

# Citrus Fruits FOR IMMUNITY

As new infectious challenges emerge and cold and flu viruses continue to circulate widely<sup>1</sup>, interest in foods for immunity is strong.

## IMMUNITY RECAP

A healthy immune system is a balance of protective inflammation and anti-inflammatory pathways utilising antioxidants to prevent damage and support microbiomes.

For both acute and chronic illness, this complex balancing act requires nutritional support<sup>2</sup> for optimal barrier, detection, targeting, elimination, and memory function.



Citrus is commonly believed to support immunity... but is it an evidence-based recommendation?



## CITRUS FRUITS are a unique nutrition package for immune support

### VITAMIN C

### CITRUS IS NOTABLE FOR VITAMIN C WHICH IS WELL-ESTABLISHED IN SUPPORTING IMMUNITY

#### Vitamin C is vital to:

- + barrier function & wound healing via collagen promotion<sup>5</sup>.
- + chemotaxis to recruit cells to targets<sup>5</sup>.
- + function of white blood cells<sup>3,5</sup>.
- + antioxidant and anti-inflammatory activity<sup>5</sup>.

#### Vitamin C improves immune outcomes in meta-analyses

| 31 RCTs* <sup>3</sup>                          | 3 RCTs <sup>4</sup>                     | 24 RCTs <sup>3</sup>                          | 5 RCTs <sup>3</sup>                                     |
|--|---|---|---|
| Reduces duration and severity of common colds. | Reduces risk and duration of pneumonia. | No effect on common cold incidence generally. | Decreased infection in short-term high physical stress. |

\*randomised controlled trials

### EMERGING SCIENCE SHOWS CITRUS BIOACTIVES SUPPORT IMMUNITY



Bioactive citrus flavonoids are in all parts of the fruit<sup>9</sup>.



Key citrus flavonones are not commonly found in other fruits<sup>9</sup>.

### BIOACTIVES

#### Bioactive citrus flavonoids support immunity in 3 ways

#### 1 Anti-microbial

- Hesperidin and hesperitin: reduce binding and replication of SARS-CoV-2, and free radical damage<sup>14,15</sup>.
- Hesperidin, hesperitin and quercetin: prevent influenza replication<sup>5,10</sup>.

#### 2 Antioxidant<sup>9,10,12</sup>

- Enhance activity of human antioxidant enzymes, and inhibit pro-oxidant enzymes.
- Absorb and neutralise free-radicals.
- Hesperidin, naringenin and orange juice: reduced reactive oxygen species in RCTs<sup>13</sup>.

#### 3 Anti-inflammatory

- Hesperidin and orange juice: reduced inflammatory markers in humans<sup>5,13</sup>.
- Naringenin, naringin and narirutin: anti-inflammatory effects (cells & animals)<sup>5</sup>.
- Hesperidin and naringin: increased microbiome short chain fatty acids (SCFA) production, particularly immune modulating propionate<sup>14</sup>.

#### Major Citrus Flavonoids<sup>9,10,11</sup>

Hesperidin  
Hesperitin  
Narirutin  
Naringenin  
Naringin  
Diosmin  
Nobiletin  
Quercetin

### FIBRE

### CITRUS FRUITS HAVE A UNIQUE FIBRE PROFILE

MOST FRUITS & VEGETABLES



== PREDOMINATELY INSOLUBLE FIBRE

CITRUS FRUITS











== A BLEND OF SOLUBLE (PREBIOTIC) & INSOLUBLE<sup>16</sup>

### Dietary fibres have direct and indirect impacts on the immune system.

- ✓ Soluble fibres (eg. pectins) abundant in citrus support gastrointestinal barrier function<sup>17</sup> and feed the microbiome to support the gut-immunity axis<sup>18</sup>.
- ✓ Citrus peel dietary fibres: contain monosaccharides (arabinose, rhamnose, xylose)<sup>19</sup> that increase anti-inflammatory SCFAs<sup>20</sup>.

# Vitamin C in citrus fruits; What we need vs what's inside<sup>7</sup>

|  | ORANGE  |      | LEMON  |      | LIME  |      | GRAPEFRUIT  |      | MANDARIN  |      |
|--|--|------|---|------|---|------|--|------|--|------|
| PEELED FRUIT          | SDT%   | RDI% | SDT%  | RDI% | SDT%  | RDI% | SDT%   | RDI% | SDT%   | RDI% |
|  | >35%   | 173% | >21%  | 106% | >21%  | 104% | >24%   | 120% | >19%   | >93% |
|  | 1 fruit (150g)   |      | 2 fruit (100g)  |      | 2 fruit (100g)  |      | half fruit (150g)  |      | 2 fruit (150g)   |      |
| ZEST<br>1 tablespoon  | >5%  | 27%  | >3%   | 18%  | >5%   | 24%  | >3%  | 16%  | >2%  | 11%  |
| JUICE 125ml           | >21%   | 106% | >23%  | 115% | >26%  | 131% | >21%   | 106% | >13%   | 67%  |

Adult Recommended Dietary Intake (RDI) = 45 mg/day. Suggested Dietary Target (SDT) = 220mg/day (men), 190 mg/day (women)<sup>6</sup>.

## Citrus is simple and impactful

### EASY AND PRACTICAL

- ✓ Familiar and easy to use and prepare.
- ✓ Available all year round, and abundant in winter when other local fruits may not be in season.
- ✓ Affordable.
- ✓ Recommending citrus reduces complexity while maintaining specificity – maximising likelihood of behaviour change<sup>21</sup>.

### ENHANCES MEALS AND ENJOYMENT

- ✓ Versatile across meal occasions.
- ✓ Diverse uses in sweet and savoury dishes.
- ✓ Adds colour variety to meals.
- ✓ Unique sweet-sour combination may improve palatability, particularly when anosmia (loss of smell) impacts flavour perception during illness or aging<sup>22</sup>.

### WHOLE FOOD

- ✓ More than vitamin C.
- ✓ Unique package of nutrients and bioactives to support immunity.

## How to recommend citrus

|   |   |   |
|---|---|---|
| <br>Whole as a snack         | <br>As juice   | <br>Slices in water or tea                           |
| <br>Grilled added to meals | <br>Freeze juice as ice blocks                              | <br>Slice segments into salads                      |
| <br>In salad dressings     | <br>Use lemon or lime juice & zest to cure seafood or beef | <br>Add lemon juice & zest to your favourite soups |

## Take home message:

While there is no silver bullet for optimal immune function, citrus fruits not only add a variety of colours and zesty flavor to meals, but contain a unique combination of nutrients and bioactives important for immunity:



The evidence-base for the benefits of these components include studies of supplements in doses achievable from whole fruit intake.

The whole fruit is a unique package that can be recommended to support immunity.



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