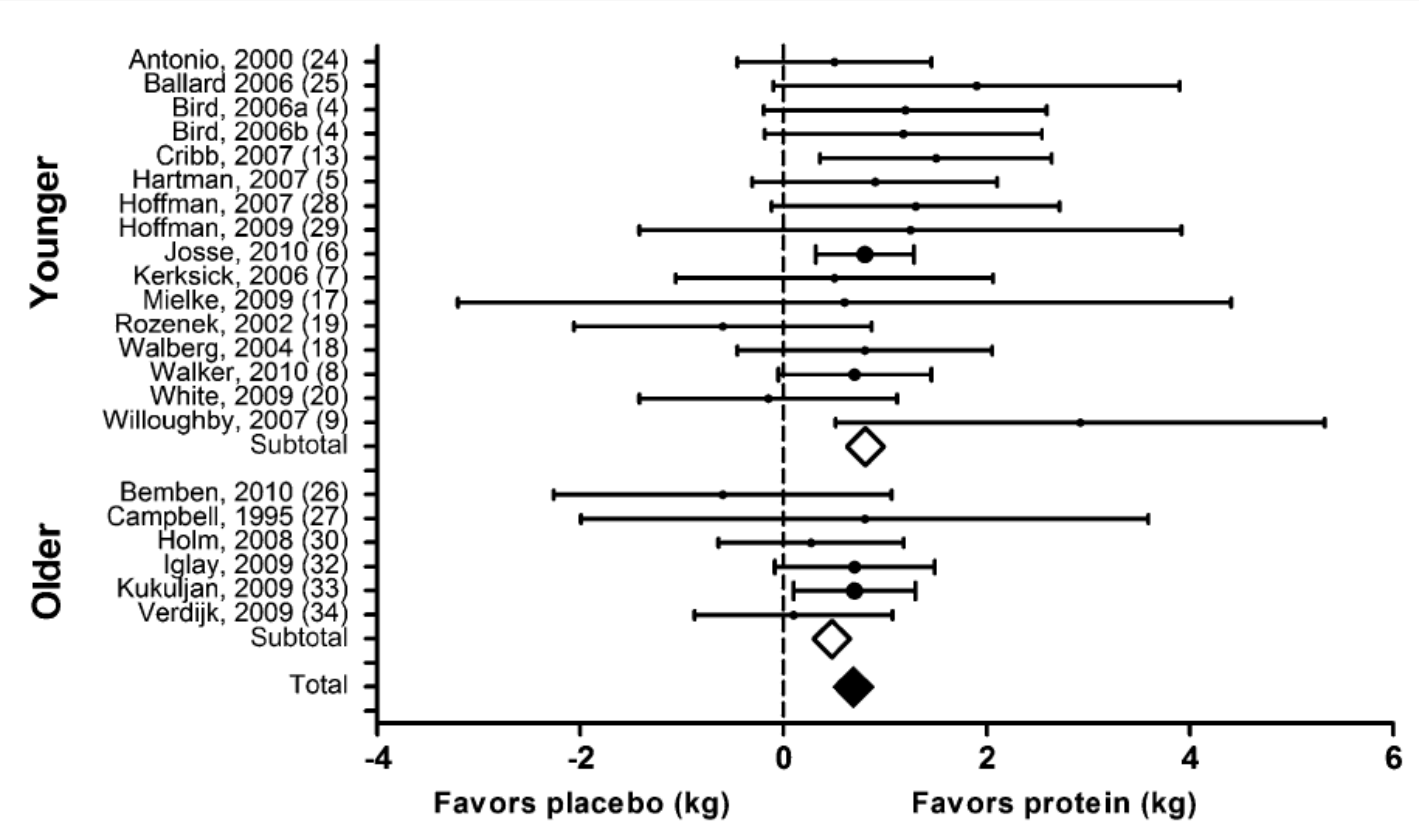
- n=106, nursing home: WP 20g/d in juice or placebo, 6 m
  - **Body Wt : WP ↑ 2.1 % / control ↓ 1.9%**
  - **Skeletal mass maintained with WP / control ↓**
  - WP group needed less physical assistance

(Bjorkman MP, Finne-Soveri H and Tilvis RS (2012) Whey protein supplementation in nursing home residents. A randomized controlled trial. *Eur Geriatr Med* 3:161-166).



