



## Plenary Session 3: Key Essential Nutrients

### Iodine deficiency and thyroid disorders in pregnant women – should we screen all pregnant women in Australia?

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#### Background

Optimal foetal and infant brain development is critically dependent upon CNS exposure to adequate concentrations of thyroid hormone from the earliest weeks of gestation through to maturity. As the foetal thyroid does not mature until late in gestation, the supply of thyroid hormone to the foetal brain must come via the placenta from the maternal circulation. To meet foetal thyroxine requirements the maternal thyroid must increase thyroid hormone synthesis and release, early in pregnancy, by approximately 50% over pre-pregnancy production rates. Failure to reach this target is usually a consequence of maternal iodine deficiency or maternal thyroid disease. Obstetrical consequences of overt or even maternal subclinical hypothyroidism include early pregnancy loss, gestational hypertension and premature delivery and if the baby survives there is an increased risk of neurological damage in the progeny, ranging from severe cretinism through to mild neurocognitive disorders.

#### Iodine deficiency in Australia

Mild to moderate iodine deficiency has re-emerged in the Australian population over the past two decades due principally to decreased amounts of iodine in dairy products as a consequence of the dairy industry abandoning iodine containing sanitisers. In 2004, we conducted a representative national iodine nutrition study in schoolchildren confirming the Australian population was mildly iodine deficient. Iodine intakes varied across the country with Queensland and Western Australia not showing evidence of iodine deficiency. The most severe iodine deficiency was found in young indigenous residents of the Northern Territory. Since 2004, there have been several surveys undertaken in pregnant women in NSW, ACT, Victoria and Tasmania confirming that approximately 50% of women are iodine deficient. Iodine intakes, calculated either from food composition or biochemical analyses of urinary iodine excretion, are consistent with half the RDI for pregnancy of 250 ug per day.

#### Thyroid function and thyroid disorders in pregnant Australian women

Studies examining a cause and effect relationship between iodine deficiency in Australian women and adverse outcomes on pregnancy and the offspring are limited. However, rising neonatal blood-spot Thyrotropin (TSH) levels in Victoria are consistent with an adverse effect of maternal and foetal iodine deficiency on the

foetus and neonate. Our recent studies of iodine excretion, thyroid function and thyroid autoantibodies in pregnant women in western Sydney have shown that subclinical hypothyroidism occurs in 6.5% of apparently healthy women, due to either iodine deficiency and/or autoimmune thyroiditis.

#### Conclusions and recommendations

As iodine deficiency is highly prevalent in pregnant Australian women, screening for iodine deficiency is a waste of resources and not recommended. All pregnant women should be advised to take an iodine supplement of 150 ug per day to reach the iodine RDI for pregnancy (8). Extrapolating the biochemical findings from pregnant women in western Sydney to the rest of the country indicates approximately 20,000 pregnant women in Australia each year are at risk of adverse effects from thyroid dysfunction. These data suggest the time has come for a national screening program for thyroid dysfunction in all pregnant women in Australia.



## Plenary Session 3: Key Essential Nutrients

### Modification of plant oils for improved nutritional value

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Most of our widely-consumed vegetable oils have, until recently, been sourced predominantly from crop plants that were selected, developed and introduced well before there was a good understanding of the impact of fats and oils on human health. Consequently their fatty acid profiles are not necessarily optimised for nutritional value, and there is considerable scope for improving their composition, such as by increasing nutritionally-desirable components (e.g. cholesterol-lowering fatty acids), reducing antinutritional components (e.g. saturated and *trans* fatty acids), and introducing new fatty acids with positive health and wellbeing effects (e.g. long-chain omega-3 fatty acids).

There are now several examples of where either conventional or transgenic techniques have been employed to develop plant seed oils with greatly improved nutritional value. Awareness of the role of saturated and *trans* fatty acids in raising blood cholesterol and thereby increasing the risk of cardio-vascular disease has stimulated the redesigning of oils to significantly reduce saturates and polyunsaturates, while simultaneously increasing oleic acid. High-oleic forms of peanut, safflower and sunflower oils have been developed by conventional breeding, capitalising on natural variability for oil composition within these species. However similar changes have not been possible for several other oilseeds such as soybean, canola, cottonseed and linseed that lack the required genetic variation. Instead, gene technology approaches, particularly the recently developed gene-silencing technologies, are now enabling the development of low-saturate, high-oleic forms in several of these species, and the first such GM oil, high-oleic soybean, has already entered commercial production. Furthermore, increased discovery of genes controlling fatty acid biosynthesis has enabled the transgenic introduction of a range of new fatty acids, encoded by either single enzymatic steps (e.g. GLA in safflower) or multi-step metabolic pathways (e.g. EPA & DHA in canola), and promises to further expand our capacity to tailor seed oil composition. As a result, a pipeline of designer plant oils with nutritionally improved fatty acid profiles is developing, including oils with very-low saturated fatty acids, elevated stearic acid, high-oleic acid, and newly introduced long-chain polyunsaturates such as GLA, SDA, EPA and DHA. This presentation will outline the approaches that have been taken to specifically modify the levels of specific fatty acids in seed oils, and update on the progress made - and impediments encountered - in taking the most advanced of these products into commercial production.



## Plenary Session 3: Key Essential Nutrients

### Zinc and selenium – changing farming practices to improve the food supply

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#### Background

Animal and horticultural products provide a range of essential nutrients and also contain health active compounds. The concentrations of some of these compounds in animal and plant products can be manipulated (either increased or reduced) through genetics, fertiliser regime or by nutritional management. Consumers in some markets prefer 'natural' as opposed to fortified products offering on-farm rather than post-farm gate opportunities. Successful on-farm manipulation of the concentrations of physiologically functional compounds to improve the food supply requires systems that produce consistent concentrations in animal and plant products. Opportunities to increase the concentrations of protein bound organic selenium (Se) and zinc (Zn) provide examples of on-farm practices to improve food supply.

#### Selenium

In Australia, there are Se-deficient soils along the coasts of mainland and the interior of Tasmania. Due to these relatively low concentrations of Se, many primary products sourced from these areas can contain relatively low Se concentrations. Fortunately, Se deficiency has largely been eliminated through intervention programs such as Se supplementation to farm animals. The major food source of Se for humans in Australia such as bread, cereals and meat products exhibit a wide range in Se contents largely because of differences in soil Se and fertiliser or feed supplementation practices. However, regional differences have been reduced through consolidation of primary products from across Australia and the globe.

While it is generally accepted that Se intakes of Australian and New Zealand consumers are sufficient to ensure no overt signs of deficiency, there is a feeling that the relatively low intakes may contribute to elevated risk for some cancers (eg. bowel and prostate). However, Se supplementation is problematic, since high Se intakes can be toxic, particularly if the source is inorganic. Protein-bound Se is more bioactive and less toxic than inorganic forms of Se and there is interest in delivering Se in organic forms in food products we consume. Products where the Se contents have been successfully increased include cereal grains, dairy products, milk and horticultural products such as broccoli and mushrooms. Some of these products have also been evaluated in animal models of cancers or oxidative stress and occasionally in human studies.

The concentration of Se in horticultural products such as broccoli and mushrooms as well as in yeast has been increased through the provision of fertilisers or growth

media that have been supplemented with inorganic Se. Selenium can substitute for sulphur in methionine and cysteine and these newly synthesised amino acids can be incorporated into proteins by the plant or fungi. The plant or fungi can assimilate the inorganic Se into their own amino acids and proteins. On the other hand, inorganic Se is poorly incorporated into mammalian proteins and so protein or amino acid bound Se, such as Se-methionine or selenised yeast, need to be fed to animals to achieve significant incorporation in food products such as meat or milk. The efficacy and safety of protein bound Se is much better than that of inorganic Se and so these are the preferred forms of delivering Se via the food supply. Horticultural and animal products containing elevated levels of Se have been shown to improve oxidative status and reduce the risk of some cancers, viral infections and neurological disease in animal models. Also, feeding supra-physiological levels of selenised yeast to animals has been shown to improve the ability to handle stressors such as heat stress or disease challenge.

There is also growing interest in the Zn status of the population and whether this can be manipulated through nutritional supplementation or fortification through the food supply. Zinc is an important component of many enzyme systems and is essential for a variety of functions. Red meat is an important source of Zn for many humans as it is generally more bioavailable than plant sources. On the other hand, plant Zn is often unavailable because of antinutritional factors such as phytate and phenolic compounds which bind with divalent cations such as iron and zinc leading to the formation of insoluble complexes that precipitate during intestinal digestion. Although there is a wide variation in Zn concentrations in various animal products, particularly meat, efforts to increase the incorporation of Zn into animal products through dietary manipulation have been largely unsuccessful. Tissue Zn is refractory to dietary level. However, plasma and tissue Zn concentrations are moderately heritable suggesting opportunities for selection of animals with higher concentrations of Zn in their food products. Efforts to improve the availability of Zn from plant foods are largely reliant on plant breeding for lower concentrations of antinutritional compounds such as phytates, through activation of endogenous phytases or supplementation with exogenous phytases.

#### Conclusion

Animal and horticultural products are already important sources of dietary Se and Zn for the general population. The opportunity to change farming practices to increase their bioavailability offers more targeted nutrigenomic or personalised nutrition approaches. Since Se is incorporated into amino acid and proteins it is relatively easy to manipulate. Opportunities to alter Zn concentrations in primary products are more likely going to involve genetic selection or activation of endogenous phytases in plant foods.



## Concurrent Session 1: Micronutrients

### Make vitamin D while the sun shines, take supplements when it doesn't

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#### Background

Research suggests ageing populations, especially those with limited sunlight exposure, have a greater dependency on dietary sources to maintain optimal vitamin D status, be it through increased consumption of vitamin D-rich foods, food fortification or vitamin D supplementation.

#### Objective

To assess the seasonality of serum 25(OH)D and the contribution of dietary and supplemental vitamin D in older, community-dwelling Tasmanian adults.

#### Design

This was a longitudinal observational study. Ninety-one adult volunteers aged 60–85 years were assessed on five occasions over 13 months. At each time point dietary intake was estimated using semi-quantitative food frequency questionnaires and participants also provided information on supplement use and sun protection behaviours. Fasting blood samples were collected for determination of serum 25(OH)D. Step-wise regression analysis was used to predict the determinants of serum vitamin D.

#### Outcomes

Mathematical modelling of serum 25(OH)D concentration applying a sine wave model, demonstrated an identical pattern to daily solar exposure (representing solar UVB exposure) with an 8-10 week time lag. The greatest magnitude effects on serum 25(OH)D concentration were summer solar UVB exposure (mean 15.9 nmol/L; 95% CI 11.8 to 19.9 nmol/L,  $p < 0.001$ ) and use of vitamin D supplements (100-600 IU/day: 10.2 nmol/L, 95% CI 0.8 to 19.6 nmol/L,  $p = 0.03$ ; 800 IU/day: 21 nmol/L, 95% CI 8.1 to 34.0 nmol/L,  $p = 0.001$ ). Seasonal variation in serum 25(OH)D concentration was significantly reduced in participants taking 800 IU/day (10.5 nmol/L; 95%CI: 5.6 to 15.4 nmol/L;  $p < 0.001$ ). Dietary vitamin D had a non-significant effect on serum vitamin D concentration. Body fat mass and use of protective clothing showed significant negative association with serum 25(OH)D concentration (-4.2 nmol/L, 95%CI -8.8 to -0.8,  $p = 0.02$  and -5.4 nmol/L, 95%CI -10.3 to -0.5,  $p = 0.03$ , respectively).

#### Conclusion

Results of this study suggest little or no contribution of dietary vitamin D towards serum vitamin D concentration. Major contributors are UVB exposure, especially in summer; and vitamin D supplements in winter.

#### Source of funding

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### New analytical data for vitamin D content of Australian animal foodstuffs

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#### Background

Understanding of the dietary vitamin D intake of Australians is hampered by a lack of analytical data for vitamin D in Australian foods.

#### Objective

To develop and establish analytical methods for measurement of vitamin D<sub>3</sub>, vitamin D<sub>2</sub> and their 25-hydroxy compounds in Australia, and to apply these methods to a range of Australian animal foods (meat, chicken, fish and eggs).

#### Design

A published HPLC method for measurement of the four D vitamers was established in the Faculty of Veterinary Science, University of Sydney, while a new LC/MS/MS method was developed and accredited at National Measurement Institute, Port Melbourne. Food samples were obtained and prepared raw for analysis from the following studies: Lamb and beef samples from: Meat & Livestock Australia D.MHN.0023 "Vitamin D in Australian lean red meat"; seafood samples from Australian Seafood CRC project 2008/905 *Australian seafood compositional profiles portal*; chicken samples from RIRDC Chicken Meat PRJ-002974 *Nutrient composition of chicken*, and PRJ-007295 *Nutritional composition of free range vs conventional chicken meat*; eggs and mackerel from J. Liu PhD thesis *The analysis and physiology of vitamin D*, Sydney University, 2012.

#### Outcomes

Vitamin D<sub>2</sub> and 25-hydroxy vitamin D<sub>2</sub> were not found in any of the foods analysed. In four species of seafood, vitamin D<sub>3</sub> was found within a range from 1.2–16 µg per 100g wet weight. Values for vitamin D<sub>3</sub> and 25-OHD<sub>3</sub>, in lean beef averaged, respectively, 0.26 µg and 0.21 µg per 100g wet weight; in lean lamb averaged, respectively, 0.27 µg and 0.26 µg per 100g wet weight; in chicken averaged, respectively, 0.25 µg and 0.5 µg per 100g wet weight; and in egg yolk ranged, respectively, from 0.5–2.9 µg and 0–4.2 µg per 100g wet weight.

#### Conclusion

These new vitamin D data could be used to estimate the vitamin D intakes of Australians when dietary intake data are available from the 2011/13 Australian Health Survey.

#### Source of funding

Meat & Livestock Australia, Seafood CRC, Rural Industries R&D Corporation, Food Standards Australia New Zealand.



## Concurrent Session 1: Micronutrients

### Vitamin B<sub>12</sub> status of omnivorous students is influenced by oral contraceptive pill use

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#### Background

Cross-sectional studies have reported variation in serum and erythrocyte vitamin concentrations between individuals however there has been limited reporting of intra-individual variability.

