

Fate of acid adapted and unadapted *Salmonella* spp. in traditional cassava fermentation

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Introduction

- Indigenous fermented foods, especially the lactic acid type are an important part in the African's diet
- Lactic fermented foods; affordability, preservation and improved food safety
- Cassava (*Manihot esculenta*, Crantz) is a major food crop consumed in Africa. Fermentation is important for preservation and may play a role in detoxification



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Non-utilisation of
starter cultures

Small scale

Spontaneous

Fermentation technology



Fermented product

Quality

Food safety??

- Enteric pathogens are important aetiological agents of diarrhoeal diseases
- Pathogenesis; surviving acid stress
- Response systems; defence mechanisms against acid stress
- Exposure to sub-optimal conditions (adaptation) enhances survival in more lethal acid challenges

- Adaptation; Gene expression and cross protection
- Survival of enteric pathogens in acidic food products
- Acid adaptation has been shown to increase survival of pathogens in some food products

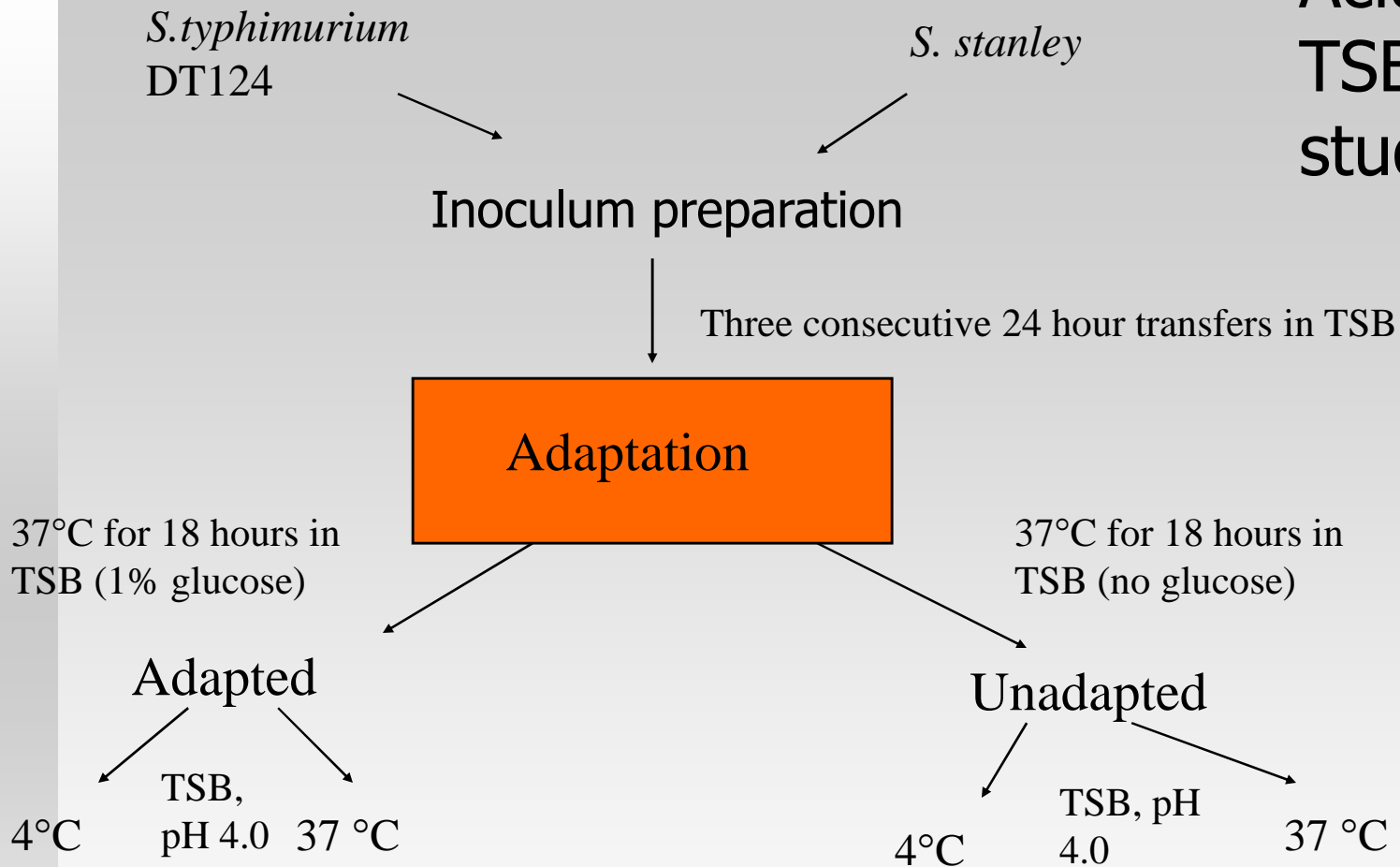
Acid adaptation and survival of pathogenic organisms in foods

