The 9th AHKDN Annual Symposium

Nutrition Management of Diabetic Kidney Disease

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17 June 2017

Diabetes mellitus & chronic kidney disease

* 49.6% patients entering renal replacement therapy due to diabetes mellitus (Kidney International Supplement, 2015, 33-38)
* 5 years survival rate
  * Transplant: 89.6%
  * Peritoneal dialysis: 50.7%
  * Hemodialysis: 55.7% (Hong Kong Journal of Nephrology, 2013, 28–43)

⇨ Slow progression of chronic kidney disease

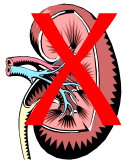
Chronic kidney diseases

Risk factors for kidney disease progression

* Diabetes Mellitus
* Hypertension
* Hyperlipidemia
* Proteinuria
* Obesity
* Smoking
* Male
* Family history of kidney diseases (e.g. polycystic kidney)

Chronic kidney diseases

- Excretion of metabolic waste products, water, electrolytes, inorganic ions, foreign chemicals, …
- Production of erythropoietin, 1,25-dihydroxyvitamin D, renin-angiotensin
- Acid-base control



- Uremic, edema, hyperkalemia, hyperphosphatemia,…
- Anemia
- Mineral & bone disorders
- High blood pressure
- Metabolic acidosis

Goals of nutritional management

* Slow the progression of CKD through
  * Optimization of glycemic, serum lipids, proteinuria & blood pressure control
  * Achieving a healthy body weight
* Provision of a nutritionally adequate, palatable & attractive diet
* Prevention of protein-energy malnutrition
* Control of edema & serum electrolytes
* Management of hyperphosphatemia & anemia

Nutritional assessment

* Anthropometrics

  Body weight (? dry, usual), body height, BMI, desirable/adjusted body weight, weight change, body composition, …

* Biochemical

  RFT, LFT, Ca, PO4, urate, eGFR, 24-hour urine protein, lipids, A1C, glucose, Hb, PTH, iron status, WBC, ESR, CRP,…

* Clinical
  * Diagnosis, medical history, medication, urine output, blood pressure
  * Stage of CKD (I - V)

* Dietary

  Current/usual dietary intake, estimated nutrient intake & requirement, activity level, GI problems, ADL dependency, social history, …

No star fruit



* Limb numbness
* Muscle weakness
* Intractable hiccups
* Consciousness disturbance
* Seizure
* Death

(Chang et al, Am J Kidney Dis, 2000, 189-93)

Protein

* ⇩ Accumulation of metabolic waste products (Suppress appetite & stimulate muscle protein wasting)
* Slow down progression of CKD (Controversial)

K/DOQI Nutrition Guideline 2000

* 0.6-0.75 g/kg/day (At least 50% dietary protein is high biological value) in adults with GFR < 25 ml/min/1.73m^2

KDIGO CKD Guideline 2012

* Avoid > 1.3 g/kg/day in adults with CKD at risk of progression
* 0.8 g/kg/day in adults with GFR < 30 ml/min/1.73m^2

High biological value = Contain all essential amino acids

* Essential amino acids
  * Leucine, Isoleucine, Valine, Lysine, Threonine, Methionine, Phenylalanine, Tryptophan, Histidine
  * Cannot synthesize in adequate amount ⇨ Obtain from diet
* Non-essential amino acids
  * Cysteine, Tyrosine, Glycine, Arginine, Proline, Glutamic acid, aspartic acid, Serine, Alanine

Protein

1 exchange high biological value protein = 7g protein

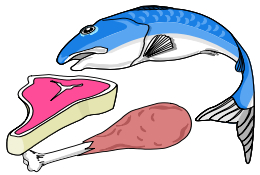
* Pork, beef, lamb, poultry, fish, seafood, milk, dairy products, egg, soy products

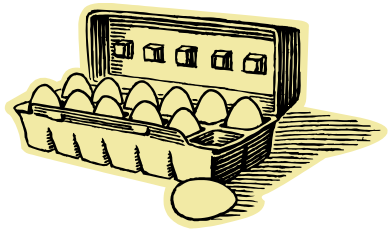
1 exchange low biological value protein = 2g protein

* Starchy food

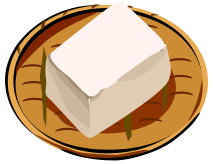
1 exchange high biological value protein







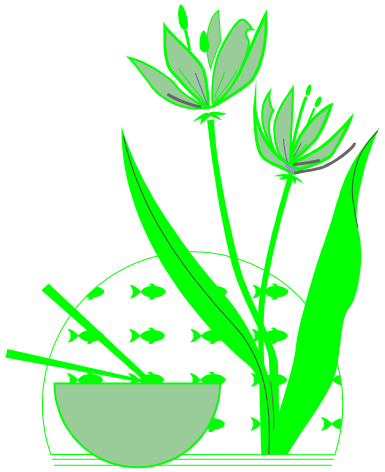




* 1 ounce cooked pork/ beef/ lamb/ poultry/ fish
* 1/3 chicken leg
* 1 slice ham
* 4 pieces prawn/ scallop (medium)
* 1 egg
* 2 egg white
* 1½ slices cheese
* 150ml yogurt
* ⅓ piece bean curd
* 4 level tablespoons cooked soy bean
* 1 piece soy bean stick (20cm long)
* 250ml milk/ soy milk

1 exchange low biological value protein

* ½ bowl rice/noodle
* 1 bowl congee
* 1 slice bread
* 4 pieces cream/soda crackers



Energy

* To spare protein for tissue protein synthesis
* To attain or maintain ideal body weight
  - ☒Underweight
  - ☒Overweight
* K/DOQI Nutrition Guideline 2000: 30-35 kcal/kg/day
* Sources of energy
  - Protein: 4 kcal/g
  - Carbohydrate: 4 kcal/g
  - Fat: 9 kcal/g

Fat

* Good energy source
* Taste of food



Overweight

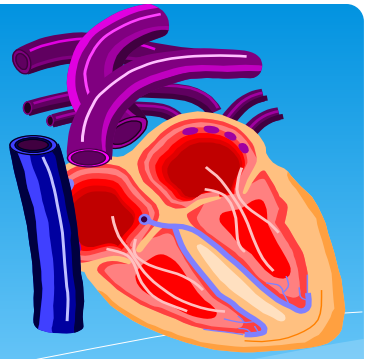


Underweight

Poor oral intake



Fat



For the management of hyperlipidemia

* 5-6% energy from saturated fat
* ⇩ trans fat

(2013 AHA/ACC guideline on lifestyle management to reduce cardiovascular risk)

Food high in saturated & trans fat





Control carbohydrate portion ⇨ DM control

* Moderate carbohydrate intake (depend on individual need & glycemic control)
* Small, frequent & regular meals
* Follow prescribed meal plan