#### Objective

To determine the intra- and inter- individual variability in the serum concentrations of vitamins B<sub>6</sub>, B<sub>12</sub>, folate and erythrocyte folate in young women; to identify relationships between diet, body mass index (BMI), age, exercise level and haematological factors that could contribute to variability; and to determine intake levels for vitamins B<sub>6</sub>, B<sub>12</sub> and folate and their food sources.

#### Design

For this study, control group data were extracted from a randomized, semi-blinded, placebo-controlled, parallel trial that was determining the effect of diet or supplement intake on the nutritional status of young women. Fasting blood samples at 0, 4, 8 and 12 weeks were used to calculate the intra-(CV<sub>I</sub>) and inter-(CV<sub>G</sub>) individual coefficients of variability for serum vitamins B<sub>6</sub>, B<sub>12</sub> and folate, and erythrocyte folate. Food frequency questionnaires (FFQ) at weeks 0 and 12 were used to identify the main sources of these vitamins.

#### Outcomes

Twenty-two healthy omnivorous female students aged 24.5 ± 1.3 years with BMI 21.8 ± 0.6 kg/m<sup>2</sup> provided the data (shown as mean ± SEM) for analyses. For all vitamins, the ranges were for CV<sub>I</sub>, 16.1 - 25.7%; CV<sub>G</sub>, 31.7 - 62.2% and the index of individuality (CV<sub>I</sub> / CV<sub>G</sub>), 0.26 - 0.81%. Use of oral contraceptive pills (OCP) was significantly (P = 0.026) associated with lower serum vitamin B<sub>12</sub> concentrations. Initial vitamin B<sub>12</sub> concentrations were 172 ± 16 and 318 ± 51 pmol/L for OCP (n = 9) and non-OCP (n = 13) users, respectively, with differences maintained at each time point during the 12 weeks. BMI, age, exercise levels, alcohol intakes and haematological factors were found not to affect serum or erythrocyte vitamin concentrations. Vitamin B<sub>12</sub> intakes were derived predominantly from traditional sources (meat, poultry, seafood and dairy) and unexpected sources such as commercial energy drinks.

#### Conclusion

Young women who use OCP had significantly lower serum vitamin B<sub>12</sub> concentrations than non-users. This is a factor for consideration when interpreting serum vitamin B<sub>12</sub> concentrations and requires further investigation of both the mechanism and functional consequences.

#### Source of funding

Pork (CRC) and Australian Pork Limited grant.

The authors have no conflict of interest.

### Effectiveness of an intervention strategy on dehydration in the mining industry

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#### Background

Staying hydrated at the workplace can be difficult for workers in the mining industry. The underground environment itself is a major barrier to healthy fluid consumption. The nature of the physical work and the potential exposure to high heat levels produce fluid loss that may exceed water intake.

#### Objective

The objectives of this study were to investigate the hydration status of workers in underground mines, identify any barriers that prevent healthy fluid consumption and test health promotion interventions to improve water consumption at home and at work.

#### Design

Data from a quasi-experimental study with a control group were examined over a 3-month period. Baseline data on pre-shift and post-shift hydration status (using the urine specific gravity [USG]: dehydration level of >1.020) and fluid consumption (using a fluid frequency questionnaire) were collected. This was followed by health promotion interventions (behavioural and environmental) to improve water consumption at home and at work. Data on pre-shift and post-shift hydration status and fluid consumption were collected again at the end of the study to determine the impact of the intervention.

#### Outcomes

At the start of the study, 61% of workers (n=45) in the control group and 57% of workers (n=42) in the study group started work in a dehydrated state. At the end of the study, 67% of workers in the control group and 44% of workers in the study group started their shift in a dehydrated state. There was a significant decrease in the pre-shift USG (improved hydration) among the night shift workers compared to the day shift workers in the study group (Mean USG=1.014 versus 1.021, P<0.05). The average self-reported volume of fluids consumed increased among people in the study group (2.7L versus 2.0L at follow-up, P<0.05) compared to those in the control group. Barriers to adequate hydration included water palatability, regular water supply, early shift timings and irregular break periods.

#### Conclusion

There is evidence to support the effectiveness of interventions to improve the hydration status of miners working underground.

#### Source of funding



## Concurrent Session 1: Micronutrients

Supported by grant from the Illawarra Health and Medical Research Institute (IHMRI)

### Water consumption and testosterone change among South Australian men

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#### Background

Studies on the association between diet and sex hormones are limited. No study has assessed fluid drinking patterns on serum testosterone (T) change.

#### Objective

We examined the effect of type of fluid intake on 5-year changes in serum T in South Australian men.

#### Design

A randomly selected, community based cohort of 718 men age 35 or older at recruitment with available data at 2 visits. Men on medications known to affect, or with established pathology of, the hypothalamo-pituitary gonadal axis, were excluded leaving 604 for analysis. Fluid intake was assessed by food frequency questionnaire at follow up. Fluid drinking patterns were determined by factor analysis. Known confounders were adjusted for using multivariate methods.

#### Outcomes

Daily water intake was 8 or more glasses in 10.3% of men, and less than 4 glasses in 74.7%. Water consumption was positively associated with T change over the preceding five years. Adjusting for age, compared with water consumption <4 glasses/d, water consumption 4-7 glasses/day and  $\geq 8$  glasses/d were associated with a T change of +0.24 nmol/L/y (95%CI: 0.03-0.45), and +0.31(0.06-0.56) nmol/L/y, respectively. Further adjustment for changes of lifestyle factors and chronic diseases between baseline and follow up did not change the association. Tea consumption was positively associated with T change. A fluid pattern with high water intake was positively associated with T change. A fluid pattern with high consumption of coffee but low intake of tea was positively associated with T decline.

#### Conclusion

Water and tea consumption prevent a decline in T level. The mechanism requires further elucidation.

#### Source of funding

This study was supported by the National Health and Medical Research Council of Australia (NHMRC project grant 627227).

### Shaken but unstirred? Effects of micronutrients on stress and trauma after an earthquake: RCT evidence comparing different formulas and doses

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#### Background

Psychological distress, including heightened anxiety, fear and depression, in those who survive a natural disaster such as an earthquake is well supported by research. Although there are many efficacious treatments, it can be a challenge to reach a large body of the community in a short period of time.

#### Objective

To compare two micronutrient (vitamins and minerals) formulas (Berocca™ and CNE™) and assess their impact on emotions and stress related to the 6.3 earthquake on February 22<sup>nd</sup> 2011 in Christchurch, NZ.

#### Design

91 adults experiencing heightened anxiety or stress 2-3 months following the earthquake were randomized to Berocca™, CNE™ low dose (CNE4), or CNE™ high dose (CNE8), for 28 days and monitored weekly via on-line questionnaires and followed one month post-trial. A non-randomized control group (n=25) completed questionnaires at baseline and 4 weeks.

#### Outcomes

All treatment groups experienced significant declines in psychological symptoms ( $p < .001$ ). CNE™ groups experienced greater reduction in intrusive thoughts as compared with Berocca™ ( $p = 0.05$ ), with no group differences on other measures of psychological symptoms. However, CNE8 group reported greater improvement in mood, anxiety, and energy ( $p < .05$ ) with twice as many reporting being "much" to "very much" improved and five times more likely to continue taking CNE™ post-trial than Berocca™ group. Treated participants had better outcomes on most measures over 4 weeks as compared to controls.

#### Conclusion

This study supports micronutrients as an inexpensive and practical treatment for acute stress following a natural disaster with a slight advantage to higher doses.

#### Source of funding

Vic Davis Memorial Trust



## Concurrent Session 2: Role of Nutrition in Animal Wellbeing

### Inclusion in the diet of concentrations of vitamin E and selenium above recommended level improves oxidative status and reduces heat stress in sheep

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#### Background

Multibillion dollar losses are imposed by heat stress on global animal production during summer months. Heat stress has been implicated in excessive production of free radicals in the body leading to oxidative stress. Antioxidants therefore may be a potential nutritional strategy to reduce heat stress by scavenging free radicals.

#### Objective

The present study was undertaken to investigate the potential of dietary vitamin E and Se at concentrations above the recommended levels to reduce heat stress.

#### Design

Twenty four Merino x Poll Dorset crossbred sheep were housed in one of 2 climatic chambers and offered either a control (10 I.U. vitamin E and 0.24 mg selenium/kg DM) or supplemental diet (100 I.U. Vitamin E and 1.20 mg Se (as SelPlex™)/kg DM). The sheep were subjected to two thermal treatments (Thermoneutral (TN): 18- 21°C and 40-50% relative humidity and Heat Stress (HS): 28-40°C and 26-30% relative humidity) for 2 weeks in a single reversal design. Physiological parameters were recorded and blood samples as well as skeletal muscle biopsies were collected for analysis of biomarkers of oxidative stress. The data was analysed by using REML.

#### Outcomes

The levels of d ROM (derived reactive oxygen metabolites) were reduced significantly ( $p < 0.001$ ) in high vitamin E and Se supplemented sheep as compared to control. Also lower OSI (oxidative stress index) coupled with comparatively higher BAP (biological antioxidant potential) was found in supplemented sheep. Vitamin E and Se supplementation also significantly reduced the respiration rate as indicated by a diet x temperature x time interaction ( $P = 0.010$ ). Recently, it has been realised that ROS act as cell secondary messengers signalling oxidative damage via transcription factors in the cell. Therefore the effect of vitamin E and Se on the expression of NF- $\kappa$ B and TNF- $\alpha$  is being investigated in heat stressed sheep skeletal muscle tissue.

#### Conclusion

Inclusion in the diet of concentrations of vitamin E and selenium above requirement improves oxidative status and reduces heat stress in sheep.

#### Source of funding

Not applicable

### Preference of broiler chickens for animal and vegetable protein diets

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#### Background

Vegetable protein (VP) diets are cheaper and safer than animal protein (AP) diets. Performance on VP diets may be similar to that on AP diets, however, the former tend to contain anti-nutritive factors and may not be as acceptable to poultry.

#### Objective

To determine the preference of broiler chicks for VP and AP diets when fed simultaneously.

#### Design

In experiment 1, 14d-old Ross-308 male and female chicks were randomly allocated to VP or AP grower (15-21d) and finisher (22-28d) diets. In experiment 2, 7d-old Cobb-500 male chicks were offered two VP diets, with soybean meal (SB) or canola meal (CM) as the major protein source, until 21 days of age. All diets were supplemented with microbial enzymes (Avizyme 1502 and Phyzyme XP; Danisco Animal Nutrition, UK) and each was fed to six replicate groups. Both experiments were conducted as part of larger projects to assess poultry productivity on the diets being tested. In experiment 2, the effect of SB and CM diets when offered in the first week prior to feeding of a diet containing fishmeal was tested. The selection of the diets offered was recorded for each period. Data collected were analysed by one-way ANOVA and mean values were considered significant at  $P \leq 0.05$ .

#### Outcomes

In experiment 1, birds generally preferred the AP diet when given a choice. On the grower diet, birds ate 62 % of AP and 38% of VP, while on the finisher diets, the selection was 82 and 18%, respectively. Preference was significant in the grower ( $P < 0.01$ ) and finisher ( $P < 0.001$ ) periods. On the main study, birds on the VP diets attained final (42d) weights that were similar to those on the AP diets. In experiment 2, birds preferred the CM diet, consuming it at 62.2% in preference to the SB diet between 8 and 14 days ( $P < 0.01$ ). Between 15 and 21 days, the birds selected CM in preference to SB, at the rate of 58.42% ( $P < 0.001$ ). Birds started on the SB diet in the main study were heavier ( $P > 0.05$ ) than those on the SB diet at 21d of age.

#### Conclusion

The results suggest a preference by chicks for AP diets even if the diets are nutritionally similar to VP diets. The chicks also preferred a diet containing CM, even if it did not support better growth. The causes of these preferences, particularly the strong aversion to VP diets, warrant investigation.

#### Source of funding



## Concurrent Session 2: Role of Nutrition in Animal Wellbeing

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### Dietary algae rich in DHA alters liver $\Delta$ -6 desaturase and carnitine palmitoyltransferase 1 mRNA and DHA content of muscle from lambs

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#### Background

Current food production systems require producers comply with environmental and dietary guidelines while maintaining profitability. Replacing grain with marine algae as a source of protein and energy for farm animals may provide an opportunity to improve public health and environmental impact.

#### Objective

This study investigated the effect of an environmentally sustainable dry algae feed supplement on body fatness, liver mRNA and muscle long chain omega-3 (docosahexaenoic acid, DHA) fatty acid concentrations.

#### Design

120 crossbred ewe lambs (~ 9 month old) were assigned to 12 groups based on initial live-weight (25-35 kg), then randomly allocated to one of 4 dietary treatments: Basal diet (ryegrass-clover hay) = BAS; Basal diet with flaxseed (10.7%) = Flax; Basal diet with algae (1.8%) = Algae; Basal diet with flaxseed (10.7%) and algae (1.8%) = FlaxAlgae. At slaughter, body fatness was assessed using GR (total thickness of fat & muscle at 12<sup>th</sup> rib) measure of the carcass. Also samples of liver (n = 12) and muscle (n = 30) were collected for mRNA analysis ( $\Delta$ -6 desaturase [FADS1] & carnitine palmitoyltransferase 1 [CPT1]) and DHA content, respectively.

#### Outcomes

A substantial (15.1 mm) and moderate (13.3 mm) increase (P<0.03) in GR occurred with Flax and FlaxAlgae diets compared with other treatments (10.7-11.4 mm). Increased (P<0.02) liver mRNA of FADS1 in Algae (79 Arbitrary Units, AU) and FlaxAlgae (81 AU) compared with lambs fed without algae (0.34-0.41 AU) was associated with an increase in muscle DHA. Muscle DHA content for BAS, Flax, Algae and FlaxAlgae groups were 7.6, 6.7, 63.4 and 49.6 mg/ 100 g muscle, respectively. The lower (P<0.05) liver CPT1 mRNA with Algae (50 AU) diet compared with all other groups (80-162 AU) suggests a decrease in fatty acid  $\beta$ -oxidation, as these animals may be using glycogen as an energy source.

#### Conclusion

These data demonstrate that supplementation with algae rich in DHA may be beneficial in increasing muscle DHA in lambs, thereby providing another dietary source of DHA.

