Microbiological profile of hydroponic vegetables grown in Singapore

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Introduction

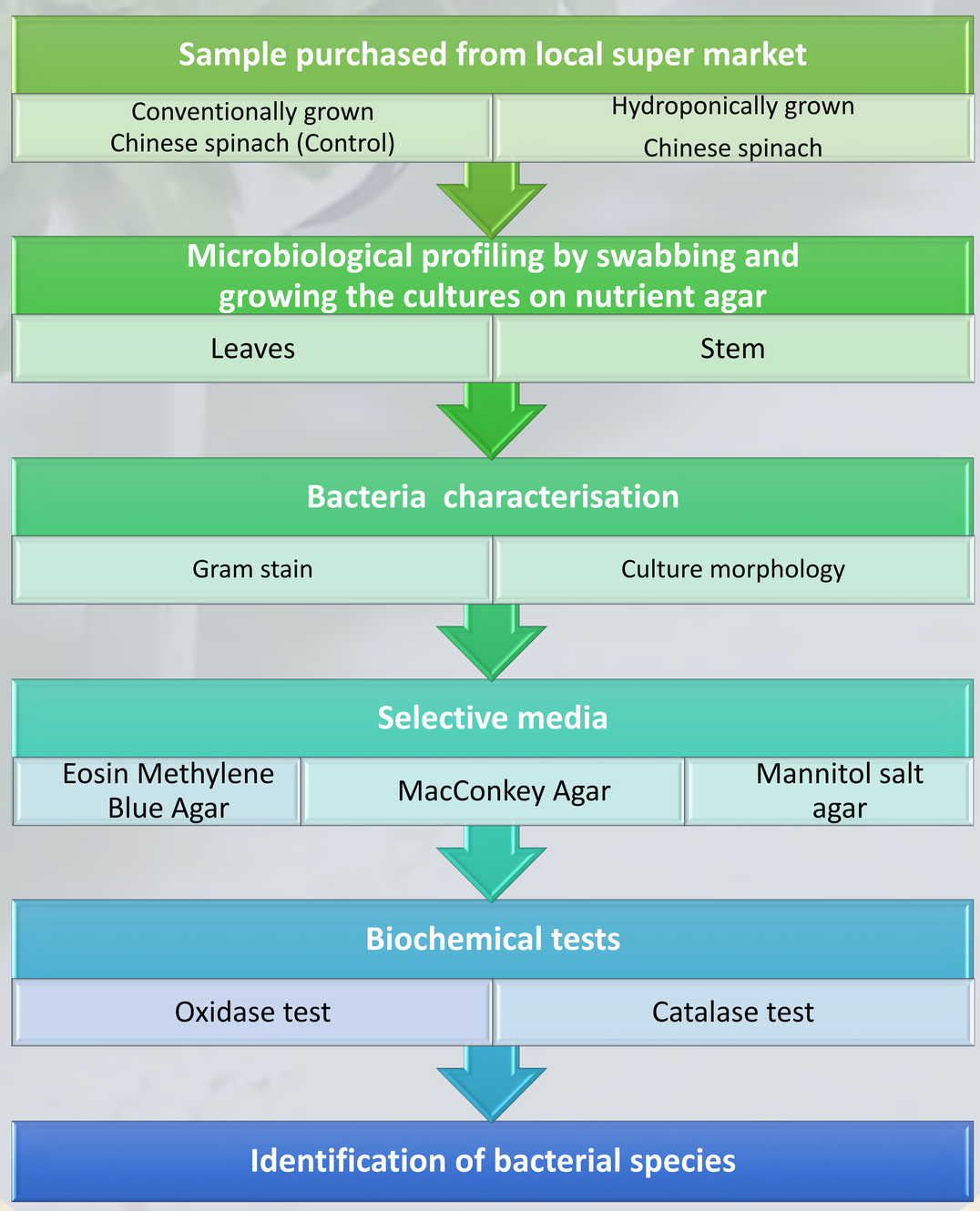
Over the years, there has been a growing demand for foods with better physical and nutritional properties in Singapore as a result of improved education and income growth. However, Singapore, being a small city, relies heavily on imports, perishable foods such as vegetables tend to be less fresh as it takes longer to reach consumers. According to the Agri-Food and Veterinary Authority, 90% of the food consumed in Singapore is imported and only 8% of the vegetables are produced locally (AVA, 2016). Hence, it is necessary to implement alternative farming techniques to ensure food security in Singapore.