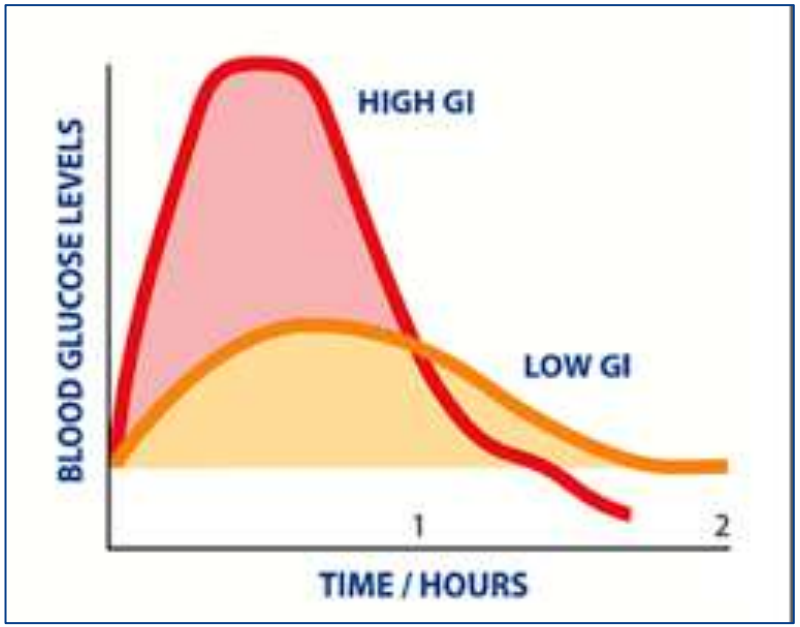






Glycemic Index

Value assigned to foods based on how slowly or how quickly those foods cause increases in blood glucose levels



Food	GI*	Food	GI*
White bread	75	Whole wheat bread	69
White bagel	72	50% cracked wheat kernel bread	58
Cornflakes	81	Oatmeal	55
Instant oatmeal	79	All-Bran	44
White rice	72	Quinoa	53
Quick cooking white basmati	63	Brown rice	50
Spaghetti, white	46	Spaghetti, whole-grain	42
Chickpeas, canned	42	Soy beans	15
Baked beans	40	Chickpeas	10
Kidney beans	34	Cashews	22
Black beans	30	Peanuts	13
Boiled white potato	82	Green peas	54
Sweet potato	70	Carrots	39

*Glucose = 100

(http://www.health.harvard.edu/diseases-and-conditions/glycemic-index-and-glycemic-load-for-100-foods)

FOOD	GI*	FOOD	GI*
Watermelon	72	Peach	42
Raisins	64	Oranges	45
Black grapes	59	Pear	38
Peach, canned	52	Apple	36
Banana	48	Prunes	29
Reduced-fat fruit yogurt	33	Full fat/ skim milk	31
Lucozade®	95	Apple juice, unsweetened	41
Fanta®	68	Tomato juice, no sugar added	38
Pretzels	83	Potato chips	56
Vanilla wafers	77	Sponge cake, plain	46
Graham/soda crackers	74	Corn chips, plain	42
Shortbread/rye crisps	64	Pizza, Super Supreme	36
Ice cream, regular	62	M & M's®, peanut	33

*Glucose = 100

(http://www.health.harvard.edu/diseases-and-conditions/glycemic-index-and-glycemic-load-for-100-foods)

Limit intake of food high in sugar in case of

* Diabetes Mellitus
* Overweight
* Hypertriglyceridemia





Fibre



* Relieve constipation
* Control serum lipids & glucose
* Recommendation: 25–30 g/day
* Choose high fibre bread/ cereals/ grains, dried beans & nuts
* Adequate intake of fruits & vegetables

Sodium

Excessive intake

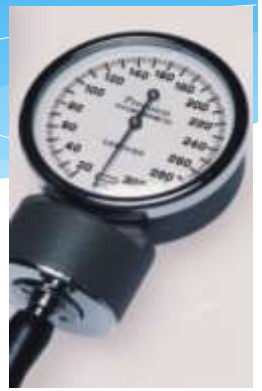
⇨ Proteinuria

⇨ Hypertension

⇨ Edema

⇨ ⇩ anti-proteinuric effect of ACE inhibitors







Sodium



≤ 2000 mg/day

(5g salt, ~1 teaspoon)

Unless contraindicated (e.g. salt losing nephropathies)

How much sodium in 1 salted egg?



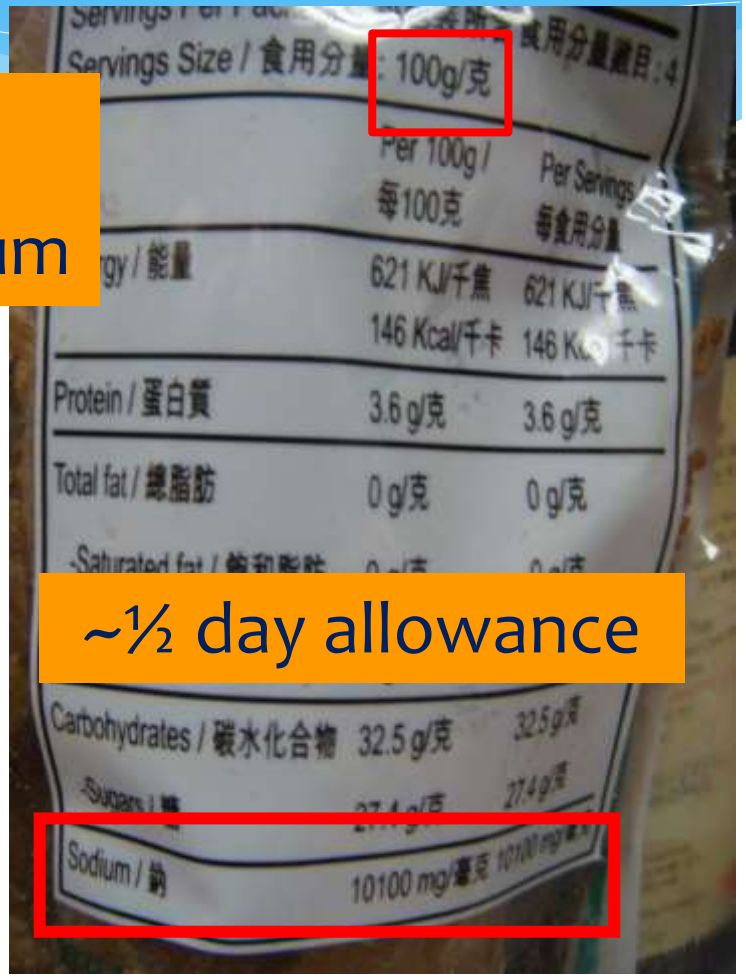


How much sodium in 1 tablespoon preserved vegetable?