#### Source of funding





## Concurrent Session 2: Role of Nutrition in Animal Wellbeing

### A soluble arabinoxylan rich fraction from wheat reduces circulating bile salts and triglyceride in pigs

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#### Background

Soluble dietary fibres (SDFs), e.g.  $\beta$ -glucan, lower plasma cholesterol and triglyceride (TAG). The mechanism of action is not well understood but it has been proposed that SDF inhibits the reabsorption of bile salts (BS) into the enterohepatic circulation and promotes their excretion in the faeces.

#### Objective

To investigate whether a soluble wheat arabinoxylan-rich fraction (AXRF) added to the diet of pigs lowers blood cholesterol and triglyceride levels and affects bile salt reabsorption.

#### Design

Pigs were randomly allocated into one of four groups ( $n = 10$ ) and fed diets with or without AXRF, for 4 wk. Blood from the jugular (JV) and hepatic portal (HPV) veins was collected, as well as digesta samples from four sites along the small intestine and the caecum.

#### Outcomes

AXRF diets decreased BS in both HPV ( $P=0.003$ ) and JV ( $P=0.001$ ) and TAG in JV ( $P=0.02$ ) but had no effect on plasma total or LDL cholesterol (both  $P>0.1$ ). AXRF delayed TAG digestion in the small intestine with the coefficient of fatty acid digestibility of 96.0% without AXRF compared to 90.4% for diets containing AXRF. Bile salts were reabsorbed with high efficiency from both with and without AXRF diets.

#### Conclusion

AXRF reduced circulating TAG and BS without increasing ileal excretion of BS.

#### Source of funding

This study was supported by a grant from the CSIRO Flagship Collaboration Fund to the High Fibre Grains Cluster via the Food Futures Flagship.



## Concurrent Session 2: Role of Nutrition in Animal Wellbeing

### Adaptation of cattle to dietary nitrate may involve adaptation to methaemobinaemia

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#### Background

Dietary nitrate is effective in reducing methane emissions from ruminants, however animals supplemented with nitrate risk nitrite toxicity that results in methaemoglobinaemia. Allowing time for adaptation of rumen microflora to nitrate and its metabolites is routine practice to reduce the levels of the toxic intermediate, nitrite. Does the animal also adapt with changes in the ability to reduce methaemoglobin?

#### Objective

To examine the effects of dietary nitrate on methaemoglobin levels and erythrocytic NADH-methaemoglobin reductase.

#### Design

Eighteen Angus steers (BW  $353 \pm 17.7$ kg) were fed a standard feedlot ration supplemented with either calcium/ammonium nitrate (10 animals) or urea on an isonitrogenous basis (0.4% N of DM) (8 animals). Blood was obtained at approximately weekly intervals for 8 weeks for determination of erythrocytic methaemoglobin level and NADH-methaemoglobin reductase activity.

#### Outcomes

Methaemoglobin levels slowly increased from a baseline of 0.5% to about 2% of total haemoglobin in the nitrate supplemented animals ( $P < 0.01$ ). There was no change in the urea supplemented animals. In the last two weeks of the trial the erythrocyte NADH-methaemoglobin reductase activity of the nitrate treated animals rose significantly above those of the urea treated animals (2.4 vs 1.5 IU/gHb) ( $P < 0.001$ ). There was no change in haemoglobin levels associated with treatment.

#### Conclusion

Longer term adaptation of animals to dietary nitrate may lead to changes not only in rumen metabolism, but also to changes in the level of red blood cell enzymes involved in the reduction of methaemoglobin.

#### Source of funding

Project funded by Cargill Inc. and the Australian Government Department of Agriculture, Forestry and Fisheries Action on the Ground projects.

### Nutritional evaluation of cassava wastes in the diets of broilers

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#### Background

Utilization of cassava wastes (CW) by broilers may increase poultry production in developing countries by reducing cost of feed production.

#### Objective

To investigate whether it is possible to formulate cheap and practical, nutritionally adequate diets from locally available CW for smallholder poultry farmers in Fiji's rural communities.

#### Design

A randomised feeding trial of 150 chicks aged 22 d was conducted to evaluate the effect of CW-based diets on carcass quality of broilers. Five diets comprising a commercial finisher diet, control and three CW-based diets containing 10, 20 and 30% CW replacement levels respectively were given to chickens for 24 d to determine the cost effectiveness of CW in the diets of broilers. There were three replicates with 10 chickens each. Daily feed intakes and weekly body weight of chickens were measured throughout the feeding trial. A metabolic trial was conducted at the end of the trial to determine utilisation of nutrients, followed by carcass evaluation of treated chickens. The costs of feeding and carcass yields were also determined.

#### Outcomes

Relative to commercial diet, inclusion of CW into the finishing diet significantly ( $P < 0.05$ ) improved feed intake, body weight gain and feed conversion ratios of broiler chickens. Increasing levels of CW in finishing diets improved ( $P < 0.05$ ) utilisation of dry matter, ash and crude fibre and dressing percentage but significantly reduced ( $P < 0.05$ ) crude fat utilization, gizzard and kidney of broiler chickens compared to chickens fed with commercial diet. None of the treatments significantly influenced utilization of crude protein, breast cuts, drumstick, liver and lung weights of broilers. Supplementation of broiler finisher diet with CW significantly reduced ( $P < 0.05$ ) total feed cost and cost of producing broiler meat compared to control and commercial diets.

#### Conclusion

Cassava wastes may alter carcass composition of broilers when replacing maize in broilers diets. CW supplementation of broiler finisher diets optimised the profits from broiler production. Thus, supplementation of broiler finishing diets with CW was more profitable than feeding commercial diets only.

#### Source of funding

Supported by grant from Fiji National University, Fiji Islands



## Concurrent Session 3: Cardiovascular Risk

### Consumption of black tea lowers night time blood pressure variability: a new mechanism for cardiovascular protection?

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#### Background

A commonly held view is that level of blood pressure (BP) accounts for all of the BP-related risk of vascular events. However, other measures derived from the assessment of BP, such as its variability, may also contribute to risk. High BP variability is emerging as an independent risk factor for cardiovascular disease.

#### Objective

There is limited understanding of the potential relationship of dietary factors with BP variability. We aimed to assess the effects of black tea on ambulatory BP variability.

#### Design

Men and women (n=111) with ambulatory systolic BP between 115 and 150 mm Hg at screening were recruited to a randomised controlled double-blind 6-month parallel designed trial. Participants consumed 3 cups/d of either powdered black tea solids (tea) or a flavonoid-free caffeine-matched beverage (control). Ambulatory BP variability, assessed as rate of BP variation during the day time (8:00–20:00) and night time (22:00–6:00), was measured at baseline, day 1, 3 months and 6 months.

#### Outcomes

Tea compared with control resulted in a lower rate of systolic (P=0.0045) and diastolic (P=0.016) BP variation during night time across the three time points, independent of level of BP and heart rate. The net effects at day 1, 3 months and 6 months, respectively, were -1.4, -3.1 and -1.8 mm Hg/h for systolic BP, and -1.7, -1.6 and -1.4 mm Hg/h for diastolic BP, corresponding to approximately 10% lower rate of BP variation. Rate of BP variation was not altered during day time.

#### Conclusion

We have demonstrated for the first time that consumption of black tea can lower night time systolic and diastolic BP variability. These effects were immediate and sustained during regular black tea consumption over 6 months, and were independent of BP level. The results demonstrate that simple dietary changes can influence BP variability. Effects of tea on BP variability may be a further mechanism to explain the reported association between tea intake and reduced risk of cardiovascular disease.

#### Source of funding

National Health and Medical Research Council of Australia; and Unilever Research and Development, Vlaardingen, The Netherlands.

### Sodium versus potassium: effects on postprandial blood pressure and measures of blood vessel function

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#### Background

Extensive research indicates excessive sodium intake leads to an increased risk of hypertension. Postprandial studies suggest endothelial dysfunction occurs in response to a meal high in sodium compared to a low sodium meal. Dietary intervention studies suggest a reduction in blood pressure (BP) and improvements in pulse wave analysis measures in hypertensive populations, following replacement of sodium with potassium.

#### Objective

The present study aimed to investigate and compare the effects of moderately high sodium (54 mM Na<sup>+</sup>; 11 mM K<sup>+</sup>), moderately potassium rich (14 mM Na<sup>+</sup>; 36 mM K<sup>+</sup>) and low sodium meals (14 mM Na<sup>+</sup>; 11 mM K<sup>+</sup>) on postprandial (up to 3 hr) blood pressure and blood vessel function as measured by pulse wave analysis.

#### Design

A double-blind cross-over study was conducted in 41 normotensive adults (mean age 57.5±11.6 years; 12 males). For 48 hr prior to testing subjects avoided food items high in sodium or potassium. Fasting subjects consumed one of three test meals; brachial BP and measures of blood vessel function, including augmentation pressure/index, were performed at 15 min intervals over 3 hr. There was a minimum of 72 hr washout between test sessions.

#### Outcomes

All three meals led to reductions in postprandial brachial and central BP (~6 mmHg; all p<0.001). Overall there was no significant difference between the three meals in their postprandial effects on brachial or central BP, or augmentation pressure/index. When postprandial data was separated into first and second 90 min periods, the low sodium meal provided the greatest reduction in both brachial and central diastolic pressure and values were significantly lower compared to the high potassium meal during the first 90 min of postprandial period (-2.20 mmHg; 95% CI -4.02 to -0.36; p=0.03)

#### Conclusion

Various meals reduced blood pressure, but there was a greater early reduction in diastolic pressure after the low sodium meal compared to the high potassium meal.

#### Source of funding

Clifford Craig Medical Research Trust, Launceston, TAS



## Concurrent Session 3: Cardiovascular Risk

### Chronic resveratrol supplementation improves FMD and cognitive performance in obese adults

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#### Background

We have previously shown an acute improvement of flow-mediated dilatation (FMD) in the brachial artery with resveratrol (a polyphenol in grapes) in mildly hypertensive overweight/obese adults. Resveratrol supplementation has recently been shown to increase cerebral blood flow acutely, without affecting cognition. However, potential benefits of long-term consumption are still unknown.

#### Objective

To evaluate effects of chronic resveratrol supplementation on FMD and cognitive performance.

#### Design

Twenty-eight obese, but otherwise healthy adults (BMI:  $33.3 \pm 0.6$  kg/m<sup>2</sup>) were randomised in a double-blind crossover trial to consume a capsule of either *trans*-resveratrol (resVida™, 75mg/day) or a colour-matched placebo. FMD and performance on the Stroop colour-word test (time taken to complete, number of uncorrected and corrected errors and interference score) were assessed at the end of 6 weeks whilst fasted and at least 18 hrs after consumption of their last capsule. Participants then crossed over to the alternate supplement and outcome measures were repeated after a further 6 weeks.

#### Outcomes

There was a sustained improvement in FMD (23% increase,  $P=0.021$ , paired *t*-test) following six-weeks of daily supplementation with 75mg resveratrol compared with placebo. The extent of improvement correlated with baseline FMD, such that those with lower FMD at baseline showed greater increases ( $r=0.47$ ,  $P=0.01$ ). Participants made 50% fewer uncorrected errors during the word-reading trial of the Stroop colour-word test ( $P=0.05$ ) after chronic resveratrol supplementation. This improvement did not correlate with resveratrol-induced change in FMD. Other components of the Stroop colour-word test were not affected by supplementation. The dose and duration of supplementation were well tolerated and safe.

#### Conclusion

Regular resveratrol consumption resulted in sustained improvement in systemic vasodilator function. A comprehensive trial is needed to confirm our preliminary finding of enhanced cognitive performance with resveratrol supplementation and whether this is attributable to improved cerebral endothelial function.

#### Source of funding

resVida™ and placebo capsules were supplied by DSM Nutritional Products, Kaiseraugst, Switzerland.

### Effects of modest salt reduction on vascular function and blood pressure in overweight and obese adults

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#### Background

The effects of a modest reduction in dietary salt intake on vascular endothelial function in overweight and obese persons are unknown.

#### Objective

Our objective was to determine the effects of a reduction in dietary sodium to 100mmol Na/day (6g NaCl) compared with usual sodium intake on measures of vascular function and blood pressure in overweight and obese subjects.

#### Design

We conducted a randomised, cross-over trial of sodium reduction to 100 mmol/day with or without sodium supplementation to 160mmol/day each for 6 weeks in 25 overweight and obese subjects. Flow-mediated dilatation (FMD), 24hr blood pressure (BP), augmentation index (AIx), pulse wave velocity (PWV) and plasma and urinary nitrate/nitrite, plasma endothelin-1 and ADMA concentrations were measured at the end of each intervention.

#### Outcomes

Twenty-five overweight and obese subjects aged  $57 \pm 7$  years (BMI  $32 \pm 4$  kg/m<sup>2</sup>; SBP  $128 \pm 11$  mmHg; DBP  $76 \pm 5$  mmHg) completed the intervention. Urinary sodium was reduced from  $155 \pm 58$  mmol/24hr on the usual salt diet compared with  $113 \pm 45$  on the reduced salt diet ( $P=0.002$ ). Weight and 24hr urinary potassium excretion were not significantly different between interventions as planned. Following sodium reduction there were significant improvements in FMD from  $3.54 \pm 2.83\%$  to  $5.63 \pm 2.79\%$  ( $P<0.001$ ) and reduction in plasma endothelin-1 (ET-1) from  $1.45 \pm 0.38$  pg/ml to  $1.25 \pm 0.39$  pg/ml ( $P=0.019$ ). Endothelium-independent vasodilatation, AIx, PWV, plasma ADMA and plasma and urinary nitrate/nitrite concentration were not significantly different between treatments. Change in FMD was significantly related to the urinary sodium to creatinine ratio ( $R = -0.470$ ,  $P<0.05$ ) and was independent of BP.

#### Conclusion

Modest sodium reduction has beneficial effects on vascular function in overweight and obese subjects which appears to be mediated by lower plasma endothelin-1 with no alteration in nitrate/nitrite concentration in the urine or plasma.

#### Source of funding

CSIRO Food, Animal and Health Science, NHMRC CCRE in Nutritional Physiology, Interventions and Outcomes



## Concurrent Session 3: Cardiovascular Risk

### Association of nitrate intake with carotid atherosclerosis in older women

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#### Background

Evidence is mounting that dietary nitrate can contribute to vascular health. However, few epidemiological studies have examined the relationship between nitrate intake and measures of vascular disease.