Recent Meta-analysis (van Loons' Group)

Forest Plot of Changes in Fat free Mass : Studies of **protein supp + Resistance Training**

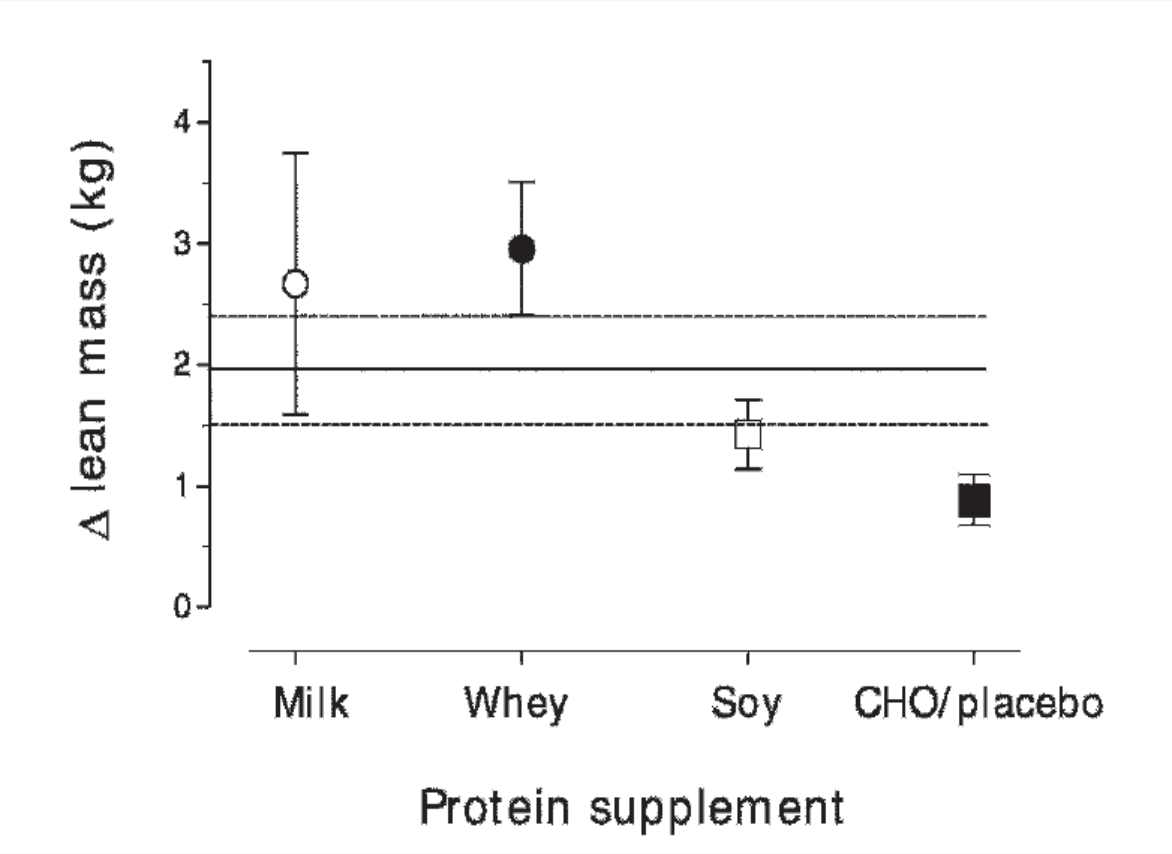


Cermak NM, Res PT, de Groot L, Saris WHM and van Loon LJC (2012) Protein supplementation augments the adaptive response of skeletal muscle to resistance-type exercise training: a meta-analysis. *American Journal of Clinical Nutrition* 96:1454-1464