100g = 10100mg sodium

1 tablespoon (10g) = 1010mg sodium



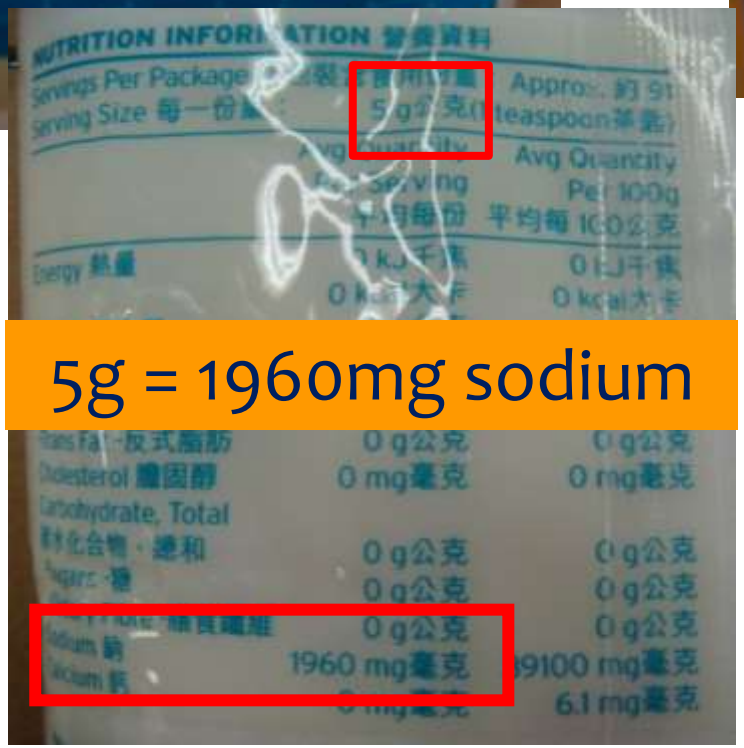


~½ day allowance

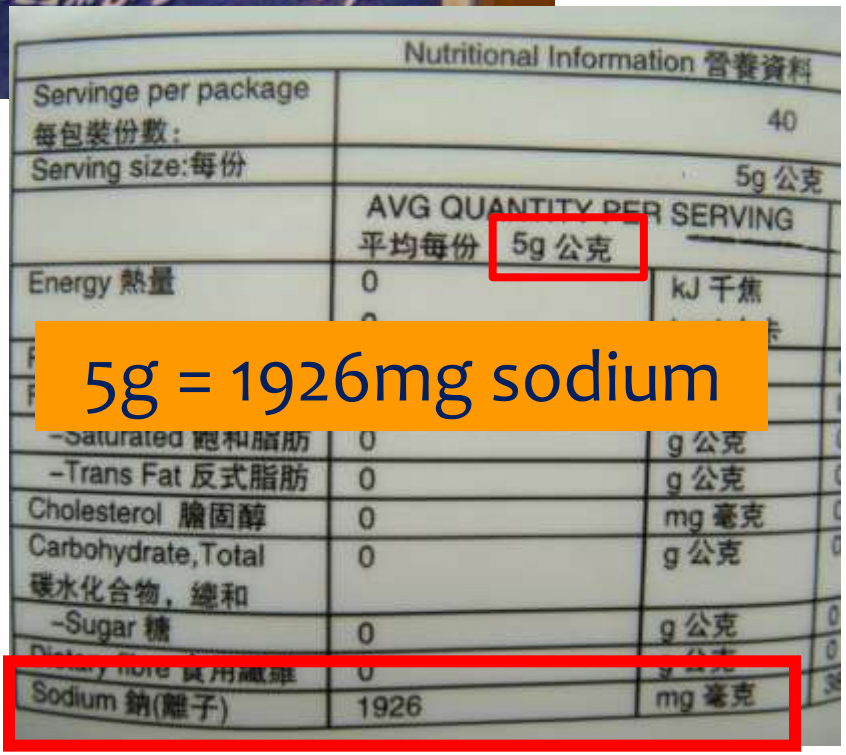




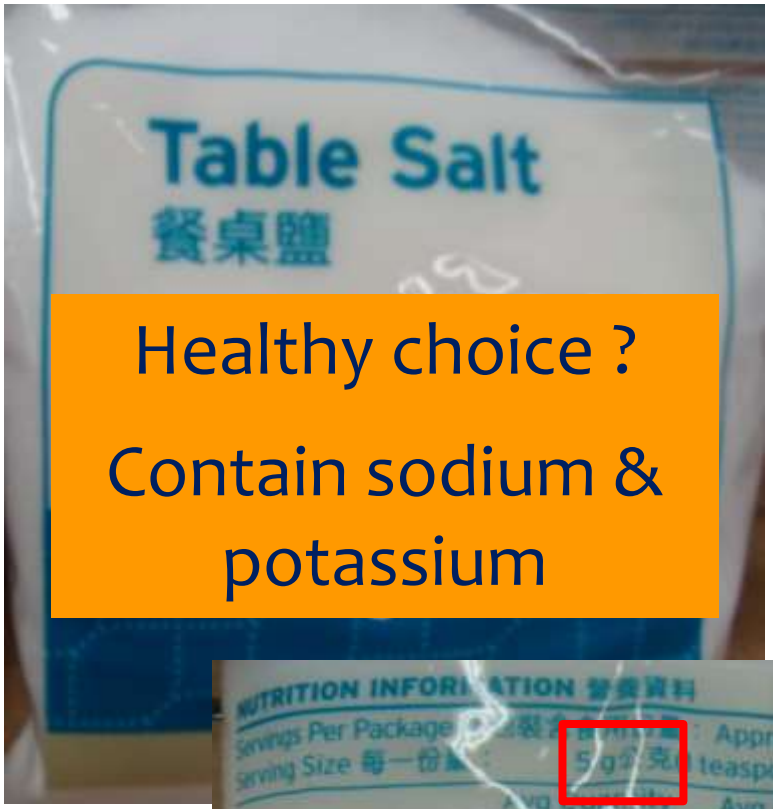
Similar sodium content



5g = 1960mg sodium

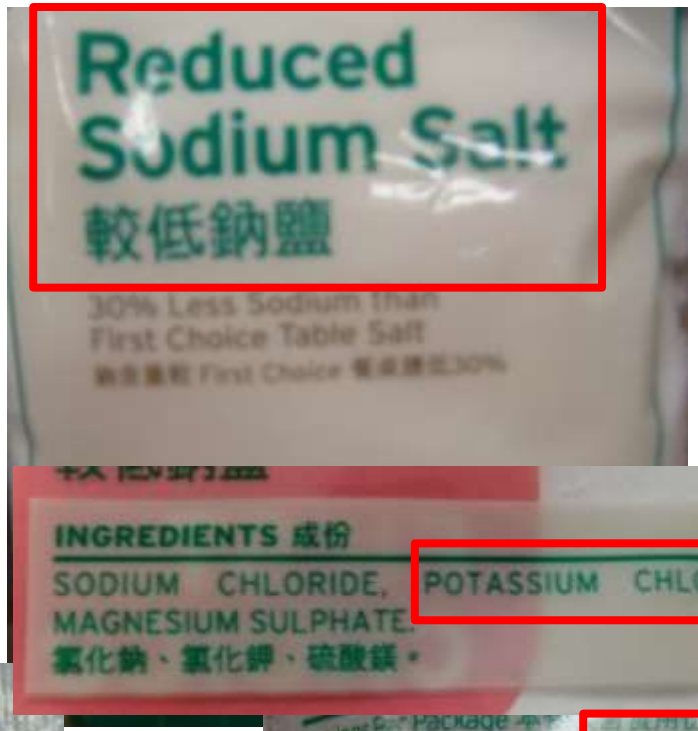


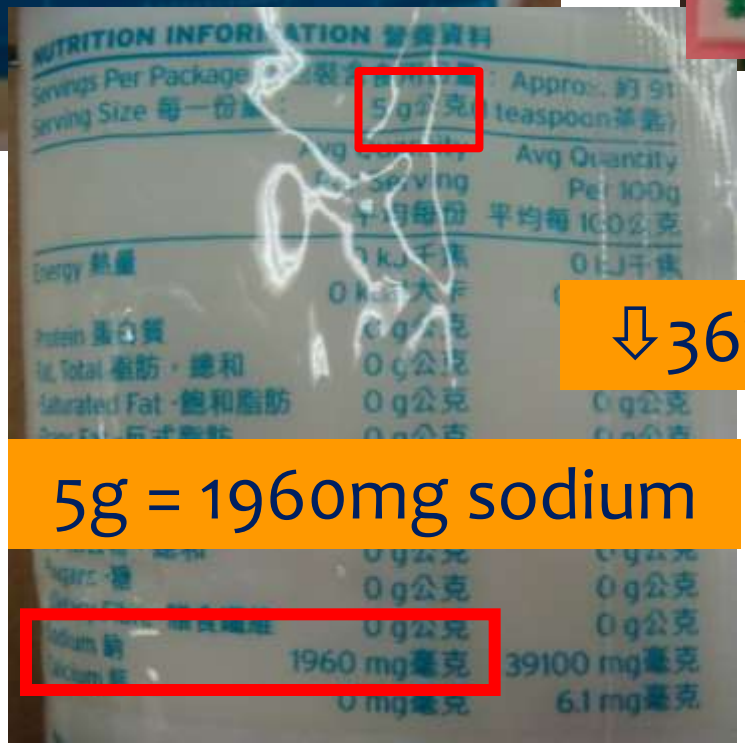
5g = 1926mg sodium



Healthy choice ?