#### Objective

The aim of this study was to investigate the relation between dietary nitrate intake and common carotid artery intima-media thickness (CCA-IMT).

#### Design

A cross-sectional analysis was performed in a population-based cohort of women over the age of 70 (n=1080) recruited to a 5 year prospective, randomised, controlled trial. The nitrate intake, assessed with a validated food frequency questionnaire, and lifestyle factors and cardiovascular disease risk factors were determined at baseline. CCA-IMT was measured using B-mode carotid ultrasound three years after enrollment.

#### Outcomes

The mean  $\pm$  SD total nitrate intake was 116  $\pm$  47 mg/d (range: 14-313 mg/d). Higher nitrate intake was associated with lower maximum CCA-IMT (standardized  $\beta$  = -0.086, P = 0.005) and lower mean CCA-IMT ( $\beta$  = -0.077, P = 0.011). A 100 mg (~2 SD) higher nitrate intake was associated with 0.025 mm lower maximum CCA-IMT and 0.021 mm lower mean CCA-IMT. This relation remained significant after adjustment for lifestyle and cardiovascular risk factors (maximum CCA-IMT:  $\beta$  = -0.088, P = 0.007; mean CCA-IMT:  $\beta$  = -0.072, P = 0.027), and was not altered after excluding women with pre-existing cardiovascular disease and diabetes.

#### Conclusion

Independent of other risk factors, increased dietary nitrate intake was associated with a lower CCA-IMT. These results are consistent with the putative vascular health benefits of nitrate-rich foods.

#### Source of funding

Healthway Health Promotion Foundation of Western Australia. National Health and Medical Research Council of Australia.

### Whole-grain and malted whole-grain wheat polyphenols, and corresponding biological effects on oxidative stress and inflammation in adults with overweight or obesity

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#### Background

Oxidative stress in obesity may be modulated by dietary antioxidants such as polyphenols. Wheat polyphenols may increase following malting, however the biological effects are unclear.

#### Objectives

To determine polyphenol content and antioxidant capacity between whole-grain wheat control (CON) and malted whole-grain wheat (MLT) breakfast cereals, and whether regular consumption differentially effects biological oxidative stress and inflammation in overweight and obesity.

#### Design

Polyphenol content in CON and MLT was compared using Folin-Ciocalteu reagent, and antioxidant capacity against 2,2-Diphenyl-1-picrylhydrazyl. Polyphenol profiles were evaluated by reverse phase HPLC. To assess biological effects, 10 adults with BMI >25 kg/m<sup>2</sup> completed a 2 x 4-wk double blind randomised cross-over trial with a 2-wk washout, consuming either CON or MLT calculated at 10% daily energy requirement for weight maintenance. At 0 and 4-wks, oxidative stress was assessed by thiobarbituric acid reactive substances and total antioxidant capacity against oxidation inhibition of 2,2'-Azino-di-[3-ethylbenzthiazoline sulphonate], and inflammation by high-sensitivity C-reactive protein. General Linear Model with repeated measures compared the effects of time, cereal, and time\*cereal interaction. Independent t-tests analysed *in vitro* polyphenol content and antioxidant activity.

#### Outcomes

Polyphenol content and antioxidant capacity was present in both cereals, however, the MLT polyphenol content was significantly greater than CON (P = 0.002), as was antioxidant capacity (P = 0.016). Consumption over 4-wks however did not differentially effect inflammation (n=8) or oxidative stress (n=9) by time, cereal or time\*cereal.

#### Conclusion

Malted whole-grain wheat may supply additional dietary antioxidants compared with regular whole-grain wheat, however cumulative effects in attenuating oxidative stress and inflammation may require increased consumption.

#### Source of funding

Sanitarium Development and Innovation are acknowledged for their kind assistance in providing the test cereals.



Concurrent Session 4: Debunking Pork Myths – Recent Advances to Drive Consumption of Australian Pork  
Sponsored by Australian Pork Ltd and Pork CRC

### Consumer perceptions of health benefits and nutritional value of pork

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#### Background

Health and nutrition are key issues considered by consumers when selecting weekly meal repertoires and recipes. Although consumer attitudes of all meats have improved over the last few years, pork has consistently scored lower than beef and chicken.

#### Objective

The 2011 Usage and Attitude study was conducted to: identify current trends and changes in general meat attitudes, behaviour and consumption and how this related to pork; identify underlying motivations, triggers and barriers of meat purchase choice and track changes in perception to the health and nutrition benefits of meat.

#### Design

A two-stage online survey was conducted with 2058 main grocery buyers / cooks aged 18-65 years throughout Australia who eat meat and do not reject pork using a ten point scale (from strongly disagree to strongly agree). A 13 day diary of their meal repertoire and recipe usage for breakfast, lunch and dinner was completed by 1000 grocery buyers. Diary data was used to compare actual usage of pork and cuts with claimed usage and to measure the importance of health and nutrition in a real-life environment. Claimed and actual behaviour was determined by cross-referencing data from all three studies.

#### Outcomes

Consumer attitudes to health and nutrition of meat have improved since 2008. A mean score of 8.1 was achieved for 'Meat is important for nutrition' compared with 7.6 in 2008. For the statement, 'Meat is good for your health', scores increased from 7.3 to 7.9. Pork was perceived by more consumers in 2011 to be 'healthy and nutritious' (66% vs. 56%, respectively) than in 2008. In contrast, chicken, beef and fish were rated more favourably for this trait (80%, 77% and 90%, respectively). In comparison to beef and lamb, pork rated lower as 'a good source of iron' (91%, 47% and 20%, respectively). Beef was rated similarly to pork for 'lean/low in fat' (30% and 31%, respectively), whilst ratings for chicken and fish were higher (64% and 84%, respectively).

#### Conclusion

Challenges remain to improve consumer perceptions of the health attributes of pork compared with other meats. Incorporating new recipes into consumers' core meal repertoire to allow them to easily make healthy and nutritious pork meals is a key focus of marketing activity.

#### Source of funding

Australian Pork Limited

### Improving the eating quality and consistency of Australian pork to meet consumer expectations

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#### Background

A model for predicting pork eating quality, using a pathways approach, is being developed using meta-regression statistical techniques and data from previously published studies. For this system to be cuts-based, additional data are required to understand the effects of, and interactions between, different cut types, cooking methods, cooking temperatures and ageing periods.

#### Objective

To determine the interactions between gender, ageing period, cut type, cooking method and final internal temperature on pork quality attributes.

#### Design

Pigs (female, entire male and surgical castrates; n=20 per gender) targeting carcass specifications of 60-75 kg and P2 fat depth of 8-13 mm were slaughtered over two days. At 24 h post-slaughter, loin, shoulder and silverside muscles were obtained and prepared into samples for objective and sensory measurements. Steaks (loin only), roasts and blocks for later preparation into stir fry were prepared from each muscle, individually labelled, packaged, aged for 2 and 7 d post-slaughter and then frozen at -20°C. Pork was cooked to either a 70 or 75°C final internal temperature using a flat plate grill for steaks, oven for roasts, electric wok for stir fry pieces and waterbath for objective tenderness. Meat quality measurements including objective tenderness, intramuscular fat content (IMF), colour, drip loss and ultimate pH were made. Data were analysed using Genstat 13.

#### Outcomes

Female and entire male produced leaner ( $P<0.001$ ) carcasses, with lower IMF levels in the loin ( $P<0.001$ ) and silverside ( $P=0.013$ ) than castrates. Cooking pork to a 75°C final internal temperature decreased objective tenderness of both the loin ( $P=0.01$ ) and silverside ( $P=0.013$ ) and increased cooking loss from both muscles ( $P<0.001$ ). Silversides from entire males were less tender ( $P=0.052$ ) than from females and castrates. For the loin and silverside, pork aged for 7 d was lighter ( $P<0.05$ ), redder ( $P<0.05$ ) and yellower ( $P<0.001$ ) in colour.

#### Conclusion

Pathway factors were demonstrated to impact on pork quality traits. These need to be considered in the implementation of potential pathways going forward.

#### Source of funding



Concurrent Session 4: Debunking Pork Myths – Recent Advances to Drive Consumption of Australian Pork  
Sponsored by Australian Pork Ltd and Pork CRC  
Australian Pork Limited and the CRC for High Integrity  
Australian Pork.

### Regular consumption of lean fresh pork has no adverse effect on body composition

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#### Background

Pork is the most widely eaten meat in the world and recent evidence shows that diets high in pork protein, with and without energy restriction, may have favourable effects on body composition. However it is unclear whether these effects are specific to pork or whether consumption of other high protein meat diets may have the same benefit.

#### Objective

We aimed to compare regular consumption of fresh lean pork, beef and chicken on indices of adiposity.

#### Design

In a nine month randomised cross-over intervention trial, 49 overweight adults were randomly assigned to consume up to 1kg/wk of pork, chicken or beef in an otherwise unrestricted diet for 3 months, followed by two further 3 month periods consuming each of the alternative meat options. BMI and waist/hip circumference were measured and body composition was determined using dual energy x-ray absorptiometry. Dietary intake was assessed using 3 day weighed food diaries. Energy expenditure was estimated from activity diaries.

#### Outcomes

There was no difference in BMI or any other marker of adiposity between consumption of pork, beef and chicken diets. Similarly there were no differences in energy or nutrient intakes or energy expenditure between diets. Volunteers' overall preference for pork was greater than for beef ( $P=0.02$ ) but not for chicken ( $P=0.23$ ).

#### Conclusion

Regular consumption of lean fresh pork had similar effects on body composition as beef or chicken and was enjoyed as much as, if not more than, chicken and beef during the trial. The perception of pork as a less healthy meat choice needs to be reconsidered.

#### Source of funding

This study was supported by a grant from the Pork CRC.

### Soy lecithin supplementation of pigs improves pork quality

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#### Background

Tenderness is considered to be the most important quality characteristic of pork. Both chewiness and shear force can contribute to tenderness. Collagen is a major component of intramuscular connective tissue that impacts on tenderness. Lecithin has the potential to inhibit collagen cross-linking and preliminary studies suggest that dietary lecithin supplementation to pigs may reduce chewiness and hardness but not shear force.

#### Objective

To determine if lecithin could reduce collagen synthesis and improves meat tenderness and other pork attributes.

#### Design

Regression and meta-analyses were conducted to determine the effects of dietary lecithin on technical aspects of meat quality and carcass characteristics. A total of 6 experiments involving doses of lecithin ranging from 0 to 80 g/kg fed to female, entire male (EM) and immunocastrated male (IC) pigs over the finishing phase. Data were analysed using Genstat 13.

#### Outcomes

Dietary lecithin increased dressing percentage in a dose-dependent manner ( $0.12\%$  per  $(g/kg)^{0.5}$ ,  $P=0.015$ ) while dressing percentage was lower in EM ( $-1.8\%$ ,  $P<0.001$ ) and IC ( $-2.3\%$ ,  $P<0.001$ ). Dietary lecithin decreased pork chewiness in a dose-dependent manner ( $0.027$  per  $(g/kg)^{0.5}$ ,  $P=0.011$ ) but there was no effect ( $P>0.16$ ) of sex. Dietary lecithin decreased pork hardness in a dose-dependent manner ( $0.056$  kg per  $(g/kg)^{0.5}$ ,  $P=0.019$ ) but there was no effect ( $P>0.15$ ) of sex. Dietary lecithin decreased muscle hydroxyproline in a dose-dependent manner ( $0.042$   $\mu g/ml$  per  $(g/kg)^{0.5}$ ,  $P=0.042$ ) but there was no effect ( $P>0.58$ ) of sex. Dietary lecithin had no effect on either shear force ( $P=0.71$ ) or cooking loss ( $P=0.79$ ). These positive effects of lecithin on meat quality need to be confirmed by consumer panels.

#### Conclusion

These data confirm that dietary lecithin can improve eating quality of pork possibly through reducing collagen synthesis as indicated by reduced hydroxyproline.

#### Source of funding

Australian Pork Limited and Pork CRC.



Concurrent Session 4: Debunking Pork Myths – Recent Advances to Drive Consumption of Australian Pork  
Sponsored by Australian Pork Ltd and Pork CRC

**Iron status of pork – an innovative approach to increase the muscle iron content of pigs**

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**Background**

Differential feeding of dietary iron (Fe) to grower-finisher pigs offers a means to manipulate Fe levels in muscle at slaughter.

**Objective**

To investigate whether Fe levels in different muscles from pigs can be manipulated by feeding lower and then higher dietary Fe levels, and to assess the impacts of this feeding regimen on aspects of Fe chemistry, physiology and gene expression.

**Design**

A total of 48 pigs was allocated at 10 kg bodyweight to one of two grower-stage diets differing in iron (Fe) content (High; 239 ppm or Low; 50 ppm) and fed *ad libitum* for 8 weeks; 8 pigs per group were then slaughtered. The remaining 32 pigs were then allocated in a cross-over design with half of the 'High' pigs fed a high Fe diet (248 ppm; High-High) while the other half were fed a low Fe diet (71 ppm; High-Low). The same design was applied to the 'Low' pigs, to create Low-High and Low-Low treatment groups, respectively. Finisher pigs were slaughtered after another 7 weeks of feeding. Blood, organ and muscle samples (*l. dorsi* - LD; *r. femoris* - RF) were collected.

**Outcomes**

Overall, Fe and myoglobin contents were higher ( $P < 0.001$ ) in the RF compared to the LD muscle. Only for RF and in the grower stage, pigs fed diet Low had less Fe than pigs fed diet High (5.5 vs 7.0 mg/kg;  $P < 0.05$ ). By the end of the finisher stage and only in the RF, pigs fed Low-High had more Fe (9.3 mg/kg;  $P < 0.05$ ) compared to pigs fed High-High and Low-Low, but it was similar ( $P > 0.05$ ) to pigs fed High-Low (8.5 mg/kg). Finisher pigs had more myoglobin than grower pigs ( $P < 0.05$ ). Blood Fe reflected the dietary intake of Fe. Pigs fed diet Low in the grower stage had less Fe in the heart ( $P = 0.055$ ) and liver ( $P < 0.001$ ), and in the finisher stage, pigs fed High-High and Low-High had more Fe in liver ( $P < 0.001$ ). RT-PCR analysis of selected genes implicated in muscle Fe metabolism and regulation showed differences between treatments.

