Plant-Based Foods: Opportunities and Challenges

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Introduction

- **Plant-based diet** used to refer full spectrum of nutritionally preferred foods include
  - Vegans
  - Vegetarians
  - Flexitarian

- **Flexitarians** focus their diets on plant-based foods but occasionally eat meat and dairy

(Derbyshire, 2017)
Food Consumption Pattern Scenario

- Plant-based diets is main source of energy globally

- Per capita food consumption has increased dramatically since last few decades

- In affluent societies, a tremendous increased in energy intake from animal-based foods has also been observed

(Vasileska and Rechkoska, 2012)
Global and Regional Pattern  
(kcal per capita per day)

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>World</td>
<td>2358</td>
<td>2435</td>
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<td>2803</td>
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<td>Developing countries</td>
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<td>2681</td>
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<td>Near East and North Africa</td>
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<td>East Asia</td>
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<td>3206</td>
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<td>3440</td>
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<td>Transition countries</td>
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<td>3385</td>
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<td>2906</td>
<td>3060</td>
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</tr>
</tbody>
</table>

(Vasileska and Rechkoska, 2012)
# Vegetable and Animal Sources of Energy in the Diet (kcal per capita per day)

<table>
<thead>
<tr>
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<tbody>
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<td>T</td>
<td>V</td>
<td>A</td>
<td>T</td>
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<td>T</td>
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<td>A</td>
<td>T</td>
<td>V</td>
<td>A</td>
<td>T</td>
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<tr>
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<td>Transition</td>
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<td>780</td>
<td>3400</td>
<td>2507</td>
<td>893</td>
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<td>Industrialized</td>
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<td>2132</td>
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<td>906</td>
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<td>950</td>
<td>3380</td>
<td>2437</td>
<td>943</td>
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</tr>
</tbody>
</table>

T = Total, V = Vegetable, A = Animal

(Popkin, 2001)
Change in Consumption in Pakistan (kg/capita/annum)

Cereals

Fruits and Vegetables

Pulses

Meat, Egg and Milk

(GOP, 2016)
# FAO Desirable Dietary Pattern and Pakistan

<table>
<thead>
<tr>
<th>Food Item</th>
<th>FAO (DDP)</th>
<th>2013-14 Dietary intake Pakistan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereals Roots and tubers</td>
<td>30%</td>
<td>25%</td>
</tr>
<tr>
<td>Bananas &amp; Plantains</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pulses, beans &amp; soya beans</td>
<td>10%</td>
<td>2.4%</td>
</tr>
<tr>
<td>Animal products</td>
<td>40%</td>
<td>30%</td>
</tr>
<tr>
<td>Added fats and oils</td>
<td>10%</td>
<td>15%</td>
</tr>
<tr>
<td>Sugars</td>
<td>5%</td>
<td>10%</td>
</tr>
<tr>
<td>Vegetables, Fruits</td>
<td>10%</td>
<td>15%</td>
</tr>
<tr>
<td>Others</td>
<td>1%</td>
<td>10%</td>
</tr>
</tbody>
</table>

(FAO, 2003; Haider and Zaidi, 2014)
Opportunities

- Cheep source of energy
- Diversity
- Nutrient density
- Economical and sustainability
- Reduce overconsumption of calories
- Alternative source of protein
- Better shelf life
- Life longevity
- Protective factors against chronic diseases
Main Energy Source
Conti....

- An estimated 4 billion live primarily on plant-based diets
- 2 billion people live on meat-based diets

(Pimentel and Pimentel, 2003)
Calories From Major Commodities (Developing Countries)

(Sabate and Soret, 2014)
Conti....
The eatwell plate

Use the eatwell plate to help you get the balance right. It shows how much of what you eat should come from each food group.

- Fruit and vegetables
- Bread, rice, potatoes, pasta and other starchy foods
- Meat, fish, eggs, beans and other non-dairy sources of protein
- Milk and dairy foods
- Food and drinks high in fat and/or sugar
## Canadian Food Guide

<table>
<thead>
<tr>
<th></th>
<th>Children</th>
<th>Teens</th>
<th>Adults</th>
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<tr>
<td></td>
<td>2-3</td>
<td>4-8</td>
<td>9-13</td>
</tr>
<tr>
<td></td>
<td>Girls and Boys</td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td>Vegetables and Fruit</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Grain Products</td>
<td>3</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Milk and Alternatives</td>
<td>2</td>
<td>2</td>
<td>3-4</td>
</tr>
<tr>
<td>Meat and Alternatives</td>
<td>1</td>
<td>1</td>
<td>1-2</td>
</tr>
</tbody>
</table>

Australian Guide to Healthy Eating

Enjoy a wide variety of nutritious foods from these five food groups every day. Drink plenty of water.