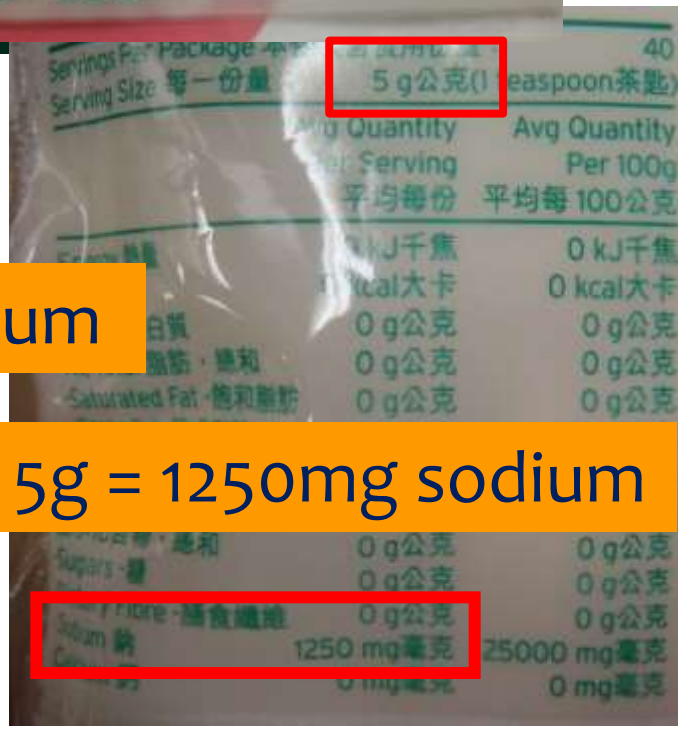
Contain sodium & potassium





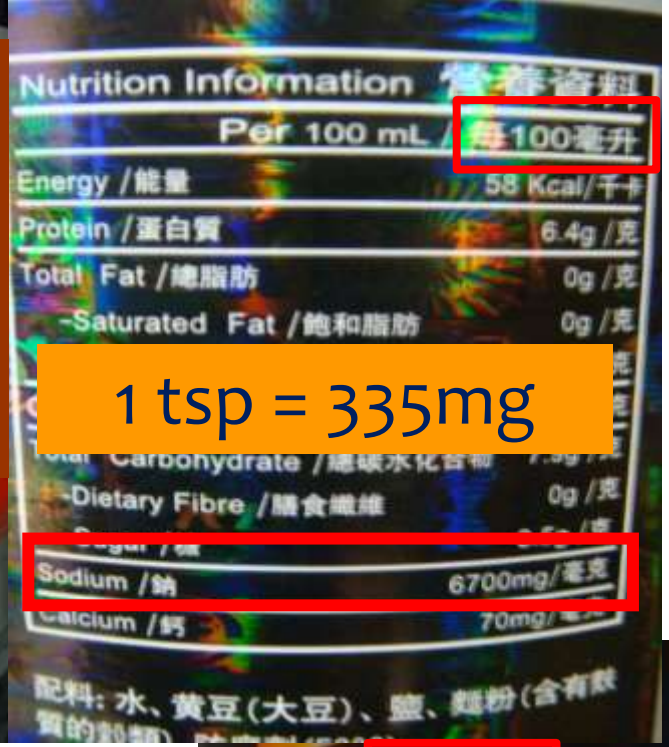
⇩36% sodium

5g = 1960mg sodium



5g = 1250mg sodium





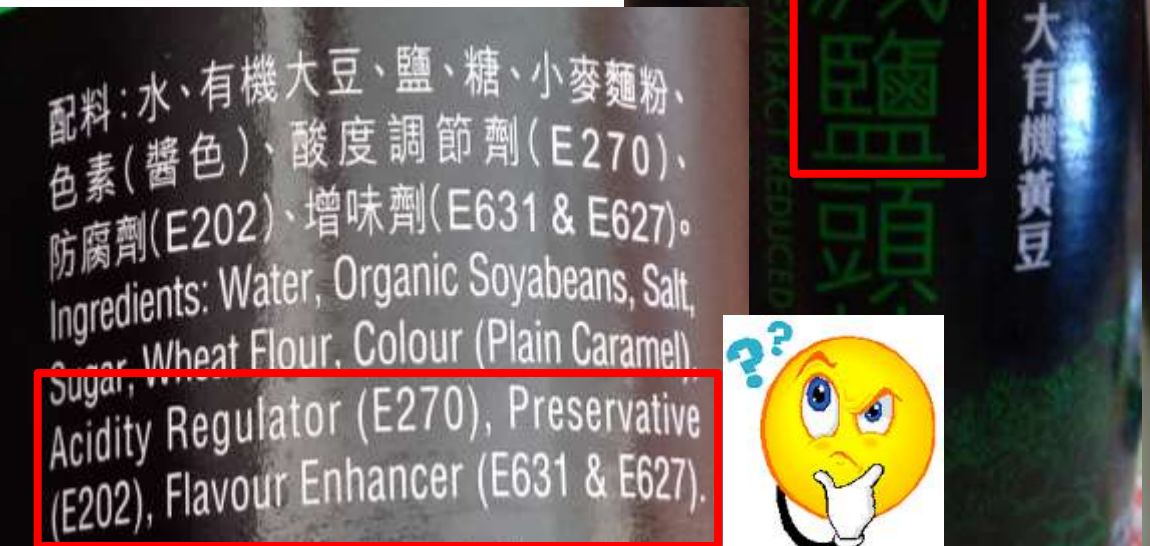
1 tsp = 335mg

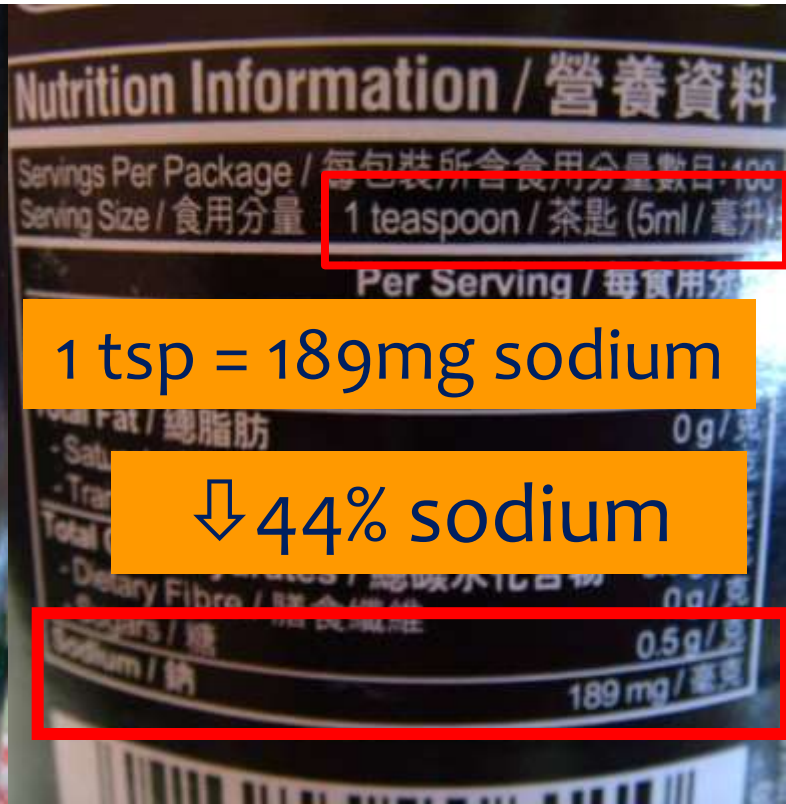
E270: Lactic acid

E202: Potassium sorbate (Preservative)

E631: Disodium inosinate

E627: Disodium guanylate





1 tsp = 189mg sodium

⇩44% sodium

1 serving sodium-containing seasoning = 250mg sodium

6 servings per day

* 1/8 茶匙鹽
* ½ 茶匙生/老抽
* ¾ 茶匙日本豉油/魚露
* 1¼ 茶匙南乳/蠔油
* 2½ 茶匙沙爹醬
* 3¾ 茶匙茄汁
* 6 茶匙茄膏
* ½ 茶匙雞粉