**Conclusion**

Feeding less Fe in the grower stage followed by more iron in the finisher stage increased muscle Fe at slaughter, but in the RF only. Feeding a low Fe diet followed by dietary repletion in pigs increased circulating serum iron levels.

**Source of funding**

Supported by Australian Pork Limited and the CRC for High Integrity Australian Pork.





## Concurrent Session 5: Advancing Nutrition Science

### Excess dietary advanced glycation end products activate the complement system

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#### Background

Formation of advanced glycation end products (AGEs) generated via the Maillard reaction are accelerated during modern food processing and are thought to be involved in the development of diabetes and renal disease. The precise molecular mechanisms by which AGEs contribute to chronic disease are not well understood. Activation of the complement system is a major pathogenic event that drives inflammatory responses in numerous diseases.

#### Objective

The aim of this study was to investigate the effects of excess consumption of dietary AGEs on activation of the complement system.

#### Design

Healthy male Sprague dawley rats (n=10/group) were randomised to receive a diet low in AGEs (unbaked rodent chow, AIN93G) or a diet high in AGEs (baked AIN93G rodent chow, 160°C for one hr, resulting in a 5-fold higher AGE content) for 24 weeks, with or without alagebrium chloride (10 mg/kg/day oral gavage, Synvista, NJ, USA) or the C5aR/CD88 receptor antagonist PMX-53 (2mg/kg/day oral gavage) and renal function was assessed in parallel with complement pathway activation, markers of reactive oxygen species (ROS) production and inflammation.

#### Outcomes

Chronic consumption of excess dietary AGEs led to activation of serum complement-C3 and urinary excretion of the proinflammatory anaphylatoxins C3a and C5a (P<0.05 for all), with increased expression of corresponding receptors C3aR and C5aR/CD88 in the renal cortex. Complement pathway activation was observed in the context of renal dysfunction, fibrosis, ROS generation and inflammation (P<0.05 for all). These defects were prevented by pharmacological inhibition of AGEs with alagebrium chloride (P<0.05). Blocking complement pathway signalling at the level of C5aR/CD88 using PMX-53 was protective against dietary AGE-induced renal dysfunction (P<0.05).

#### Conclusion

Our studies demonstrate that excess dietary intake of AGEs stimulates activation of the complement pathway promoting the development of chronic kidney disease and provides insight into the effects of highly processed foods underlying chronic disease development.

#### Source of funding

National Health & Medical Research Council of Australia.

### Glycaemic control in Type 2 diabetes mellitus is associated with expression of zinc transporters

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#### Background

Insulin resistance and dyslipidaemia are linked to zinc status potentially via zinc's role in signaling pathways and other metabolic processes. Zinc homeostasis is regulated primarily by the activities of zinc transporter families, which are responsible for cellular zinc export (ZnT; SLC30) or influx (Zip; SLC39).

#### Objective

To investigate the relationship between measures of glycaemic control and expression of selected zinc transporter mRNA in peripheral blood mononuclear cells (PBMC) in post-menopausal women with Type 2 diabetes mellitus (DM).

#### Design

Women with Type 2 DM were recruited to take part in a randomised controlled zinc supplementation trial. The present analysis reports on baseline data from 24 participants. Fasting blood samples were collected to determine plasma zinc, serum glucose concentrations and percentage of glycated haemoglobin (HbA1c). Total RNA was isolated from PBMC and transcribed into cDNA by reverse transcription. Expression of selected ZnT and Zip mRNA was quantified by Taqman real-time PCR.

#### Outcomes

Participants had impaired glycaemic control as evidenced by serum glucose concentrations ( $6.9 \pm 1.2$  mmol/L; mean  $\pm$  SD) and HbA1c ( $6.5 \pm 0.6\%$ ) above the reference ranges. HbA1c was correlated inversely with ZnT1 mRNA expression ( $r=0.5$ ,  $P<0.05$ ). Inverse correlations were observed between serum glucose concentrations and ZnT7 mRNA ( $r=0.4$ ,  $P<0.05$ ). ZnT8 mRNA expression was detected in 11 of 24 participants. In those who expressed ZnT8, a positive correlation was found with serum glucose concentrations ( $r=0.7$ ,  $P<0.05$ ). Plasma zinc concentrations ( $13.2 \pm 1.9$   $\mu$ mol/L) and the expression of Zip mRNA in the present analysis were not related to HbA1c or serum glucose concentrations.

#### Conclusion

Glycaemic control in women with type 2 DM is associated with impaired cellular zinc homeostasis, as seen by lower levels of ZnT1 and ZnT7 gene expression. ZnT8 has been reported to co-localise with pancreatic islets and appears to be involved in zinc accumulation and regulation of insulin secretion. The observation that measures of glycaemic control are associated with zinc transporter gene expression requires further investigation.

#### Source of funding

Sydnovate (University of Sydney) and The Medical Advances Without Animals (MAWA) Trust



## Concurrent Session 5: Advancing Nutrition Science

### Resistant starch dose dependently reduces adiposity in obesity-prone and obesity-resistant rats

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#### Background

Animal studies show that diets containing resistant starch (RS) at levels not achievable in the human diet reduce body weight and/or adiposity in rodents. Whether lower amounts of RS elicit favourable metabolic effects in obese and non-obese animals is not known.

#### Objective

To determine whether RS dose-dependently reduces adiposity in obesity-prone (OP) and obesity-resistant (OR) rats.

#### Design

Male Sprague-Dawley rats (n=120) were fed a moderate-fat, high-energy diet for 4 wk. Rats that gained the most weight (40%) were classified as obesity-prone (OP) and obesity-resistant (OR) rats were those that gained the least weight (40%). OP (n=8) and OR (n=8) rats were randomly allocated to one of six groups. One group was killed for baseline measurements, the other five groups were allocated to AIN-93 based diets that contained 0, 4, 8, 12 and 16% RS (as high amylose maize starch) for 4 wk. These diets were matched for total and complex carbohydrate content. At 0, 4 and 7 wk, insulin sensitivity was calculated by homeostasis model assessment of insulin resistance (HOMA-IR) and adiposity was determined by dual-energy X-ray absorptiometry (DXA). At 8 wk, rats were euthanized and fat pad weights, intestinal digesta short chain fatty acid (SCFA) pools and plasma gut hormone levels were determined.

#### Outcomes

OP rats gained less weight with 4, 12 and 16% RS, but OR animals required 16% RS. Irrespective of phenotype, diets containing 8% RS or more reduced adiposity compared to the control group. All diets containing RS increased total SCFA pools in the caecum and lowered plasma GIP concentrations compared to the 0% RS, whereas plasma GLP-1 and PYY were increased when the diet contained at least 8% RS. Insulin sensitivity was not affected by RS.

#### Conclusion

The inclusion of RS at levels potentially achievable in the human diet was effective in reducing adiposity and weight gain, which is supported by changes in gut hormone and carbohydrate fermentation in OP and OR rats

#### Source of funding

Not applicable.

### Variant homocysteine-related transsulphuration pathway genes as risk factors in adenomatous polyp aetiology

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#### Background

Genetic variation alters nutrient metabolism, and acts as a critical risk factor in disease aetiology.

#### Objective

To ascertain whether cystathionine- $\beta$ -synthase (CBS) 844ins68 and cystathionine gamma-lyase (CTH) G1208T variations might influence folate and methyl group metabolism, and hence, be aetiologically significant factors in the incidence of adenomatous polyps, a clinical phenotype often linked to folate status.

#### Design

212 participants were recruited from a local gastroenterology clinic. Colonoscopy was conducted as a screening protocol for colonic pathology. Subjects (40-89 yrs) comprised of 121 females and 91 males. Food frequency questionnaires were conducted and were analysed using Foodworks™ (version 3.02). Blood folate was measured using a chemiluminescent immunoassay. Homocysteine (hcy) was analysed by HPLC. Genotype analysis was performed using RFLP.

#### Outcomes

Thirty eight participants were diagnosed having adenomatous polyp (17%). CBS844ins68 heterozygosity (single insertion) was observed in 19 control and 11 adenomatous polyp subjects (12 and 28% respectively). There were no double insertion subjects in either group. CBS844ins68 variation was associated with increased adenomatous polyp occurrence (P=0.012), and gave an odds ratio of 2.73 (CI: 1.15-6.4). CTH G1208T T allele frequency for control and case subjects was 0.28 and 0.24 respectively. No association was observed between CTH G1208T genotype and risk of adenomatous polyp. However, the intake of total dietary folate and plasma hcy level predicted adenomatous polyp risk for homozygous recessive (TT) individuals (P=0.0096 in both cases).

#### Conclusion

CBS844ins68 variation may increase risk for adenomatous polyp. Total dietary folate intake, and hcy level are associated with polyp occurrence in the CTH G1208T TT genotype. These genetic variants in the transsulphuration pathway may cause altered SAM and methylation status. This may therefore be a significant biochemical factor in the pathoetiology of adenomatous polyps.

#### Source of funding

Northern Sydney Central Coast Health



## Concurrent Session 5: Advancing Nutrition Science

### The effect of folate and Ab42 on genome stability and cytotoxicity in human lymphocytes measured using cytokinesis-blocked micronucleus cytome assay

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#### Background

Alzheimer's disease (AD) is hypothesized to be associated with the abnormal accumulation of beta amyloid peptide 42 (Ab42) which may induce DNA damage and reduced regenerative potential. Micronutrient deficiency may exacerbate these effects. For example, folate is important in maintaining genome stability and has been shown that under conditions of low folate, uracil (dUMP) accumulates resulting in excessive uracil incorporation into DNA leading to chromosome aberrations.

#### Objective

The aim was to investigate whether Ab42 induces DNA damage and cell death in lymphocytes and whether this is exacerbated under conditions of low folate.

#### Design

Peripheral blood lymphocytes were cultured with medium under conditions of low folate (LF, 20nM/L) and high folate (HF, 200nM/L). Lymphocytes were challenged with a series of Ab42 concentrations (0, 5, 10, 15µM) and genome stability events were investigated using the cytokinesis-blocked micronucleus cytome assay. Outcome measures scored included the nuclear division index (NDI), binucleated (BN) cells with micronuclei (MNi), nucleoplasmic bridges (NPBs), nuclear buds (NBuds), necrosis and apoptosis.

#### Outcomes

It was observed that the frequency of BN cells and the NDI cultured in LF or HF was significantly ( $P < 0.05$ ) decreased in the presence of Ab42 of lymphocytes. However, there were no significant changes in DNA damage events when cells were challenged with Ab42.

#### Conclusion

This suggests that Ab42 influence cell proliferation but does not induce an increase in DNA damage events in lymphocytes under conditions of either LF or HF. Although there were no direct cellular toxic effect, it is clear that Ab42 may potentially reduce the regenerative potential of cultured lymphocytes.

#### Source of funding

Not applicable

### Kruppel-like Factor 3 (KLF3) regulates the novel insulin-sensitising adipokine, C1q/TNF-related protein 12 (CTRP12)

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#### Background

KLF3 is a transcription factor that we have shown to be involved in the regulation of adipogenesis in vitro. Klf3 null mice are lean and protected from diet-induced obesity and glucose intolerance. CTRP12 is a novel adipose-derived factor thought to modulate insulin action, and we have identified it as a target gene of Klf3 through chromatin immunoprecipitation analysis.

#### Objective

To determine if Klf3 knockout (KO) mice have elevated plasma CTRP12 levels as a result of de-repression of the CTRP12 gene and increased expression in adipose tissues.

#### Design

Male wild-type (WT) and Klf3 KO mice (n=6-10 per group) were fed either a chow or high-fat diet. Glucose tolerance was assessed at 10 weeks. Plasma CTRP12 protein levels were determined by western blotting. CTRP12 mRNA expression was measured relative to 18S in white and brown adipose tissue by real time PCR.

#### Outcomes

Male Klf3 KO mice remained lean and resistant to glucose intolerance on a high fat diet. Plasma CTRP12 levels were significantly increased (~5 fold) in the Klf3 KO mice on both chow and high fat diet compared to wild-type mice ( $P = 0.0001$ ). Plasma CTRP12 levels in WT mice, but not KO mice, were dependent on the nutritional fed/fasted state. CTRP12 mRNA expression was significantly upregulated in both white and brown adipose tissue from KO mice.

#### Conclusion

The findings suggest that Klf3 plays a role in the regulation of CTRP12. Mice lacking expression of the Klf3 gene have increased CTRP12 gene expression in adipose tissue and significantly elevated CTRP12 levels in the circulation that may be contributing to the improved metabolic profile of these mice.

#### Source of funding

Project grant NHMRC



## Concurrent Session 6: Dietary Methodology

### How frequently do Australian children eat? A method to measure occasions of eating

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#### Background

Describing the number of times in a day a person eats requires the definition of an 'occasion of eating', a deceptively difficult task. Such a definition allows the description of food intake patterns through the day, and the description of meals, and snacks. An occasion of eating can be defined by a time interval within which food is eaten, or by asking the subject who is being observed to name each occasion of eating. The former method is prone to misclassification of meals eaten outside of standard times, while the latter requires subjects to conceptualise eating occasions in a standard and consistent way.

#### Objective

To determine the food intake patterns of Australian children after defining individual occasions of eating by the elapsed time between instances of food intake.

#### Design

Data from the 24-hour dietary recall of the computer assisted personal interview (CAPI) of the 2007 Australian Children's Nutrition and Physical Activity Survey was used to determine the daily frequency of eating on a single day by children aged 2 to 16 years. An eating occasion was defined as sequential food intake where the last food item is separated from the next by at least 1 hour without food intake. Multivariate linear regression was used to assess the joint association of age, sex and dietary energy intake with the number of occasions of eating in a day.

#### Outcomes

The number of occasions of eating ranged from 1 to 10 times a day, with the mode being 5 occasions on the survey day (38% of children overall), followed by 6 occasions (26%) and 4 occasions (20%). The overall percentage of occasions of eating greater than 1 hour in duration (extended eating) was 3.8%. For children eating on 4, 5 or 6 occasions during the day, the final occasion of eating showed the greatest prevalence of extended eating at 5.9%, 3.6% and 2.8% respectively. The number of occasions of eating was positively associated with dietary energy, negatively associated with age and higher for girls than boys (all  $p < 0.001$ ).

#### Conclusion

The number of daily eating occasions for children can be usefully measured by measuring the time elapsed between eating occasions.

#### Source of funding

CSIRO Preventative Health Flagship, Obesity Theme.