- **Grain (cereal) foods**, mostly wholegrain and/or high cereal fibre varieties
- **Lean meats and poultry, fish, eggs, tofu, nuts and seeds and legumes/beans**
- **Milk, yoghurt, cheese and/or alternatives, mostly reduced fat**
- **Use small amounts**
- **Only sometimes and in small amounts**

**Vegetables and legumes/beans**
- Broccoli
- Red lentils
- Chickpeas
- Red kidney beans
- Green beans
- Red capsicums
- Cucumber
- Peppers
- Carrots
- Corn
- Asparagus
- Pumpkins
- Mushrooms
- Brussel sprouts
- Lettuce
- Tomatoes
- Spinach
- Peas
- Broccoli
- Peppers
- Corn
- Asparagus
- Pumpkins
- Mushrooms
- Brussel sprouts
- Lettuce
- Tomatoes
- Spinach

**Fruit**
- Kiwi fruit
- Grapes
- Mango
- Pineapple
- Orange
- Apple
- Banana
- Pear

**Rolled oats**
- Quinoa
- Nuts
- Seeds
- Wheat flakes

19
Diversity
Conti....

- 250-300 thousand known edible plant species
  - Humans use only 150-200

- 75% of the world’s food → 12 plants and 5 animal species

(Heiman and Greenway, 2016)
Nutrient Density
Eating The Nutrient Dense Way

Conti....
### Nutrient Density of Foods

*Indicating the frequency with which various foods should be eaten*

<table>
<thead>
<tr>
<th>Unlimited Quantities</th>
<th>Green vegetables</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All-raw vegetables</td>
</tr>
<tr>
<td></td>
<td>Non-starchy cooked vegetables</td>
</tr>
<tr>
<td></td>
<td>Beans and legumes</td>
</tr>
<tr>
<td></td>
<td>Fresh fruit</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Limited Quantities Daily</th>
<th>Cooked starchy vegetables</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Whole grains</td>
</tr>
<tr>
<td></td>
<td>Raw nuts, seeds, and avocado</td>
</tr>
</tbody>
</table>

| Limited Quantities Weekly | Fish[^1] • Fat-free dairy |
|----------------------------| Wild meats and fowl • Eggs |

| Rarely | Red meat • Refined grains • Full-fat dairy/cheese • Refined oils/sweets |

[^1]: Fish[^1] includes omega-3 fatty acids.
Economical and Sustainable
Conti....

<table>
<thead>
<tr>
<th>Items</th>
<th>Units</th>
<th>Islamabad 27-04-2017</th>
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<tbody>
<tr>
<td>Wheat</td>
<td>Kg</td>
<td>35</td>
</tr>
<tr>
<td>Wheat Flour</td>
<td>Kg</td>
<td>39</td>
</tr>
<tr>
<td>Chicken farm</td>
<td>Kg</td>
<td>163</td>
</tr>
<tr>
<td>Petrol</td>
<td>Ltr</td>
<td>74</td>
</tr>
<tr>
<td>Diesel</td>
<td>Ltr</td>
<td>83</td>
</tr>
<tr>
<td>Rice Basmati</td>
<td>Kg</td>
<td>85</td>
</tr>
<tr>
<td>Vegetable ghee</td>
<td>Kg</td>
<td>151</td>
</tr>
<tr>
<td>Eggs</td>
<td>Doz</td>
<td>86</td>
</tr>
<tr>
<td>Sugar</td>
<td>Kg</td>
<td>66</td>
</tr>
<tr>
<td>Beef</td>
<td>Kg</td>
<td>352</td>
</tr>
<tr>
<td>Gram Pulse</td>
<td>Kg</td>
<td>154</td>
</tr>
<tr>
<td>Milk Fresh</td>
<td>Ltr</td>
<td>99</td>
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<tr>
<td>Masoor Pulse</td>
<td>Kg</td>
<td>153</td>
</tr>
<tr>
<td>Moong Pulse</td>
<td>Kg</td>
<td>152</td>
</tr>
<tr>
<td>Mash Pulse</td>
<td>Kg</td>
<td>203</td>
</tr>
<tr>
<td>Red Chilies</td>
<td>Kg</td>
<td>300</td>
</tr>
<tr>
<td>Onion</td>
<td>Kg</td>
<td>54</td>
</tr>
<tr>
<td>Mutton</td>
<td>Kg</td>
<td>806</td>
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<tr>
<td>Tomatoes</td>
<td>Kg</td>
<td>49</td>
</tr>
<tr>
<td>Potatoes</td>
<td>Kg</td>
<td>44</td>
</tr>
<tr>
<td>DAP</td>
<td>50 Kg</td>
<td>2588 *</td>
</tr>
<tr>
<td>Tea</td>
<td>Kg</td>
<td>1025</td>
</tr>
<tr>
<td>Urea</td>
<td>50 Kg</td>
<td>1368 *</td>
</tr>
</tbody>
</table>