* ¾ 茶匙磨豉/柱侯醬
* 1 茶匙豆豉/腐乳
* 2¼ 茶匙甜麵豉醬
* 3 茶匙蝦膏
* 5 茶匙嗚汁

1 serving sodium-containing seasoning = 250mg sodium

= 1塊火腿 

= 1條熱狗腸 

= ½條臘腸 

= 8粒乾瑤柱 

= 1茶匙梅菜 

= ⅛隻鹹蛋 

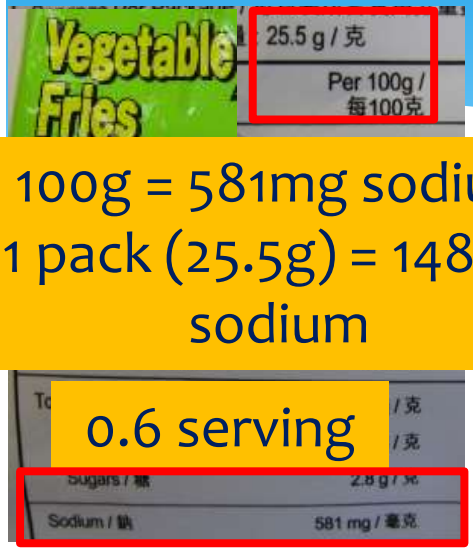
= 1½茶匙炸菜 

= ½隻皮蛋 

= 4克鹹魚 

= ¾茶匙冬菜 

Sodium in pre-packed food

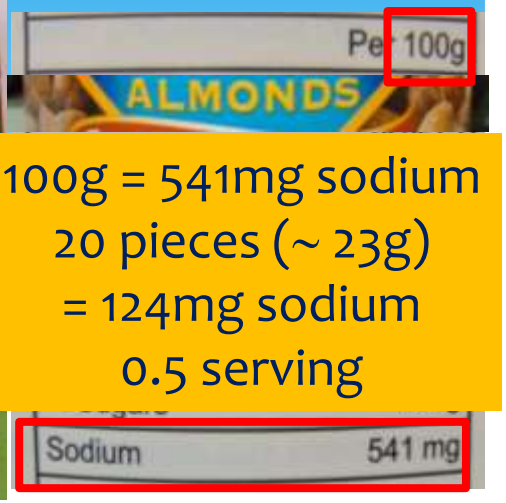


100g = 581mg sodium
1 pack (25.5g) = 148mg sodium

0.6 serving



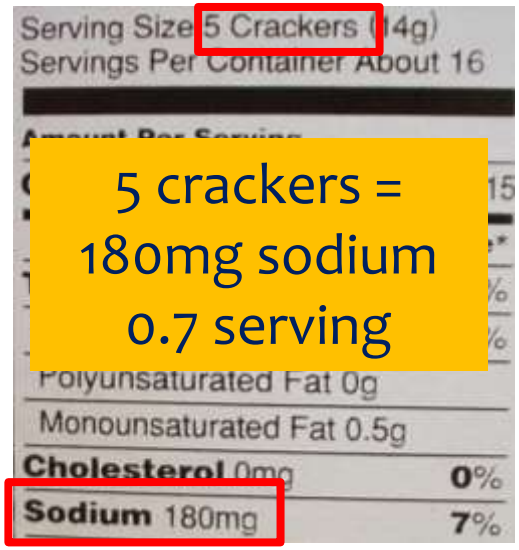
1 pack (22g) = 18mg sodium
Low in sodium



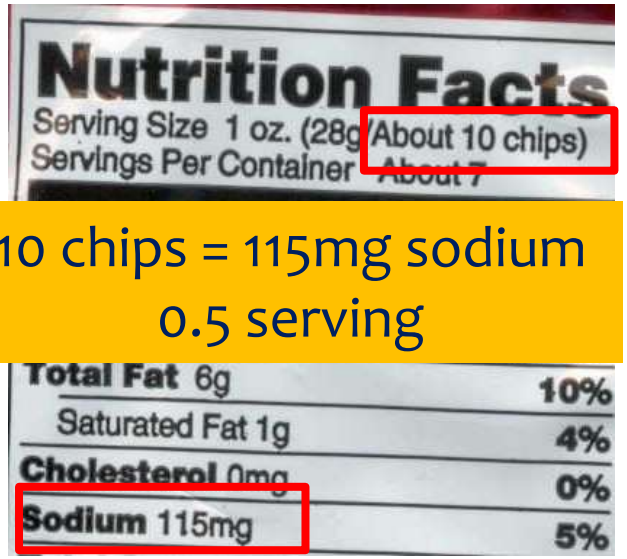
100g = 541mg sodium
20 pieces (~ 23g) = 124mg sodium
0.5 serving