### Comparing short food questions to 24-hour recall to assess children's dietary intake

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#### Background

Short dietary questions provide data on key indicators of food intake and habits, and are used as a rapid method of monitoring eating behaviour. It is important to assess the performance of short dietary questions relative to more comprehensive methods of dietary assessment.

#### Objective

To assess the performance of short dietary questions to measure population group intake compared to 24-hour diet recall.

#### Design

Data from the Australian National Children's Nutrition and Physical Activity Survey 2007 was used ( $n=4487$ ). Children reported their intake on three short food questions relating to serves of fruit and vegetables and type of milk consumed. Response to these questions was compared to estimated intake from the mean of two 24-hour recalls. Age and body weight status were assessed as modifiers of the relationship between methods.

#### Outcomes

There was a stepwise increase in fruit intake by response category of the short question ( $p < 0.001$ ), however the short question overestimated fruit ( $\pm$ juice) intake at each level of intake. For example, those reporting 1 or 2 serves of fruit per day by the short question consumed 0.7 and 1.3 serves respectively by 24-recall. The difference between methods increased with increasing intake, and was significantly greater for older than younger children at almost all levels of fruit intake (by 0.2-0.5 serves,  $p < 0.001$ ). Obese individuals tended to overestimate their fruit intake more on the short question than other children, and this overestimation increased at higher levels of reported intake. Over reporting of vegetable intake was only evident at higher levels of reported intake (3+ serves a day). For vegetable intake, the difference between methods was less consistent than fruit at different levels of intake but tended to be greater for younger children. Almost 86% of children who consumed whole milk by the short question consumed mainly whole fat milk by recall, but agreement was lower for reduced fat (70%) and skim milk (48%).

#### Conclusion

Estimated fruit intake of children is higher when measured by short question than by 24-hour recall, while estimated vegetable intake measured by short question appears to be higher than by 24-hour recall only when higher intake is reported. Type of milk reported by short question is less reliable when less commonly used milk types are nominated.

#### Source of funding

CSIRO Preventative Health Flagship, Obesity Theme



## Concurrent Session 6: Dietary Methodology

### Is there a seasonality effect due to the seven month sampling time frame of the 2007 Australian National Children's Nutrition and Physical Activity Survey?

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#### Background

Food Standards Australia New Zealand (FSANZ) uses national nutrition survey data to conduct dietary exposure estimates for its risk assessments. The 2007 Australian National Children's Nutrition and Physical Activity Survey (ANCNPAS) collected data from February to August, thereby missing spring and most of summer. It is important for FSANZ to understand the potential influence of survey timing on estimates of population nutrient intakes or exposure to food chemicals, such as pesticide residues, due to seasonality in the food supply.

#### Objective

To determine whether the 7 month time frame of the 2007 ANCNPAS was likely to have had an effect on estimates of food consumption, nutrient intake or exposure to other food chemicals, compared to a full year survey time frame.

#### Design

As the 1995 National Nutrition Survey (NNS) included all months of the year, the data for children aged 2-16 years were used to evaluate estimates of food consumption, nutrient intakes and exposure to selected food chemicals (food additives, pesticides and contaminants) from 12 months of data and from February to August only. The 1995 results were also indirectly compared to the 2007 data, noting differences in survey design. All estimates were undertaken using FSANZ's standard methods for conducting dietary exposure assessments.

#### Outcomes

The 7 or 12 month survey time frame appeared to have little influence on estimates of food consumption amounts from the 1995 NNS, except for soft drinks. It is therefore possible that the 2007 ANCNPAS may have reported lower soft drink consumption than would have been found from a 12 month survey. The consumption of cordials was much lower in 2007 compared to 1995, when assessed against the 1995 NNS data collected over the same time frame or 12 months, indicating differences may be due to a change in food consumption patterns and not seasonal effects. The survey time frame did not appear to have an important influence on estimates of population nutrient intakes or dietary exposure to other food chemicals.

#### Conclusion

The 2007 ANCNPAS data are considered appropriate for use in FSANZ risk assessments, keeping in mind potential limitations for food chemicals found in soft drinks and other foods that may be seasonally consumed.

#### Source of funding

Department of Health and Ageing

### Prediction of body composition of Aboriginal and Torres Strait Islander Australians by bioimpedance spectroscopy

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#### Background

Bioelectrical impedance analysis (BIA) is a popular technique for the assessment of body composition, since the equipment is non-invasive, highly portable and inexpensive, but requires validation in different populations. Bioimpedance spectroscopy (BIS) is a variant of the BIA technique having the same practical advantages but purported to be less susceptible to population specificity.

#### Objective

To validate BIS-predictions of body composition against those provided by dual-energy X-ray absorptiometry (DXA) in an Aboriginal (A) and Torres Strait Islander (TI) population.

#### Design

This sub-study of the eGFR Study was undertaken in Darwin and the Torres Strait Islands. Participants were healthy volunteers (80:53, F:M), aged 16 to 82 y with mean body mass index 31.8±6.4 (F) and 30.4±5.9 (M) kg/m<sup>2</sup> respectively and 38 were of A, 70 of TI and 25 A/TI descent. DXA analysis on Thursday Island was with an Hologic Delphi W instrument (n=85) and in Darwin with a Norland XR46 instrument (n=48) with data being converted to Hologic equivalent values. Whole-body (wrist-ankle) BIS measurement was undertaken with an Impedimed SFB7 BIS instrument and body composition predicted using mixture (Hanai) theory modelling with coefficients previously determined in an Australian but predominantly Caucasian population. Data were analysed using correlation and limits of agreement analysis.

#### Outcomes

Fat-free mass predicted by BIS was highly correlated (Pearson's  $r = 0.97$ ) with that measured by DXA. Agreement between the methods was high (Lin's concordance correlation  $r = 0.97$ ). BIS overestimated FFM by 0.21 kg (0.4%) with limits of agreement of -6.8 to 6.4 kg (-11.9 to 11%). A similar level of agreement between methods was observed for body fat. Neither ethnicity nor sex significantly affected agreement between the methods.

#### Conclusion

BIS is a convenient and suitable method for the assessment of body composition of the Australian Indigenous population.

#### Source of funding

NHMRC, SeaSwift, Cardiovascular Lipid Pfizer Award & Douglas and Lola Douglas Australian Academy of Science Award.



## Concurrent Session 6: Dietary Methodology

### Factors predicting retention to diet during a web-based 12-week lifestyle intervention

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#### Background

Retaining participants on diet programs without providing face-to-face support remains a challenge for lifestyle interventions. Web-based programs can reduce in-person contact with participants yet, relatively little is understood regarding how these programs can be most efficacious.

#### Objective

The aim of this study was to determine which factors predict self-reported retention to the dietary component of a web-based lifestyle program in order to inform improvements to future internet interventions.

#### Design

An interactive website was developed based on the CSIRO Total Wellbeing Diet (TWD). Overweight/obese Australian adults registered for the 12-week online trial and received unguided access to an interactive website ( $n = 7929$ ). 5152 registrants used the site with 413 (90.1% female) completing the evaluation survey. At registration, users provided demographics (sex, age, self-reported height and weight) and completed a series of behavioural items including body dissatisfaction, the proactive coping scale, and measures of perceived behavioural control and behavioural intention to stay on the diet. The evaluation survey measured perceived usefulness and ease of use of, and attitudes toward the website based on the Technology Acceptance Model. Regression was used to predict retention to the diet from demographic, behavioural and evaluation factors as well as the number of days that a user was still active on the site (membership length).

#### Outcomes

Participants reported staying on the TWD for an average of 6.86 weeks (SD = 4.20) and losing 4.12% (SD = 4.06) of their initial weight. Retention to the diet was associated with percentage weight lost over 12 weeks ( $r = 0.53$ ,  $P < 0.001$ ). Combined the factors accounted for 33.6% of the variance in retention to the diet. Attitudes toward the website ( $\beta = 0.19$ ,  $P < 0.01$ ), perceived behavioural control ( $\beta = 0.12$ ,  $P < 0.05$ ) and length of membership to the site ( $\beta = 0.40$ ,  $P < 0.001$ ) all positively predicted the duration that participants reported staying on the diet.

#### Conclusion

Increasing participants' confidence in staying on a dietary program could improve duration on the program. In an online intervention, appeal of the site may be particularly important for helping retain participants and maintaining dietary changes. Features of web-based interventions which retain participants needs further research.

#### Source of funding

Not applicable.

### Identifying premenopausal women with increased risk of low iron status using questionnaires

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#### Background

Premenopausal women are at increased risk of low iron status due to menstrual losses. Other blood losses such as blood donation and nose bleeds further increase risk, as do high levels of physical activity and low dietary iron intake. It may be possible to assess risk of low iron status using self-completed questionnaires.

#### Objective

To assess whether iron intake, blood loss and physical activity information recorded using questionnaires can identify premenopausal women who have increased risk of low iron status.

#### Design

A cross-sectional study was undertaken at Deakin University (Burwood). A short diet checklist, blood loss questionnaire and the Active Australia Survey were completed by premenopausal women ( $n=49$ , mean (SD) age=25.6 (5.4) years). Eighty percent ( $n=39$ ) of women who completed questionnaires also provided a fasting blood sample for analysis of serum ferritin, haemoglobin and serum transferrin receptor. Univariate linear regression and binary logistic regression analyses were performed.

#### Outcomes

Twenty-one percent of participants ( $n=8$ ) had low iron stores (serum ferritin  $< 15 \mu\text{g/L}$ ), 3% ( $n=1$ ) had anaemia (haemoglobin  $< 120 \text{g/L}$ ), and 8% ( $n=3$ ) had high transferrin receptor ( $> 4.4 \text{mg/L}$ ). Blood donation was inversely associated with serum ferritin ( $P=0.01$ ) and positively associated with serum transferrin receptor ( $P=0.03$ ). No other aspects of blood loss, diet or physical activity were associated with serum ferritin, haemoglobin, or transferrin receptor. Risk of low iron status (at least 1/3 abnormal biomarkers) was not able to be predicted when iron intake, blood loss and physical activity were considered together in a binary logistic regression model.

#### Conclusion

In this study, diet, blood loss and physical activity questionnaires did not predict low iron status in premenopausal women.

#### Source of funding

Funding provided by the Centre of Physical Activity and Nutrition (Deakin University), Australian Red Cross Blood Service and Meat and Livestock Australia



## Concurrent Session 7: Children

### Do New Zealand toddlers need iron-fortified foods to ensure their dietary iron requirements are met?

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#### Background

Adequate nutrition during toddlerhood is essential for optimal growth and development, yet biochemical data suggest that 12-24-month-old children are at risk of iron deficiency. Mathematical modelling combined with experimental interventions can provide strong evidence regarding the types of foods required to improve toddler iron status.

#### Objective

To determine the types of foods required to ensure adequate dietary iron intakes for 12-24-month-old New Zealand children.

#### Design

First, a 4-phase modelling approach based on linear and goal programming was used to identify foods required to improve toddler iron intakes. Subsequently, the efficacy of the identified foods for improving biochemical iron status in 225 healthy 12-20-month-old New Zealand children was tested in a 20-week randomised controlled trial.

#### Outcomes

Mathematical modelling indicated that only replacement of non-fortified cow milk with an iron-fortified toddler milk ensured adequate iron intakes. If no iron-fortified foods were allowed in the models, a recommendation for  $\geq 2$  servings/day of red meat was necessary although unlikely to provide more than 56% of recommended iron intakes. The randomised controlled trial that tested these recommendations (iron-fortified toddler milk or red meat compared with control (non-fortified milk)) resulted in a serum ferritin 68% higher in the iron-fortified toddler milk group ( $P < 0.001$ ) than in the control group. Serum ferritin was 29% higher in the red meat group ( $P = 0.033$ ) compared to the control group, because the red meat group maintained its concentration (10% increase;  $P = 0.241$ ) while the control group tended to decrease serum ferritin concentration (14% decrease;  $P = 0.063$ ).

#### Conclusion

Dietary iron recommendations are difficult to achieve using foods habitually consumed by New Zealand toddlers. An increased intake of red meat is satisfactory to maintain body iron stores. However, to achieve an increase in body iron stores during toddlerhood, as is currently recommended, it is necessary to consume iron-fortified milk in place of unmodified cow milk.

#### Source of funding

Supported by the Health Research Council of New Zealand, Meat and Livestock Australia, Meat and Wool New Zealand, and the University of Otago.

### Effects of fish oil supplementation on learning and behaviour in Indigenous children from remote community schools

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#### Background

Indigenous Australian children frequently have lower literacy and education outcomes than non-Indigenous children. They are also at risk for malnourishment, and Australian children generally are not consuming enough of the healthy food groups including omega-3 polyunsaturated fatty acids (n-3 PUFA). These are critical for healthy brain function and are therefore required for optimal learning and behaviour outcomes.

#### Objective

To investigate the effects of supplementation with fish oil on learning and behaviour outcomes in children from primarily Indigenous remote community schools. Preliminary outcomes are reported here.

#### Design

The study was a randomised controlled trial with one-way crossover. Children were provided with 6 small fish oil (providing 750mg long-chain n-3 PUFA/day) or placebo capsules at school each day for 2 school terms (20 weeks) and then switched to fish oil for a further 2 terms (20 weeks). Primary outcomes were reading and spelling on the Wide Range Achievement Test (WRAT) and Draw-A-Person (DAP): non-verbal assessment of cognitive development.

#### Outcomes

A total of 447 children were enrolled in the study by their parents; 417 were assessed at baseline, 318 at 20 weeks and 249 at 40 weeks. At 20 weeks, for those who took an average of 2 or more capsules (250mg n-3 PUFA)/day, there were no significant differences between the groups on reading or spelling but the treatment group showed significantly higher improvements on DAP ( $P = 0.022$ ). The placebo group showed a similar magnitude of improvement after switching to fish oil from weeks 20-40.

#### Conclusion

These children did not show improved reading or spelling with fish oil supplementation in contrast to previous studies in children with learning difficulties. However they did show improvements in a non-verbal test of cognitive development following fish oil supplementation. The lack of improvements in literacy outcomes could be due to a number of factors including poor school attendance, learning environment and learning support at home. This needs to be teased out in further studies; one such study is currently underway in four SA primary schools.

#### Source of funding

ARC-Linkage grant in partnership with Vifor Pharma.