Is Whey Protein the most beneficial protein source ?....*evidence in younger adults*

University of Reading

- Review of 9 studies
- Resistance training induced changes in muscle mass with protein supplements



Phillips SM, Tang JE and Moore DR, (2009) The Role of Milk- and Soy-Based Protein in Support of Muscle Protein Synthesis and Muscle Protein Accretion in Young and Elderly Persons. *J Am Coll Nutr* 28:343-354

Is Whey Protein the most beneficial protein source ?....*evidence in older adults*

University of Reading

- n=48 males: acute consumption of labelled casein, whey or casein hydrolysate (20g)
  - protein synthesis rate sig. greater from whey
  - Whey digested & absorbed faster & has more leucine

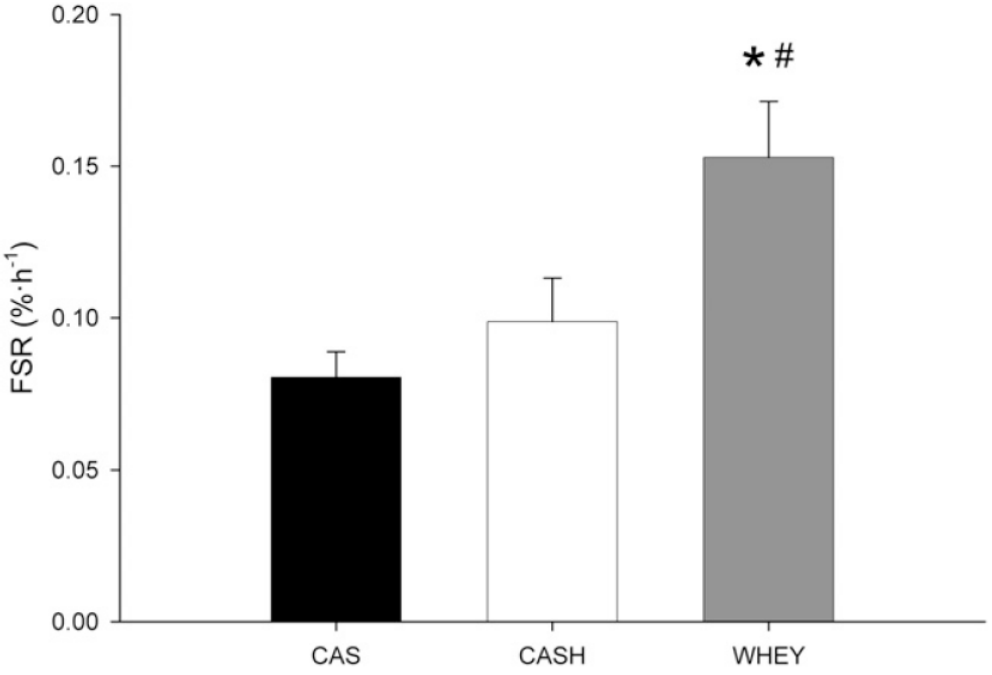


FIGURE 5. Mean (±SEM) mixed muscle protein fractional synthetic rates (FSR), with tissue-free L-[1-^{13}C]phenylalanine enrichments as precursor, after ingestion of casein (CAS; n = 16), casein hydrolysate (CASH; n = 16), and whey (WHEY; n = 16). Data were analyzed with ANOVA with Bonferroni correction. *WHEY significantly different from CAS, $P < 0.01$. #WHEY significantly different from CASH, $P < 0.05$.

Pennings et al (2011) Whey protein stimulates postprandial muscle protein accretion more effectively than do casein and casein hydrolysate in older men. *American Journal of Clinical Nutrition* 93:997-1005

NIZO
YOUR FOOD RESEARCHERS

8th NIZO Dairy Conference: Functional Enzymes for Dairy Applications

11–13 September 2013, Papendal, The Netherlands

Speaker

Luc van Loon

Abstract title: Milk protein and muscle maintenance

What do ONS provide ?