100g (~2 pieces) = 540mg sodium
2 servings

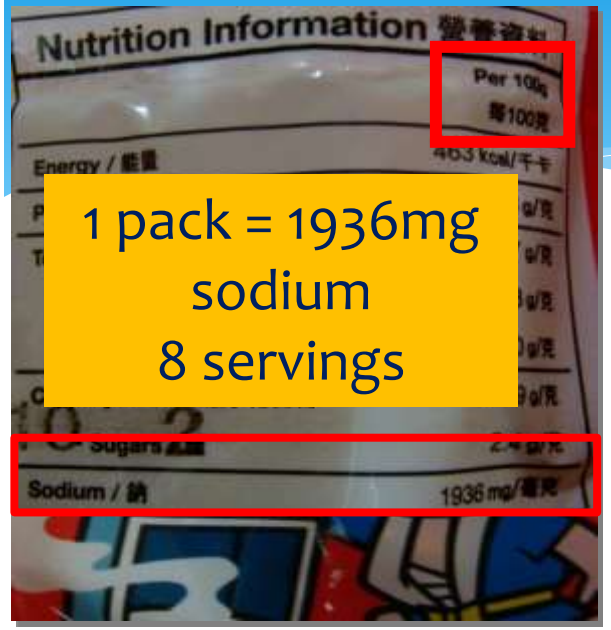


5 crackers = 180mg sodium
0.7 serving

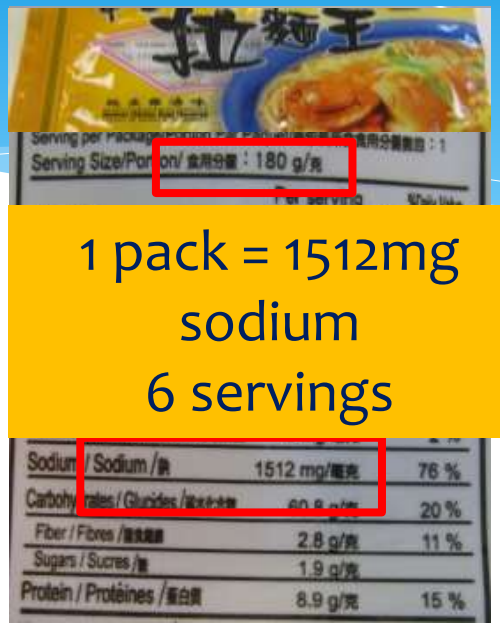


10 chips = 115mg sodium
0.5 serving

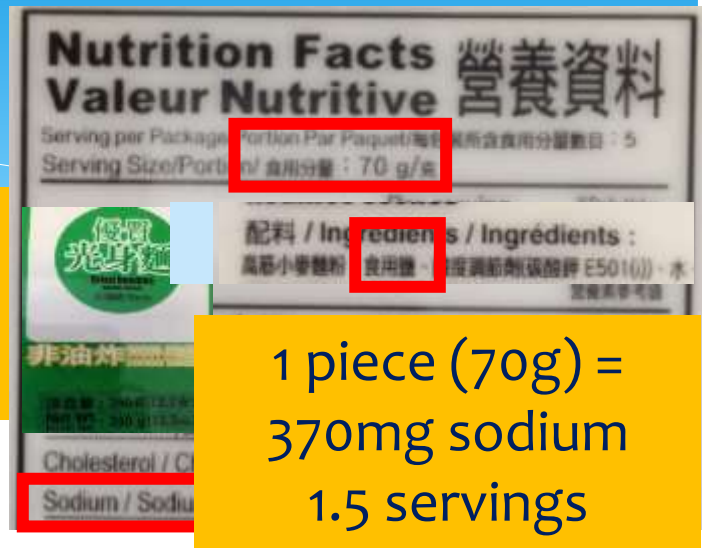
Sodium in pre-packed food



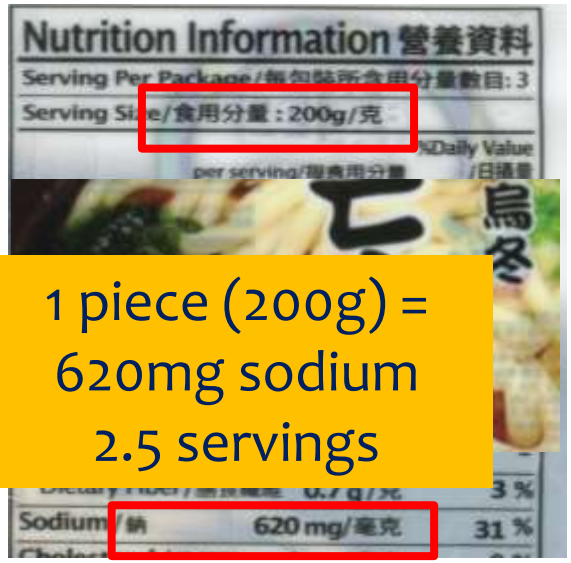
1 pack = 1936mg sodium
8 servings



1 pack = 1512mg sodium
6 servings



1 piece (70g) = 370mg sodium
1.5 servings



1 piece (200g) = 620mg sodium
2.5 servings

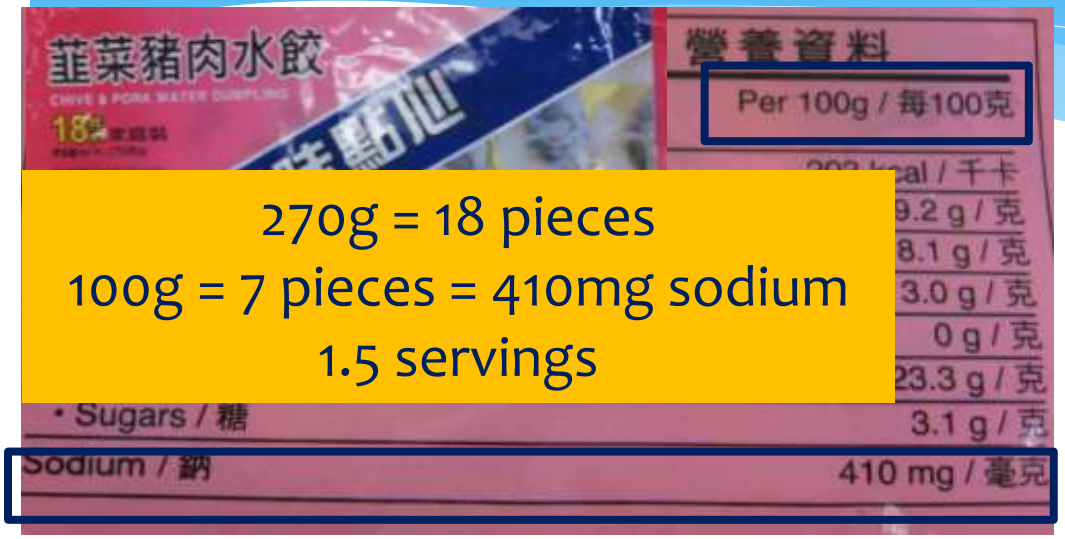


1 piece (200g) = 333mg sodium
1.3 servings



1 piece (50g) = 7mg sodium
low in sodium

Sodium in pre-packed food



270g = 18 pieces
100g = 7 pieces = 410mg sodium
1.5 servings



0.3 can (100g) = 640mg
2.6 servings

Seasonings







香茅雞柳 (3份)