## Concurrent Session 7: Children

### Changes in long chain omega-3 polyunsaturated fatty acids intake among 12-year old children during a five-year follow-up

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#### Background

Several studies reported Australian children to have low intakes of long chain omega-3 polyunsaturated fatty acids (LCn-3 PUFA). It is important to investigate whether there is an observed change in LCn-3 PUFA consumption over time among children and adolescents.

#### Objective

To assess changes in LCn-3 PUFA consumption among 12-year old Australian children during five years of follow-up.

#### Design

Data from participants of the Sydney Childhood Eye Study was used. Intake of LCn-3 PUFA [eicosapentaenoic acid (EPA), docosapentaenoic acid (DPA) and docosahexaenoic acid (DHA)] was assessed by a 120-item food frequency questionnaire (FFQ). Six hundred and thirty four children provided usable FFQ data at both baseline and five-year follow-up. Dietary intakes of the fatty acids were adjusted for energy intake by using the nutrient density model. Log transformation was used where data was not normally distributed.

#### Outcomes

Mean ( $\pm$ SD) intakes of total LCn-3 PUFA, EPA, DPA and DHA at 12 y were 297.47 ( $\pm$ 287.91) mg, 102.67 ( $\pm$ 114.75) mg, 63.43 ( $\pm$ 39.79) mg and 129.81 ( $\pm$ 146.68) mg, respectively and at 17 y were 346.95 ( $\pm$ 343) mg, 122.43 ( $\pm$ 138.21) mg, 63.21 ( $\pm$ 37.90) mg and 160.30 ( $\pm$ 178.11) mg, respectively. There was a significant increase in mean intake of total LCn-3 PUFA, EPA and DHA between children at 12 and 17 y after adjustment for energy intake ( $P < 0.05$ ). Median intakes were lower than mean intakes and there was a significant increase in median intake of total LCn-3 PUFA and DHA (after energy adjustment) from age 12 to 17 ( $P < 0.05$ ). In addition, 28% of children increased their fish and seafood intake by more than 0.5 serve (70 g) per week.

#### Conclusion

LCn-3 PUFA consumption, in particular DHA, increased from 12 to 17 y independent of energy intake. While some children increased their fish and seafood intake, the majority of children did not.

#### Source of funding

Sydney Childhood Eye Study was supported by National Health and Medical Research Council, Westmead Millennium Institute, Vision Co-operative Research Centre and the National Heart Foundation of Australia.

### The clustering of dietary, physical activity and sedentary behaviours among children aged 5-6 and 10-12 years

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#### Background

The clustering patterns of obesity-related behaviours and their associations with socio-demographic indicators and overweight and obesity are poorly understood, particularly in younger children.

#### Objective

To examine the clustering patterns of dietary, physical activity (PA) and sedentary behaviours in children, and their associations with socio-demographic characteristics and overweight and obesity.

#### Design

In this cross-sectional study, questionnaires were completed by parents of 362 children aged 5-6 years and 610 children aged 10-12 years from Greater Melbourne, Australia. Children wore accelerometers for up to seven days and children's height and weight were measured by trained researchers. K-medians cluster analysis was used to identify groups of younger and older children with shared dietary, PA and sedentary behavioural patterns. Chi-square ( $\chi^2$ ) tests assessed socio-demographic differences across clusters. Multiple linear and logistic regression models were used to examine associations between clusters and BMI z-score and overweight/obesity, respectively.

#### Outcomes

Three distinct clusters were identified and labelled as 'Most healthy', 'Energy-dense (ED) consumers who watch TV' and 'High sedentariness/low moderate-to-vigorous PA (MVPA)'. Older boys were more highly represented in the 'Most healthy' cluster and older girls in the 'High sedentariness/low MVPA' cluster ( $\chi^2 = 22.4$ ;  $p < 0.001$ ). Among both age-groups, significantly higher proportions of children with low educated mothers comprised the 'ED consumers who watch TV' cluster while significantly higher proportions of children with high educated mothers were found in the 'Most healthy' cluster, respectively (younger children:  $\chi^2 = 34.9$ ,  $p < 0.001$ ; older children:  $\chi^2 = 27.3$ ,  $p < 0.001$ ). No significant associations with BMI z-score or weight status were found after adjusting for gender, maternal education and clustering by school.

#### Conclusion

Identification of clustering of dietary, PA and sedentary behaviours in children, and across socio-demographic groups may help target public health initiatives to those most in need.

#### Source of funding

The Health, Eating and Play study (HEAPS) was funded by the Victorian Health Promotion Foundation.





## Concurrent Session 7: Children

### Impact of breakfast skipping on Australian children's nutrient intake

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#### Background

Breakfast is an important meal of the day and data on breakfast skipping among Australian children are lacking.

#### Objective

To determine if nutrient intake and anthropometric differences exist between Australian children classified according to breakfast and cereal consumption.

#### Design

Nutrient intake reported via 24-hour recalls and anthropometric measurements collected from the 2007 Australian National Children's Nutrition and Physical Activity Survey were analysed (n= 4487, 2-16y). Breakfast consumers were children who consumed an energy containing food or beverage between 0500h and 0930h and breakfast skippers as those who did not. Breakfast cereal included ready to eat, puffed grains muesli and oats. Breakfast consumers were subcategorised as breakfast cereal (BC) or non-cereal (NC) consumers. Daily energy, nutrient intake, likelihood to meet estimated average requirement (EAR) for fibre and calcium, Body Mass Index (BMI), waist circumference and physical activity measures were compared between groups.

#### Outcomes

The majority of children consumed breakfast (96%; n=4289). Breakfast skippers were older than consumers (12.8±0.3 y vs. 8.4±0.1 y, respectively, P<0.001) and there were more female skippers than males across all age groups. Breakfast skipping was prominent in the age group 14-16y with 68% and 54% of boys and girls, respectively. Over a third of children did not consume breakfast cereal for breakfast (34%). There were no differences in daily energy intake, BMI or waist circumference across all groups. Breakfast skippers had lower calcium and folate and higher total fat intakes than breakfast consumers (P<0.01). Breakfast consumers (BC and NC consumers) were 5.5 and 3.3 times more likely to meet the EAR for calcium and fibre, respectively than skippers (P<0.0001). BC consumers had a higher intake of fibre, calcium, folate, carbohydrate and sugar and lower intake of total fat than NC breakfast consumers (P<0.01). BC consumers were 3.0 and 1.6 times more likely to meet the EAR for calcium and fibre, respectively than NC breakfast consumers (P<0.001).

#### Conclusion

Breakfast skipping is uncommon in Australian children. Those who consumed breakfast had a better nutrient profile than skippers and breakfast cereal consumers had higher nutrient intake than non-cereal consumers.

#### Source of funding

Research grant from Cereal Partners Worldwide.

### Infant and young child feeding during Queensland's summer of disasters: challenges and outcomes

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#### Background

Infants and young children are nutritionally vulnerable during emergencies and natural disasters whether families are evacuated or remain in their homes. Disruption to the mother/infant breastfeeding dyad and lack of safe appropriate foods and fluids can have profound consequences for infant wellbeing.

#### Objective

This research following Queensland's "summer of disasters" in 2010/11 sought to identify predictors of infant morbidity amongst environmental, social and nutritional risk factors associated with natural disaster in a resource rich country. It aims to enhance knowledge of infant and young child feeding in emergency (IYCFE).

#### Design

This retrospective cohort study used a single online questionnaire to investigate feeding issues and challenges and associated infant morbidity amongst affected Queensland infants aged less than 24 months. Degree of dislocation and disruption during the emergency was investigated including access to services and effects on feeding practice, nutrition and related morbidity. Infant visits to medical practitioners, hospital admission and a panel of symptoms were used as outcome measures.

#### Outcomes

Lack of infrastructure for safe preparation of appropriate infant foods and fluids predicted infant hospitalisation (p=0.019), while disruption to breastfeeding practice during weather-related family dislocation predicted visits to medical practitioner (p=0.000) in this cohort (n=137). Infants aged over 6 months suffered more fever ( $\chi^2=5.21$ , p=0.022), runny nose/cold ( $\chi^2=9.10$ , p=0.003), and cough/wheeze ( $\chi^2=8.15$ , p=0.004) after the event than those aged less than 6 months. Infants exclusively breastfed at the event were less likely to visit a doctor ( $\chi^2=10.07$ , p=0.002) than those receiving no or non-exclusive breastfeeding.

#### Conclusion

In spite of the small number of participants, this research suggests that there are challenges in providing safe nutrition and hydration to infants and young children during emergency and natural disaster even in resource rich environments, and that these challenges may be associated with infant morbidity. Recommendations for IYCFE policy are discussed. Specific evidence-based policy in IYCFE will enhance community resilience in Australia and may save infant lives.

#### Source of funding

RN is supported by an Australian Postgraduate Award.



## Concurrent Session 8: Metabolic Syndrome

### Effects of pistachios and walnuts on hemodynamic reactivity to stress: Clinical trials in adults with dyslipidemia

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#### Background

Observational studies show that habitual nut consumers are at lower risk of cardiovascular (CV) disease. Improvements in lipids and lipoproteins are one contributor to cardioprotective effects of nuts. Fewer studies have examined effects of nuts on blood pressure and peripheral vascular constriction.

#### Objective

We have conducted 2 randomized, controlled clinical trials to examine the effects of walnuts and pistachios on vascular endothelial function and CV response to acute stress in the laboratory.

#### Design

Each of these studies used a randomized, crossover, controlled-feeding design, and adults with elevated LDL cholesterol were enrolled. Treatment periods ranged from 4-6 weeks and all meals were provided. In the walnut study, the typical participant ate 37 g/d of walnuts and 15 g/d of walnut oil and a typical western diet served as the control. In the pistachio study, a low fat diet was compared to moderate fat diets containing 1-2 servings/d of pistachios. At the end of each diet, cardiovascular parameters were measured after a rest period and during brief, standardized stress tasks in the laboratory (cold pressor, mental arithmetic, simulated public speaking).

#### Outcomes

Diets containing nuts produced substantial changes in the pattern and magnitude of hemodynamic responses to acute stress. The diets containing walnuts/walnut oil significantly reduced diastolic blood pressure and peripheral vascular constriction at rest and during stress. In the pistachio study, systolic blood pressure reductions were greatest with 1 serving/d per day vs. 2 servings/d (-4.7 vs -2.4 mmHg). In contrast, the diet containing 2 servings/d of pistachios had the largest effect on peripheral vascular constriction.

#### Conclusion

Taken together, these studies show that hemodynamic load is modifiable by changes in fatty acid intake. Although reductions in blood pressure were modest in magnitude, nuts also had substantial, beneficial effects on the lipid profile and peripheral vascular resistance. The nut diets did not affect vascular endothelial function.

#### Source of funding

Supported by the Western Pistachio Association (now American Pistachio Growers), the California Walnut Commission, and US-NIH grant M01RR10732

### Effect of diet choice on weight loss in people with type 2 diabetes

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#### Background

Obese individuals have low adherence and high attrition rates in clinical weight loss diets studies. Choice in the type of diet offered may be a strategy to improve adherence and attrition.

#### Objective

This study aims to investigate the impact of dietary choice on adherence and attrition rates over a 12 week period.

#### Design

130 overweight or obese (BMI >27 kg/m<sup>2</sup>) adults aged 40 - 75 years with type 2 diabetes or pre-diabetes completed the 12-week study. Participants were randomized 1:1 to either *no choice* group (participants placed on the CSIRO Diet) or *choice* group (participants able to choose between the CSIRO Diet, the Mediterranean Diet or the South Beach Diet and to change diets if need be). Primary end points were change in weight, glucose and HbA<sub>1c</sub> and secondary end points were changes in lipids and blood pressure.

#### Outcomes

There were no difference in attrition rates or weight loss between groups (4.3% *no choice* vs 2.9% *choice*; 4.9 kg *no choice* vs 5.1 kg *choice*). No volunteers chose to change their diet. There was a gender diet interaction ( $P=0.03$ ): females in *choice* lost more weight compared to females in *no choice*, whereas males in the *no choice* lost more weight than males in the *choice*. Those participants with an HbA<sub>1c</sub> of <6.8% lost 0.6-1% more weight than those with a higher HbA<sub>1c</sub>. HbA<sub>1c</sub> (0.6%,  $P<0.001$ ) and triglycerides ( $P<0.05$ ) were reduced with no significant differences between groups.

#### Conclusion

Participants assigned a choice in diet did not have greater weight loss or lower attrition rates. The gender differences need further exploration. HbA<sub>1c</sub> changes can be large even with modest weight loss.

#### Source of funding

Not applicable.



## Concurrent Session 8: Metabolic Syndrome

### Short term effects of fish and fish oil consumption on total and high molecular weight adiponectin levels in overweight adults

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#### Background

Fish or fish oil consumption may increase levels of total and high molecular weight (HMW) adiponectin, a hormone associated with anti-inflammatory and insulin-sensitising effects, however it is not known if the effects of the food and supplement are the same.

#### Objective

The objective of this study was to compare the impact of consumption of fish and fish oil supplements (providing the same amount of long chain omega-3 polyunsaturated fatty acids [LC n-3 PUFA]) on total and HMW adiponectin.

#### Design

29 overweight participants underwent a two week run-in period, followed by a four week isocaloric dietary intervention which provided 1.8g of LC n-3 PUFA in the form of either fish or fish oil supplements. Primary outcomes were changes in plasma total and HMW adiponectin. Secondary outcomes were changes in anthropometric variables, plasma insulin and glucose levels, and dietary intakes.

#### Outcomes

Changes in plasma HMW adiponectin during the intervention period were significantly different between groups ( $p=0.009$ ). Mean HMW adiponectin increased by 0.29ug/mL in the 'fish' group and decreased by 0.58ug/mL in the 'supplement' group. Similar trends were seen for total adiponectin however these did not reach statistical significance. There were no significant changes in other anthropometric and biochemical variables. Dietary data suggested the 'fish' group significantly increased their fish ( $p=0.001$ ) and dietary LC n-3 PUFA ( $p=0.001$ ) consumption over the course of the study.

#### Conclusion

Short-term consumption of fish and fish oil supplements did not have the same effects on HMW adiponectin levels. The impact of fish intake on HMW adiponectin levels may not be mediated by its LC n-3 PUFA content alone.