(GOP, 2017) 26
Compared to plant-based foods, meat production requires:

- More energy
- More land
- More water resources

The American’s livestock consumes 7 times more grain than consumed by the entire US population.

(Pimentel and Pimentel, 2003)
It Take A Lot Then We Think:

The production of 1 kilogram beef costs:

- 15,455 liters of water
- 6.5 kilograms of crop
- 330 square meters of ground
- 16.4 kilograms of carbon dioxide
(Springmanna et al., 2016)
Reduce Overconsumption of Calories
Globally, there are 2.5 times more overweight than undernourished people

One in three adults are overweight
(Ranganathan et al., 2016)
Alternative Source of protein
Global Population will increase from 7.2 billion to 9.6 billion by 2050

Demand for protein will strain the environment
Factors that involve in selection alternative source of protein

- Availability
- Affordability
- Quality, safety
- Supply chain and sustainability
Conti…. Flow diagram of US feed to food protein flux

Mt = 10^{12}

(Shepon et al., 2016) 37
Life Longevity

- Life span shows linear correlation with plant-based diet

Per day \( \alpha \) Extra year to a life span

Dies 19 month earlier

Dies 19 month later

(Wyatt, 2018)
Lower Diseases Burden
Highest life expectancy (1st)

Higher diseases burden
Lower life expectancy (19th)

Average consumption of Meat per year, per person

Japan 44 KG
UK 101 KG
USA 125 KG
AUSTRALIA 110 KG

(FAO, 1988)
Better Shelf Life
Better Shelf Life
Less Number of Chronic Diseases
Several studies have shown that plant-based foods can be helpful in prevention and management of chronic diseases such as:

- Heart diseases
- Type II diabetes
- High blood pressure
- Obesity and overweight
- Cancer

(Kubola and Siriamornpun, 2008; Sofi et al., 2008)
% Diseases Burden

Low- and Middle-Income Countries
- 2002: 44% Communicable, maternal, perinatal, and nutritional conditions, 44% Noncommunicable diseases, 12% Injuries
- 2030: 54% Communicable, maternal, perinatal, and nutritional conditions, 32% Noncommunicable diseases, 14% Injuries

High-Income Countries
- 2002: 85% Communicable, maternal, perinatal, and nutritional conditions, 9% Noncommunicable diseases, 6% Injuries
- 2030: 89% Communicable, maternal, perinatal, and nutritional conditions, 7% Noncommunicable diseases, 3% Injuries

(Hawkes, 2018)
Challenges

- Anti-nutritional factors
- Limiting amino acids
- Deficient vitamins and minerals

Bioavailability
Biological value
Anti-Nutritional Factors
Conti….