材料：	雞髀肉(去皮)	12 安士	生粉	1 湯匙
	鹽	¼ 茶匙	胡椒粉	½ 茶匙
	糖	¾ 茶匙	薑蓉	1 湯匙
	麻油	1½ 茶匙	蒜蓉	1 湯匙
	酒	1½ 茶匙	油	2 茶匙
	薑汁	1 湯匙	每份含430毫克鈉質	
香茅汁：	香茅(切粒)	4 湯匙	麻油	1 湯匙
	薑蓉	1 湯匙	糖	1½ 茶匙
	蒜蓉	1 湯匙	生粉	2 茶匙
	老抽	1 茶匙	水	3 安士
	生抽	½ 茶匙	油	2 茶匙

洋葱番茄雞柳 (3份)



每份含605毫克鈉質

材料：	雞髀肉(去皮)	12 安士	生粉	1 湯匙
	鹽	¼ 茶匙	胡椒粉	½ 茶匙
	糖	¾ 茶匙	薑蓉	1 湯匙
	麻油	1½ 茶匙	蒜蓉	1 湯匙
	酒	1½ 茶匙	油	2 茶匙
	薑汁	1 湯匙		
番茄汁：	洋葱(切絲)	3 安士	鹽	¼ 茶匙
	薑蓉	1 湯匙	糖	1 湯匙
	蒜蓉	1 湯匙	生粉	1 湯匙
	番茄(切粒)	6 安士	水	4 安士
	茄膏	3 湯匙	油	2 茶匙
	嗚汁	1 茶匙	胡椒粉	½ 茶匙
	檸檬汁	¾ 茶匙		

七彩甜酸肉絲 (4份)



材料:

柳梅/瘦肉 (去肥，去筋)	6兩	蒜茸	2 茶匙
蔥	1/4兩	薑茸	1茶匙
紅燈籠椒 (切絲)	1兩	乾蔥 (切碎)	2茶匙
青燈籠椒 (切絲)	1兩	酒	1 茶匙
橙燈籠椒 (切絲)	1兩	油	2 湯匙
罐頭桃片 (切絲)	2兩		

每份含384毫克鈉質

調味料:

鹽	1/4茶匙	粟粉	1/4茶匙
糖	1/4茶匙	水	6茶匙
黑胡椒粉	1/3茶匙	麻油	2茶匙

甜酸汁:

醋	3茶匙	鹽	1/4茶匙
水	3湯匙	粟粉	1/2茶匙
茄汁	3茶匙	麻油	1茶匙
糖	1/2茶匙	油	1茶匙

Eating out

早餐

* 餐蛋即食麵
* 牛油多士
* 咖啡





晚餐

* 例湯
* 西炒飯
* 凍檸茶
* 紅豆沙









午餐

* 乾炒牛河
* 凍奶茶



Total: 7400mg sodium

⇨ **Choose healthy eating out choices**

⇨ **Reduce frequency of eating out**

Potassium

* Blood pressure control
  * Dietary Approaches to Stop Hypertension (DASH) diet: Adequate intake of dietary potassium
* Chronic kidney disease

⇩ urine output & excretion of potassium + Excessive intake of dietary potassium

⇨Hyperkalemia: Ventricular arrhythmias, paralysis, respiratory failure

⇨Restrict dietary intake of potassium

Other causes of hyperkalemia

* Laboratory error (Hemolysed red blood cells)
* Metabolic or respiratory acidosis, insulin deficiency (Altered potassium distribution)
* Adrenal deficiency (Reduced potassium excretion)
* Rhabdomyolysis, tumor lysis syndrome (Abnormal potassium release from cell)
* Medications
  * Potassium-sparing diuretics (Amiloride, Dyazide), antibiotics (Trimethoprim, Pentamidine) (Block sodium channel in distal nephron)
  * ACEIs, ARBs, COX-2 inhibitors, Heparin, NSAIDs, Tacrolimus (Block aldosterone production)
  * B Blockers (Abnormal potassium distribution)
  * Spironolactone (Block aldosterone receptors)
  * Cyclosporin (Block Na^+, K^+-ATPase activity in distal nephron)
  * Potassium/ herbal supplements (Increased potassium load)

Food high in potassium

生果、蔬菜



果仁



豆及豆製品













咖啡、濃茶　湯、中國藥材　奶　鮮果汁　代鹽

Soak & boil vegetable to reduce its potassium content

Fruit low in potassium

* 雪梨 (1個中)



* 紅毛丹 (4粒)



* 藍莓 (1杯)



* 青蘋果 (1個中)



* 紅蘋果 (1個細)



* 啤梨 (1個細)



Vegetable low in potassium

* 節/冬瓜



* 紅/黃/青椒



* 生菜/油麥菜



* 菜心/芥蘭



* 芥菜



* 翠玉/合掌瓜



* 絲瓜



* 椰菜花



* 青/白豆角



* 四季豆



* 椰菜



* 黃芽白/紹菜



* 青/老黃瓜



* 芽菜/唐芫茜



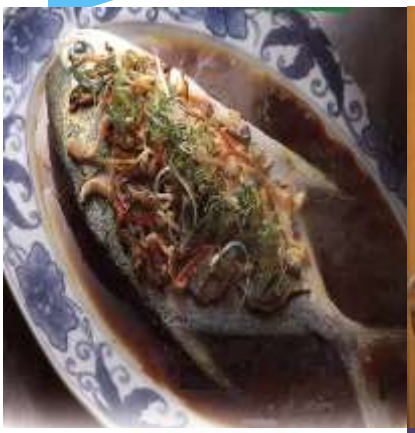
Phosphorus



* Retention of phosphorus as renal function decreases
* Hyperphosphatemia: Renal osteodystrophy, parathyroid gland hyperplasia, myocardial fibrosis, heart & valve calcification, cardiovascular sudden death
* Phosphate binders: Take with meals
  * Calcium carbonate: Chew well
  * Sevelamer: No need to chew
  * Aluminum hydroxide: Not recommended for long term use to prevent aluminum intoxication

Food high in phosphorus

魚、海產、蝦米 骨/魚/豆湯 內臟 蛋黃 豆/菇菌類














硬殼果 全麥食品 朱古力 奶製品 可樂飲品

Phosphorus density of common foods

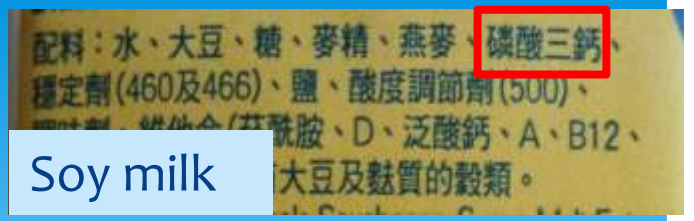
Food	Actual phosphorus(mg) / Protein(g)	Adjusted phosphorus (mg) / Protein (g)
Poultry	6.6 - 7.6	4.8 - 5.4
Red meat	8.1 - 8.6	6 - 6.3
Fish	10.2 - 12.3	7.5 - 9
Tofu	12.7 - 13.6	7.5 - 7.6
Soy beans	14.5	8.5
Dried beans	14.9 - 15.7	8 - 12
Nuts	18.4 - 24.5	10.9 - 14.4
Cheddar cheese	20.7	15.3
Milk	26.1 - 30.9	19 - 26
Yoghurt	27 - 29.5	19.8