#### Source of funding

Small Grants Scheme, Smart Foods Centre and Food and Health Strategic Research Initiative, University of Wollongong. Fish products were provided by Simplot Australia. Fish oil supplements were provided by Blackmores Australia.

### A multiethnic study on leptin concentrations in patients with type 2 diabetes mellitus and its relation with anthropometric measures

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#### Background

Leptin was found to play a role in insulin sensitivity and insulin resistance. However, limited studies have evaluated ethnic variation on plasma leptin levels among multi-ethnic type 2 diabetic subjects in Malaysia.

#### Objectives

To investigate ethnic differences on leptin concentrations in Malay, Chinese and Indian patients with type 2 diabetes and its association with anthropometric measurements.

#### Design

A cross-sectional survey was carried out in 305 patients with type 2 diabetes aged 19-75 years from the Penang General Hospital, Malaysia. The questionnaire items included respondents' medical history and demographic information. Anthropometry measurements included weight, height, waist circumference, hip circumference, waist-to-hip ratio and body composition. Blood samples were drawn and plasma leptin concentrations were measured using a commercial ELISA kit. Data was analysed using one-way ANOVA, linear regression and general linear model ANCOVA.

#### Outcomes

Leptin concentrations were significant higher in Malays (adjusted mean [95%CI]: 23.60 [18.87, 28.33] ng/mL) and Indians (22.93 [19.03, 26.83] ng/mL) than in Chinese (17.40ng/mL [14.98, 19.81] ng/mL). A significant sex by ethnic origin interaction with plasma leptin was present ( $P=0.012$ ), as Malay women had significant highest leptin concentrations than the Indian and Chinese women, whereas no significant differences were observed among men. Women had significantly higher leptin concentrations ( $28.23 \pm 18.29$  ng/mL) than men ( $12.86 \pm 12.15$  ng/mL). Leptin concentrations showed a positive correlation with body mass index, body fat and waist-to-hip ratio. According to multiple linear regression model, 45.2% of the variation in leptin concentrations is explained by sex, body fat and BMI.

#### Conclusion

This study concluded that leptin levels were closely related to anthropometric variables. Hyperleptinemia in Malays may be associated with leptin resistance and variability of leptin gene. Future studies may investigate leptin gene polymorphisms in this population.

#### Source of funding

Supported by the Universiti Sains Malaysia Research University Postgraduate Research Grant Scheme.



## Concurrent Session 8: Metabolic Syndrome

### The association of waist to height ratio and cardiometabolic risk factors in adolescence

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#### Background

Obesity in children is associated with cardiometabolic risk which continues into adulthood. Waist to height ratio (WHtR) in adults may be more closely associated with cardiometabolic risk than body mass index (BMI); however there is a paucity of information in children.

#### Objective

To examine the associations between WHtR and BMI, in childhood and adolescence and cardiometabolic risk factors in adolescence.

#### Design

The Avon Longitudinal Study of Parents and Children (ALSPAC) is a large, longitudinal population-based cohort from Bristol, UK. This study used ALSPAC data from 2858 adolescents aged 15 yr and from 2708 of these participants as children aged 7-9 yr. Height, weight and waist circumference were measured at both time points and used to calculate WHtR and BMI. Fasting glucose, insulin and lipids and blood pressure were measured at age 15 yr. Overweight/obese was defined using International Obesity TaskForce criteria for BMI and a cut-point of  $\geq 0.5$  was used to define high WHtR. Logistic regression was used to examine the associations.

#### Outcomes

In adolescents with a WHtR  $\geq 0.5$ , the odds ratio for three or more cardiometabolic risk factors was 6.9 [95% CI: 4.5-10.8] in males and 3.8 [2.3-6.3] in females ( $P < 0.001$ ). This association was also present prospectively in males: male children with a WHtR  $\geq 0.5$  were 4.3 times more likely to have three or more risk factors [2.4-7.6] ( $P < 0.001$ ). This association was not significant in female children (OR=1.5 [0.6-3.6],  $P = 0.037$ ). The magnitudes of the associations were similar when BMI was used.

#### Conclusion

WHtR  $\geq 0.5$  and overweight/obesity are associated with increased odds of multiple cardiometabolic risk factors cross-sectionally in adolescents and prospectively in male children. WHtR may be a simple alternative to BMI without the need for reference charts, lending itself to the public health message: "keep your waist circumference to less than half your height".

#### Source of funding

SPG is supported by a Cancer Institute NSW Early Career Research Development Fellowship

### Food label education does not reduce sodium intake in people with type 2 diabetes mellitus: a randomised controlled trial

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#### Background

Hypertension is highly prevalent in people with type 2 diabetes (T2DM) and is a risk factor for cardiovascular disease. Dietary sodium intake is above the recommended level in people with T2DM. Modest dietary sodium restriction has been shown to have a blood pressure lowering effect.

#### Objective

To investigate whether urinary sodium excretion can be reduced by educating people with T2DM to read the nutrition information panel (NIP) to determine the sodium content.

#### Design

In a three month randomised controlled trial, 78 adults (49 men, 29 women) with T2DM were recruited from a Diabetes Centre at a tertiary hospital in Adelaide, South Australia. The intervention group was educated in a single session (10-15 minutes) to read the NIP to determine the sodium content. Participants were instructed to choose products which complied with the Food Standards Australia New Zealand guideline of  $< 120\text{mg}$  sodium/100g food. The control group continued on their usual diet. Outcome measurements were performed at baseline and 3 months. The primary measure was 24 hour urinary sodium excretion. Secondary outcomes were systolic and diastolic blood pressure and urinary aldosterone excretion. Data was analysed using repeated measures analysis of variance.

#### Outcomes

At 3 months mean urinary sodium excretion was unchanged in the intervention ( $174 \pm 71$  mmol/24 hours and  $175 \pm 72$  mmol/24 hours) and control group ( $167 \pm 86$  mmol/24 hours and  $161 \pm 74$  mmol/24 hours), and there was no between group difference ( $P > 0.05$ ). There was no change in systolic and diastolic blood pressure or urinary aldosterone excretion.

#### Conclusion

Sodium excretion was not reduced following the label reading education provided to this group of people with T2DM.

#### Source of funding

Supported by a grant from the Division of Health Sciences, University of South Australia.



## Concurrent Session 9: Food Behaviour

### Vegetable size as a way of increasing children's vegetable consumption

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#### Background

The size of snack foods has been shown to influence intake, but it remains unknown if this concept applies to children's vegetable consumption.

#### Objective

The present study investigated if increasing the size of carrots will increase children's carrot intake.

#### Design

In a cross-over randomized design, 41 children (19 girls, 22 boys,  $8.5 \pm 1.6$  years) were offered  $500 \pm 60.9$ g of small, and large carrots to consume ad libitum for 10 minutes during two separate sessions at their school, separated by one week. Parents filled out questionnaires about their children's vegetable consumption at home.

#### Outcomes

Children consumed 22% more of the large ( $86.4 \pm 59.6$ g), than of the small pieces of carrots ( $70.4 \pm 49.2$ g,  $P = 0.04$ ), which was associated with a higher pace of eating of the large ( $0.21 \pm 0.11$ g / second) compared to the small carrots ( $0.17 \pm 0.09$ g / second). At home, the more often children were presented with small vegetables the less frequently they consumed vegetables ( $r = -0.33$ ,  $P = 0.001$ ), the more children were presented with medium ( $r = 0.27$ ,  $P = 0.008$ ) or large vegetables ( $r = 0.29$ ,  $P = 0.005$ ) the more frequently they consumed vegetables at home. Taste liking of the carrots did not change during consumption.

#### Conclusion

Offering large rather than small sized vegetables might be a viable way to increase children's vegetable consumption.

#### Source of funding

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### Effect of vegetable texture on the effort of eating using surface electromyography in children

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#### Background

Children are not consuming adequate amounts of vegetables. The effort involved in chewing corresponds with the muscle activation produced by the masseter muscle when the food is consumed, which can be reliably measured using surface electromyography (EMG).

#### Objective

To investigate the association between effort of eating, vegetable texture, and vegetable consumption, and to examine the test-retest reliability of the maximum voluntary contraction non-normalized and normalized scores using surface electromyography of the masseter muscle of children.

#### Design

Eleven children (6 males, 6-12 yrs), attended two test sessions in a randomised cross-over design. Surface EMG measures, liking and ad libitum intake (g) were assessed for whole and grated carrots over the two days. These measures were obtained from the masseter muscle of both the left and right masseter muscles by bipolar surface electrodes.

#### Outcomes

The correlation between first and second measure of SEMG was significant  $r=0.96$  ( $P<0.001$ ). Whole carrots required a greater effort than eating grated carrots per gram of carrot consumed ( $P<0.05$ ). However, no difference in total effort or duration of carrot consumption during the ad libitum intake was observed between grated and whole carrots.

#### Conclusion

SEMG is a reliable measure for contraction of the masseter muscle and a promising tool to measure eating effort in children. The masseter muscle contraction seems to have little influence on children's duration of eating vegetables.

#### Source of funding

C-PAN, Deakin University.



## Concurrent Session 9: Food Behaviour

### Sensory characteristics of Australian children's reported diets (Australian National Children's Nutrition and Physical Activity Survey 2007) and implications for nutrient and weight status

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#### Background

Liking (hedonics) of food tends to drive dietary choice particularly amongst children. "Taste" is often reported to be the main driver of liking, suggesting that sensory characteristics may drive food intake, which in turn influence nutritional and health outcomes, including weight status. Past research adopted a diversity of sub-optimal methods whilst concluding that there is limited evidence for relationships between sensory characteristics and/or the hedonics of food and weight status. However an absence of evidence is not evidence of absence. There is a need for further research.

#### Objective

To augment the Australian National Children's Nutrition and Physical Activity Survey 2007 (ANCNAPAS 2007) food intake database with sensory characteristics. To seek relationships between sensory characteristics of foods reported and nutrient and weight status and to determine if there are systematic differences between normal weight and overweight/obese children's diets.

#### Design

Frequency of consumption identified foods as characteristic of the reported diet. A trained sensory panel (n=10) characterized foods for 5 basic tastes, fatty mouthfeel, 3 textures and flavour impact (using 100 mm scales). Following criteria, these representative foods were applied to foods consumed across the whole database.

#### Outcomes

In total 212 foods (with 17 repeats for quality control) were characterised. Overall, the dietary taste profile ( $\Sigma$  scores), based on ratings of the representative foods, can be characterized as: 39% sweet; 25.7% salt; 14.3% sour; 13.7% umami and 7.3% bitter. The 10 sensory characteristics were applied to foods in the ANCNAPAS 2007 database.

#### Conclusion

The augmented database creates a tool that allows for numerous questions to be answered, including the primary aim of seeking weight status differences and, also, relationships with socio-demographics, nutrient intake, energy density, and core versus non-core foods. Answers may allow for targeted food interventions based on sensory drivers of dietary patterns.

#### Source of funding

CSIRO Preventative Health Flagship, Obesity Theme.

### Fatty food preferences in monozygotic and dizygotic twin pairs

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#### Background

High fat foods are universally liked and consumed however consumption varies between individuals suggesting genotype may influence fat preference. While some studies suggest fat preference may be moderately heritable, the environment also plays a highly prevalent role, especially in the context of fatty foods which are actively promoted and highly accessible.

#### Objective

The objective of the study was to explore the influence of genetic and environmental factors on fatty food preference by using a twin pairs design.

#### Design

Monozygotic (MZ; n=42) and dizygotic (DZ; n=19) twin pairs aged 12-68 years were recruited from the 2012 Twins Plus Festival, a national convention of twins. Twin pairs were asked to taste a 20g sample of no fat (NF; 0%) and high fat (HF; 15%) chocolate custard and indicate preference using a 9-point hedonic scale (1=dislike extremely, 9=like extremely). All participants were asked to indicate with a 'yes' or 'no' response whether a perceivable difference between samples was evident. Self-reported height and weight was also collected to determine body mass index.

#### Outcomes

Ninety two percent of participants (n=56) indicated they could perceive a difference between high and low fat custard samples. However, fatty food preference did not differ significantly between zygosity (DZ twins: HF liking=5.41  $\pm$  2.18, LF liking=6.36  $\pm$  1.4; MZ twins: HF liking=6.62  $\pm$  1.81, LF liking=6.08  $\pm$  1.93; P>0.05).

#### Conclusion

This study suggests preferences for fatty foods maybe largely influenced by environmental factors, as opposed to genetic factors.

#### Source of funding

Not applicable.



## Concurrent Session 9: Food Behaviour

### Preparation of decaffeinated green tea from underutilised old tea leaves using hot water

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#### Background

Although known as a rich source of the strong health-promoting antioxidants, the catechins, green tea also contains high levels of caffeine. Being a central nervous system stimulant, caffeine can cause negative effects in some people and this has led to demand for decaffeinated green tea. Only the apical bud and the top four leaves are normally used to make high quality green teas, while the older lower leaves (fifth to tenth down the stems) are cut and used for mulch.

#### Objective

To determine whether hot water could be used to remove caffeine from freshly-picked old leaves to make decaffeinated green tea.

#### Design

To determine the optimal conditions for decaffeination using hot water, freshly-picked old green tea leaves were blanched in water for 5 to 25 min at 100°C and a water-to-tea ratio of 20:1mL/g, respectively. The blanched tea leaves were then removed from the solution and heated at 80°C for 4h in a drying oven to obtain dried green tea. The catechin and caffeine content of the dried green tea was determined by HPLC and compared with a dried green tea made from freshly-picked but unblanched old tea leaves dried at 80°C for 4h in a drying oven.

#### Outcomes

The results showed that using hot water was an effective method to remove caffeine. Blanching the underutilised old tea leaves for 10min at 100°C and a water-to-tea ratio of 20:1mL/g removed 80% of the caffeine while retaining 85% of the catechins. In a scaled up production process, a 100 kg of underutilised old tea leaves could be expected to yield approximately 44 kg of decaffeinated green tea with a moisture content of less than 3.5%, a catechin level of 4.7% (w/w) and a caffeine level of less than 0.15% (w/w).

#### Conclusions

The optimal conditions for decaffeinating the underutilised old tea leaves using water were 100°C for 10min and a ratio of water-to-tea of 20:1mL/g. In this way, a dried green tea high in the strong health-promoting antioxidants, the catechins, but low in caffeine could be prepared from older lower leaves (fifth to tenth down the stems).

#### Source of funding

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