University of Reading

1

6 – 10g protein / 100ml (portion 200ml)

Use Milk Protein Concentrates, WPC / WPI & Caseinates

2

Energy
100-200 kcal/100ml

Vitamins & Minerals
11 Vits & 13 minerals at ca. 40% DRV per portion

foodie

Why have other fortified products ?

- Protein–energy ONS can have beneficial effects on body composition and nutritional status (Lauque *et al*., 2000)
- Compliance is poor (Gosney, 2003; Nolan 1999)
- Greatest wastage on elderly care wards where patients reported disliking the taste (72%) and sweetness (56%) (Gosney, 2003)
- What about providing other fortified meal opportunities?

University of Reading

Ice cream: an example of an “ONS” alternative

key benefits

- alternative oral nutritional supplement (ONS)
- higher in calories than standard ice cream
- vitamin, mineral and protein enriched
- “hard” rather than ”soft” ice cream
- aiming for not too fast to melt!!

H foodie

ice cream:
an example of an "ONS" alternative

University of Reading

why did we developed this?

- ice cream often preferred to ONS beverage
- standard IC too low in calories to match an ONS
- mineral and vitamins in ice cream have less taste impact due to lower temperature
- older volunteers liked enhanced formulation as much as standard

nutritional information	standard IC (100ml)	mappmal IC (100ml)
Energy (kcal)	128	215
Protein (g)	3	5
Carbohydrates (g)	14	14
Fat (g)	7	15
Addition of Minerals / Vitamins	No	Yes (as for ONS beverage)

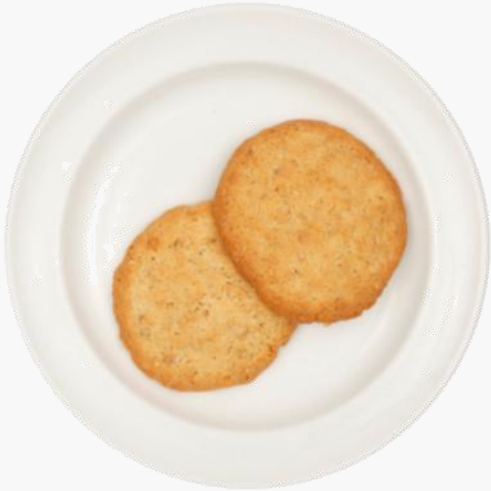
foodie

Cookies:
making more of a traditional snack

University of Reading

key benefits

- alternative oral nutritional supplement (ONS)
- high in calories and adequate protein
- vitamin, mineral and protein enriched
- not too hard to bite
- not to leave too many dry particles in mouth (avoid choking)
- portion size : 40 g (2 biscuits)



foodie

Cookies:

University of Reading

nutritional information	standard digestive biscuit s (100g)	mappmal cookies (100g)
Energy (kcal)	470	517
Protein (g)	7	**12**
Fat (g)	22	32
Addition of Minerals / Vitamins	No	**Yes**