Adjusted for digestibility & absorption: Animal $\geq$ 70%; Plant 50%; Mixed meals 50-70%

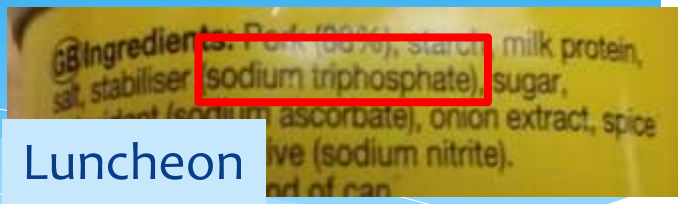
Phosphorus in snacks & drinks

Food additives

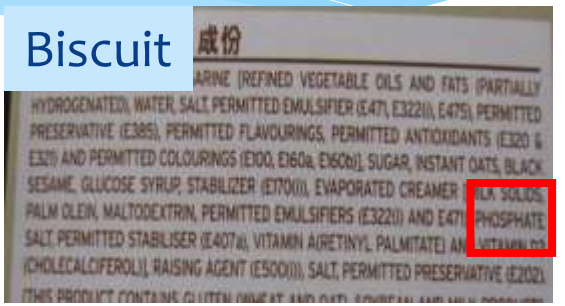
* Inorganic phosphorus
* Highly absorbable
* Color, anti-oxidant, acidity regulator, acid, emulsifier, stabilizer, raising/firming/anti-caking agent
* E338-343, 383, 450-452, 541, 542, 1410, 1412-1414, 1442



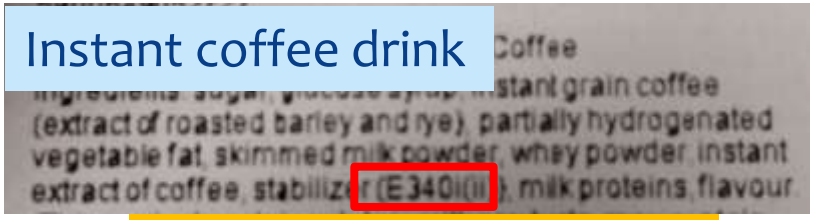
Soy milk



Luncheon

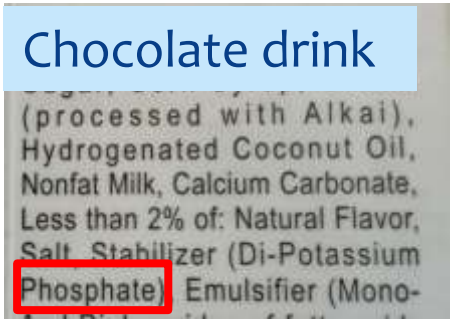


Biscuit

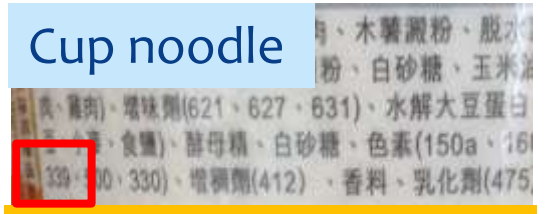


Instant coffee drink

E340 Potassium phosphate

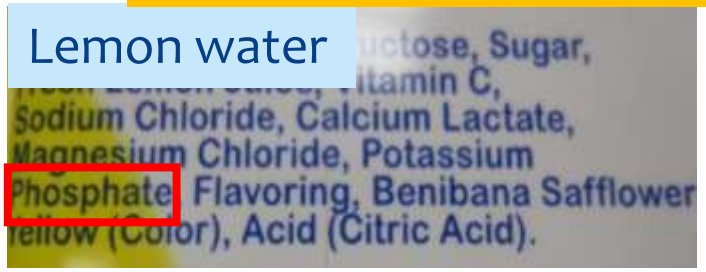


Chocolate drink



Cup noodle

E339 Sodium phosphate

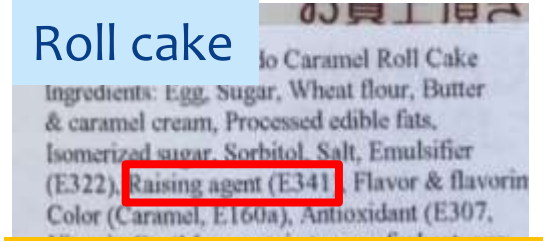


Lemon water



Cola drink

E338 Phosphoric acid



Roll cake

E341 Calcium phosphate

Alcohol

Control of blood pressure & serum triglyceride

* Male: No more than 2 servings/day
* Female: No more than 1 serving/day

1 serving

= 360ml beer

= 150ml white/ red wine

= 45ml whisky



Fluid



Depend on clinical status

* Degree of impaired renal function
* ⇧ fluid requirement: Nephrolithiasis, UTI, salt-losing nephropathy, diarrhea, vomiting, excessive perspiration, pressure ulcers (Stage II, III, IV), fever
* ⇩ fluid requirement: Dilutional hyponatremia, congestive heart failure, edema, ascites

Fluid restriction

* Use smaller cup
* Suck ice cube or rinse mouth to relieve thirst
* Decrease intake of sodium

Vitamins

* Recommended Daily Intake (RDI)
* Vitamin D: 1,25-dihydroxyvitamin D3 (active form) may be required for treatment of secondary hyperparathyroidism
* Vitamin C: Excreted by kidney
  * Excessive intake ⇨ ↑ blood oxalate level
  * Deposition of oxalate in heart, kidney & blood vessels
  * Precipitation of acute pseudogout
* Vitamin A: Excreted by kidney, Excessive intake ⇨ Toxicity

⇨ **Avoid over-the-counter supplement**

Minerals

Iron

* Dietary restriction, impaired absorption
* ↓ absorption: Tea, coffee, milk, high fibre food
* ↑ absorption: Vitamin C rich food
* Supplement may be required

Nutritional supplement

Standard RTF



Concentrated RTF



Juice based



Standard powder



DM



Pulmonary



Renal



Semi-elemental



Modular – Protein, Carbohydrate, Fat



Considerations in choosing nutritional supplement

* Renal vs Non-renal formulae

  Depend on serum electrolytes level & fluid requirement

* DM vs standard formulae

  ? Need a low carbohydrate diet

* Nutritional status & current dietary intake
* Preference & tolerance
* Cost
* ADL & social support

Summary

* Balanced diet ⇨ Provide adequate nutrients
* Adequate energy & protein intake ⇨ Avoid malnutrition
* Avoid excessive energy ⇨ Maintain ideal body weight
* Avoid excessive protein intake ⇨ ⇩ Accumulation of metabolic waste products
* Control carbohydrate portion, regular meal pattern, limit sugary food intake & choose low GI food ⇨ Better DM control
* Choose high fibre food ⇨ Control serum glucose & lipid level
* Limit alcohol intake ⇨ Control blood pressure & serum triglycerides level
* Limit saturated & trans fat intake ⇨ Control serum lipid level

Summary

* Limit salt intake ⇨ Control blood pressure, proteinuria & edema
* Use natural seasoning to enhance flavor of food
* Potassium & phosphorus intake depend on serum level
* Fluid intake depend on clinical status
* Adequate intake of minerals & vitamins
* Avoid over-the-counter supplement
* No star fruit
* Individualized meal plan
* Relax diet restriction if appropriate

Thank you