Hydroponics is defined as the cultivation of plants in nutrient-enriched water with or without the mechanical support of an inert medium such as sand or gravel (Encyclopedia Britannica, 2015). The high nutrient concentration in nutrient solution supports growth of a wide array of microorganisms under hydroponic conditions and can be introduced to growing crops from contaminated irrigation water (Xu and Warriner, 2005). Microorganisms introduced in this manner persists on plants for longer periods as compared to crops cultivated in soil as it infects the interior of the plant instead of the exterior as of those in soil (Settanni *et al.*, 2013). Being a relatively new farming practice, there is limited knowledge on the microbiological safety profile of vegetables grown hydroponically.

Aims

1. To explore hydroponic farming techniques in Singapore.
2. To establish the safety profile of hydroponic vegetables grown locally by investigating their susceptibility to microbes and its corresponding effect on shelf-life of the produce.

Methods



Results

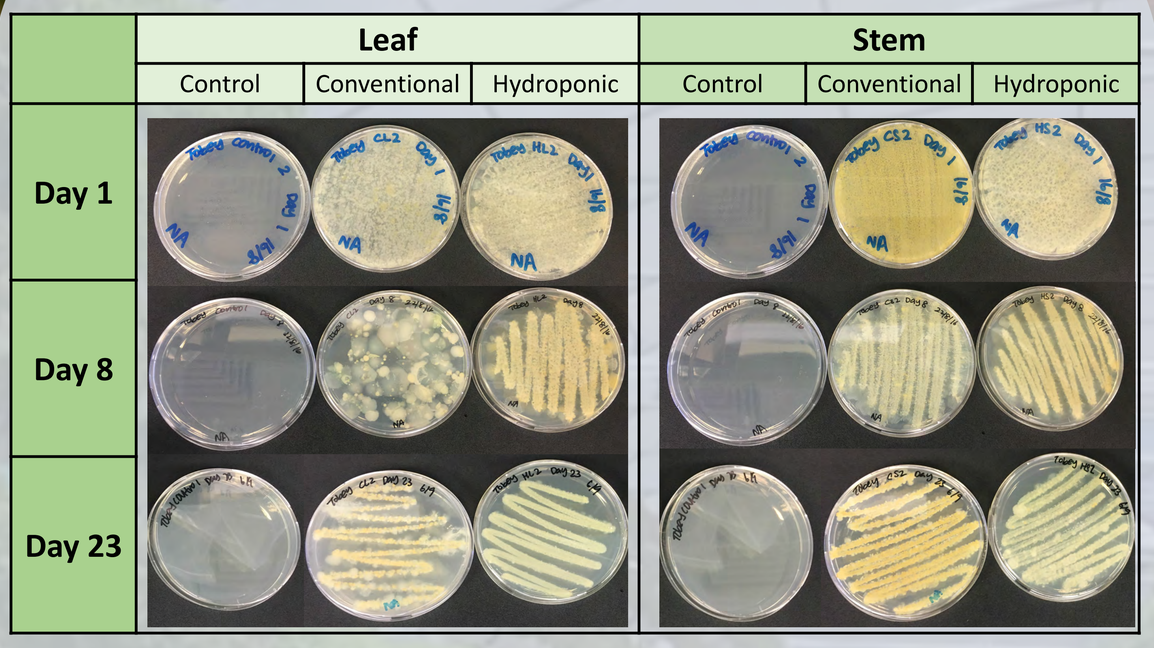


Figure 1-18. Representative plates of mixed bacteria from swab test of spinach leaves conducted on nutrient agar from day 1, 8 and 23 of purchase respectively, with negative control plates. Plates were incubated at 37℃ for 18 hours.

Table 1 . Summary of bacteria identified in both conventionally and hydroponically grown Chinese spinaches

Conventionally grown Chinese spinach	Hydroponically grown spinach
Xanthomonas spp. *Erwinia* spp. *Bacillus cereus* *Staphylococcus aureus* *Proteus* spp.	*Xanthomonas* spp. *Erwinia* spp. *Bacillus cereus* *Staphylococcus aureus* *Proteus* spp.
Acinetobacter spp. *Bacillus mycoides* *Morganella* spp. *Enterobacter* spp. *Citrobacter* spp.	*Providencia* spp. *Klebsiella* spp.
Different genera = 10	Different genera = 7

Discussion

- No pesticides and postharvest processing was employed in a local hydroponic farm which could result in a shorter shelf-life.
- Generally, there is high bacterial diversity across Chinese spinach from both sources. Fertilizers used during conventional farming might contain manure, harboring more microorganisms.
- Common spoilage microorganisms such as *Xanthomonas*, *Erwinia* and *Bacillus* spp. were detected in both Chinese spinach (Sperber *et al.*, 2009).
- Most bacteria are enterobacteriaceae and can be eliminated by heat easily.
- However, regular food testing should still be conducted to improve the microbiological quality of Chinese spinach sold commercially and to safeguard food security in Singapore.
- Future recommendations:
  - Further biochemical testing is required to characterise bacteria to the species level

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