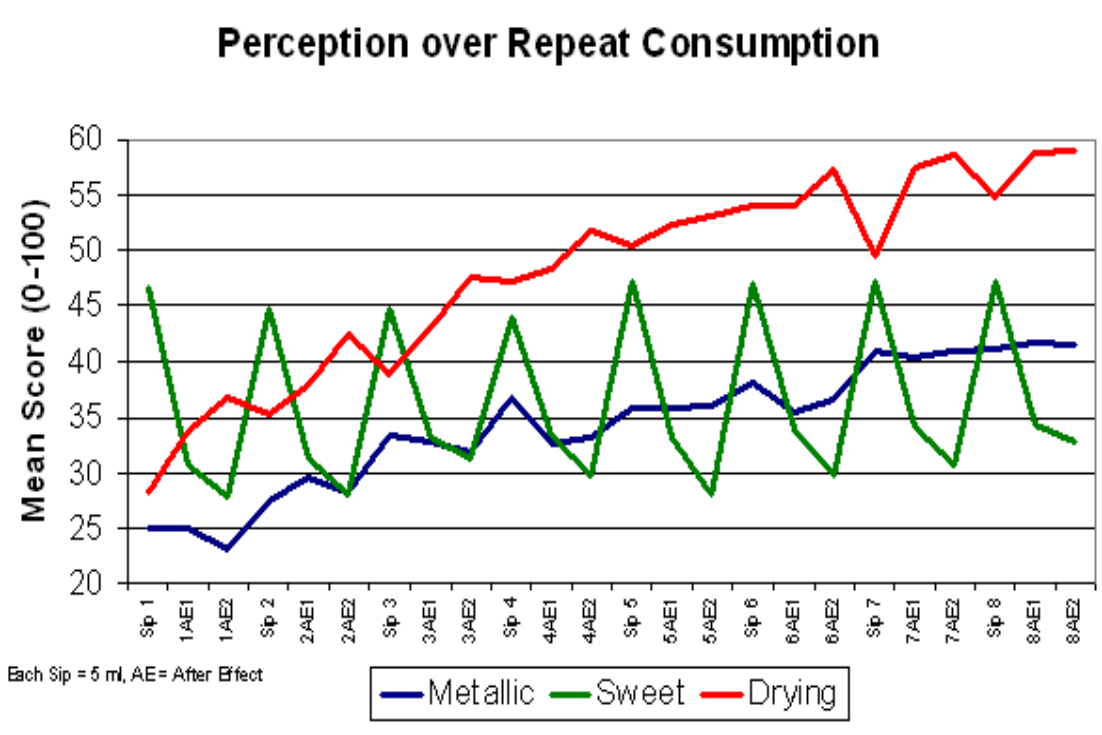
Tsikritzi,, Moynihan, Gosney, Allen,& Methven,L (2012), *JSFA, in press*

foodie

Challenges of WP Incorporation

- Stability :
  - pH : aggregation occurs when net charge ≅0 at pI
  - WP emulsions unstable at pH5 (esp heated)
  - As ↑ Ca : ↓pH; effecting stability
  - Use of WP + minerals in matrix can cause coagulation
- Taste : WPC / WPI have a distinct dairy flavour
- Mouth drying

Effect of Repeat Consumption of ONS : Sequential Profiling (Sensory panel)



- Sensory panel tasted 8 consecutive 5 ml shots of ONS
- Scored 5 attributes after each shot, and twice between shots as after effects
- Sweetness perception maintained over time.
- Metallic and Mouthdrying Perception build with time

The Drink makes you need a Drink !!

Methven L, et al (2010) *Food Quality and Preference* 21:948-955

Mouth drying perception by older adults

- **Rennet whey mouth drying**
  - Heat treated Rennet Whey was compared to skimmed milk by older and younger adults

- Older Volunteers found rennet whey to be significantly more mouth drying than skimmed milk ($p=0.03$)
- Young volunteers found no significant difference between samples for mouth drying
- Suggests mouth drying is more important and easier to detect by older adults