- **Phytates**
  - ✓ Iron, Zinc

- **Oxalates**
  - ✓ Calcium

- **Fiber**
  - ✓ Minerals

- **Tannis**
  - ✓ Protein

- **Saponins**
  - ✓ Protein

(Gemede and Ratta, 2014) 48
Limiting Amino Acids
<table>
<thead>
<tr>
<th>Food</th>
<th>Limited Amino Acid</th>
<th>Complement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beans</td>
<td>Methionine</td>
<td>Grains, nuts, seeds</td>
</tr>
<tr>
<td>Grains</td>
<td>Lysine, threonine</td>
<td>Legumes</td>
</tr>
<tr>
<td>Nuts/seeds</td>
<td>Lysine</td>
<td>Legumes</td>
</tr>
<tr>
<td>Vegetables</td>
<td>Methionine</td>
<td>Grain, nuts, seeds</td>
</tr>
<tr>
<td>Corn</td>
<td>Tryptophan, lysine</td>
<td>Legumes</td>
</tr>
</tbody>
</table>
Deficient Vitamins and Minerals
Vitamins

- Vitamin B12
- Vitamin D

Minerals

- Zinc
- Calcium

(Gibson et al., 2011)
Bioavailability
Examples of diets with estimated overall iron bioavailability

<table>
<thead>
<tr>
<th>Typical diet</th>
<th>Bioavailability of Fe</th>
</tr>
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<tbody>
<tr>
<td>Cereal-based, roots or tubers and legumes (with negligible meat, fish or</td>
<td>Low (5% absorption)</td>
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<tr>
<td>ascorbic acid-rich foods)</td>
<td></td>
</tr>
<tr>
<td>Cereal-based, roots or tubers (with small quantities of food of animal origin,</td>
<td>Intermediate (10% absorption)</td>
</tr>
<tr>
<td>or containing ascorbic acid and large amounts of tea or coffee)</td>
<td></td>
</tr>
<tr>
<td>Diverse diet containing generous quantities of meat, poultry and fish or</td>
<td>High (15% absorption)</td>
</tr>
<tr>
<td>foods containing high amounts of ascorbic acid</td>
<td></td>
</tr>
</tbody>
</table>

(Tontisirin et al., 2002)
Biological value
<table>
<thead>
<tr>
<th>Source of protein</th>
<th>PER</th>
<th>BV</th>
<th>NPU</th>
<th>Chemical score</th>
<th>Limiting amino acids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egg</td>
<td>4.5</td>
<td>94</td>
<td>90</td>
<td>100</td>
<td>Nill</td>
</tr>
<tr>
<td>Milk</td>
<td>3</td>
<td>84</td>
<td>75</td>
<td>65</td>
<td>S-Containing amino acids</td>
</tr>
<tr>
<td>Fish</td>
<td>3</td>
<td>85</td>
<td>70</td>
<td>60</td>
<td>Tryptophan</td>
</tr>
<tr>
<td>Meat</td>
<td>2.7</td>
<td>75</td>
<td>76</td>
<td>70</td>
<td>S-Containing amino acids</td>
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<tr>
<td>Rice</td>
<td>2.2</td>
<td>68</td>
<td>60</td>
<td>60</td>
<td>Lysine, threonine</td>
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<tr>
<td>Wheat</td>
<td>1.5</td>
<td>58</td>
<td>47</td>
<td>42</td>
<td>Lysine, threonine</td>
</tr>
<tr>
<td>Bengal gram</td>
<td>1.7</td>
<td>58</td>
<td>47</td>
<td>45</td>
<td>S-Containing amino acids</td>
</tr>
<tr>
<td>Red gram</td>
<td>1.5</td>
<td>57</td>
<td>46</td>
<td>45</td>
<td>S-Containing amino acids</td>
</tr>
<tr>
<td>Groundnut</td>
<td>1.7</td>
<td>55</td>
<td>45</td>
<td>44</td>
<td>Lysine, threonine, S-Containing amino acids</td>
</tr>
<tr>
<td>Soyabean</td>
<td>2.1</td>
<td>65</td>
<td>55</td>
<td>55</td>
<td>S-Containing amino acids</td>
</tr>
</tbody>
</table>

PER=Protein Efficiency Ratio, BV=Biological Value, NPU=Net Protein Utilization, S=Sulphur
Strategies to shift consumption

(Ranganathan et al., 2016) 57
Conclusion

- Adopting plants based diets could be beneficial:
  - In alleviating food insecurity
  - In reducing gas emission and global warming
  - In imparting therapeutic benefits

- Strategies like shift consumption wheel are beneficial in reducing challenge regarding plants based diets
Take Home Massage

Balanced diet with more focus on plant-based foods and less red meat foods......

We can ensure quality life
References


Conti....


Conti....


Conti…. 


Thank You
ANY
QUESTIONS?