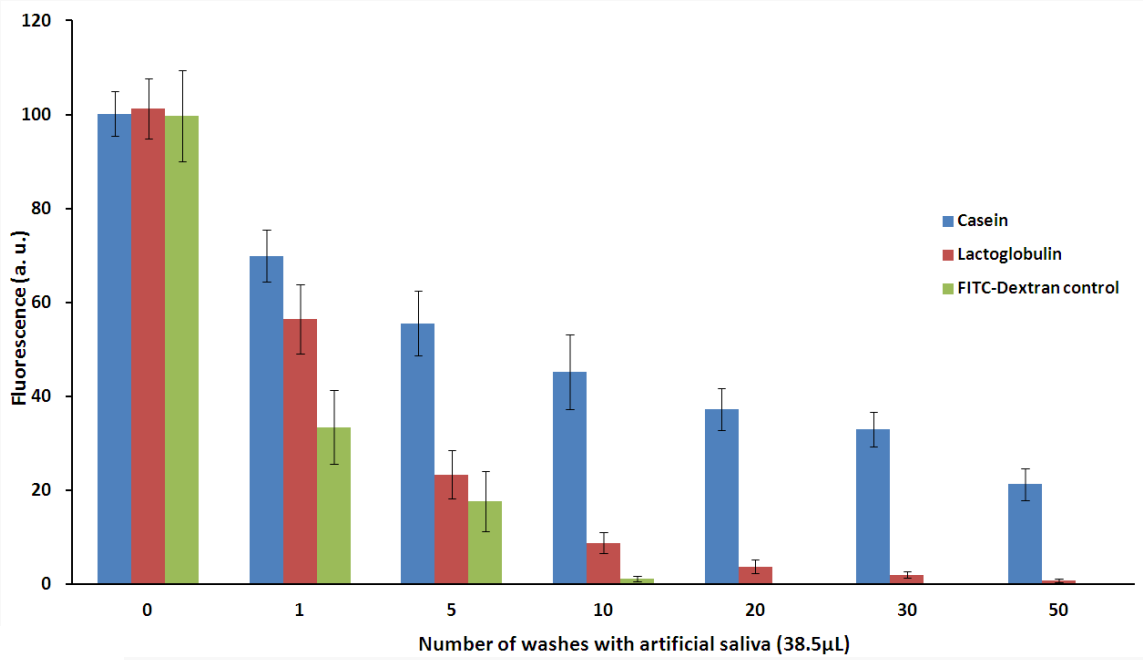
Wither, Gosney & Methven (2013) *J Sensory Studies*, in press

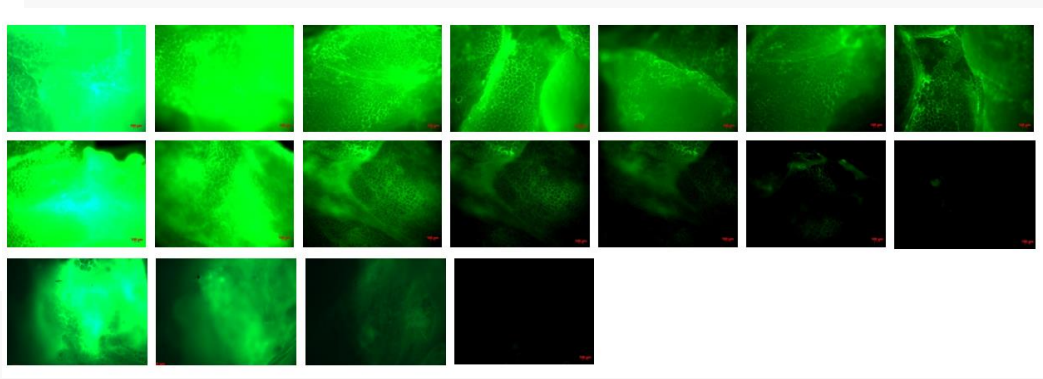
What causes Whey Protein Mouth Drying ?

- Some authors found ppt in mouth, but only in low pH systems
- ONS are near pH7…so not due to ppt
- Could the whey protein interact directly with the mucosa ?

Mucoadhesion of milk proteins

- Mucoadhesion of pure milk proteins assessed by fluorescence microscopy
- Casein and β-Lactoglobulin both bound directly to porcine oral mucosa
- Mucoadhesion may play a role in perception of dairy mouth drying





Withers, Cook, Methven, Gosney & Khutoryanskiy (2013) *Soft Matter*, to be submitted

Acknowledgements

- Dr Roussa Tsikritzi (UoR)
- Dr Caroline Withers (UoR)
- Prof Margot Gosney (UoR)
- Prof Paula Moynihan (UoN)
- Volunteers & Sensory Panel
- UoR Students

Please take a look at

www.hospitalfoodie.com

Thank you!