Food	Organism	Reference
Cheese	<i>Salmonella typhimurium</i>	Leyer and Johnson, 1992
Ketchup	<i>Salmonella</i> spp. <i>Escherichia coli</i> 0157:H7	Tsai and Ingham, 1997
Fruit juice	<i>Escherichia coli</i> 0157:H7	Hsin-Yi and Chou, 2001
Corn/cowpea porridge	<i>Shigella flexneri</i>	Tetteh et al., 2004
Fermented milk	<i>S.typhimurium</i>	Shen et al., 2007

OBJECTIVES

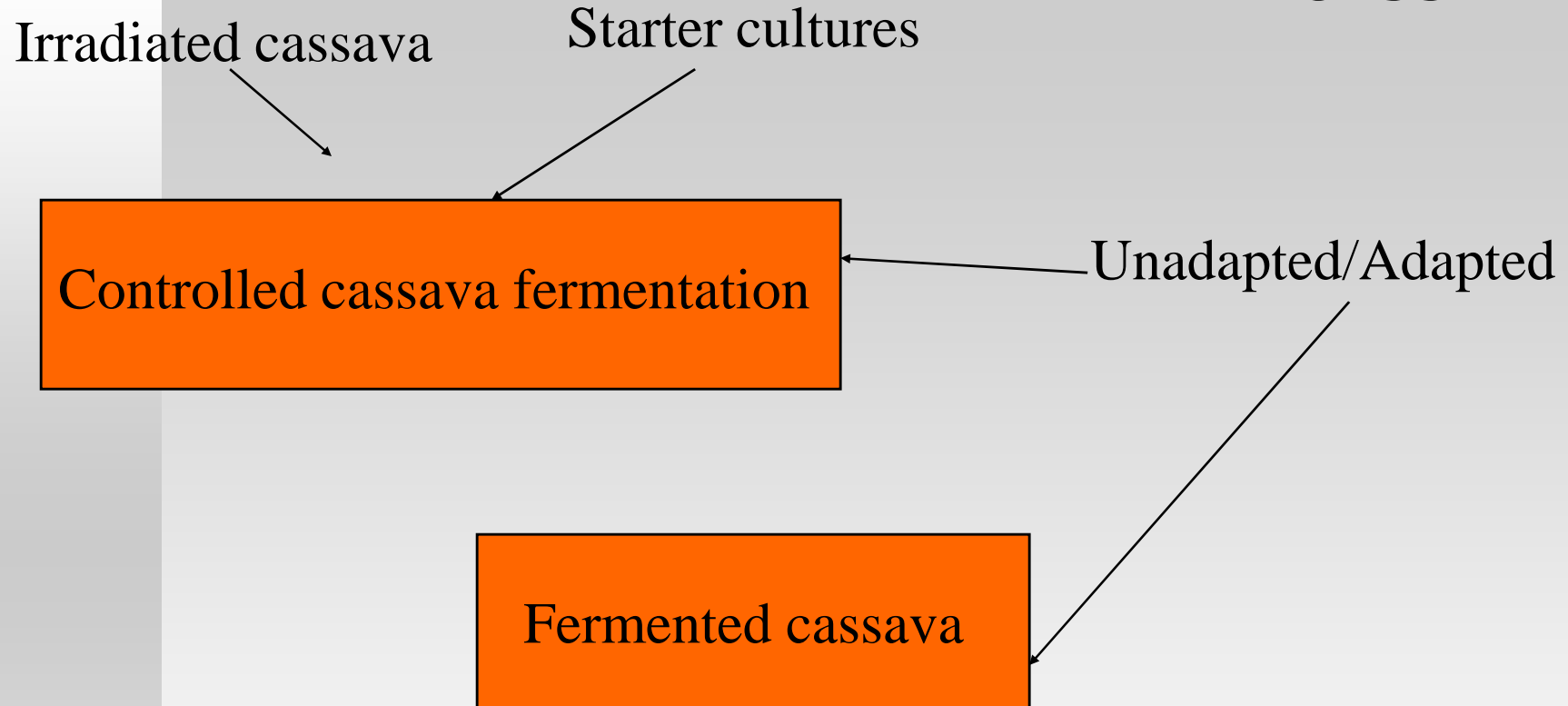
- Study the growth, survival and inactivation characteristics of 2 *Salmonella* spp. as influenced by adaptation in;
 - Acidified tryptone soya broth (TSB) at 4°C and 37 °C
 - Cassava

Acidified TSB studies



- Stationary phase cultures of unadapted (pH 7.4 + 0.05) and adapted (4.80 ± 0.05)
- TSB acidified with lactic acid
- Viable population determined at intervals on tryptone soya agar (TSA)

CASSAVA



- pH of cassava determined at appropriate intervals
- Viable population of *Salmonella* (XLD) and starters (MRS) also determined

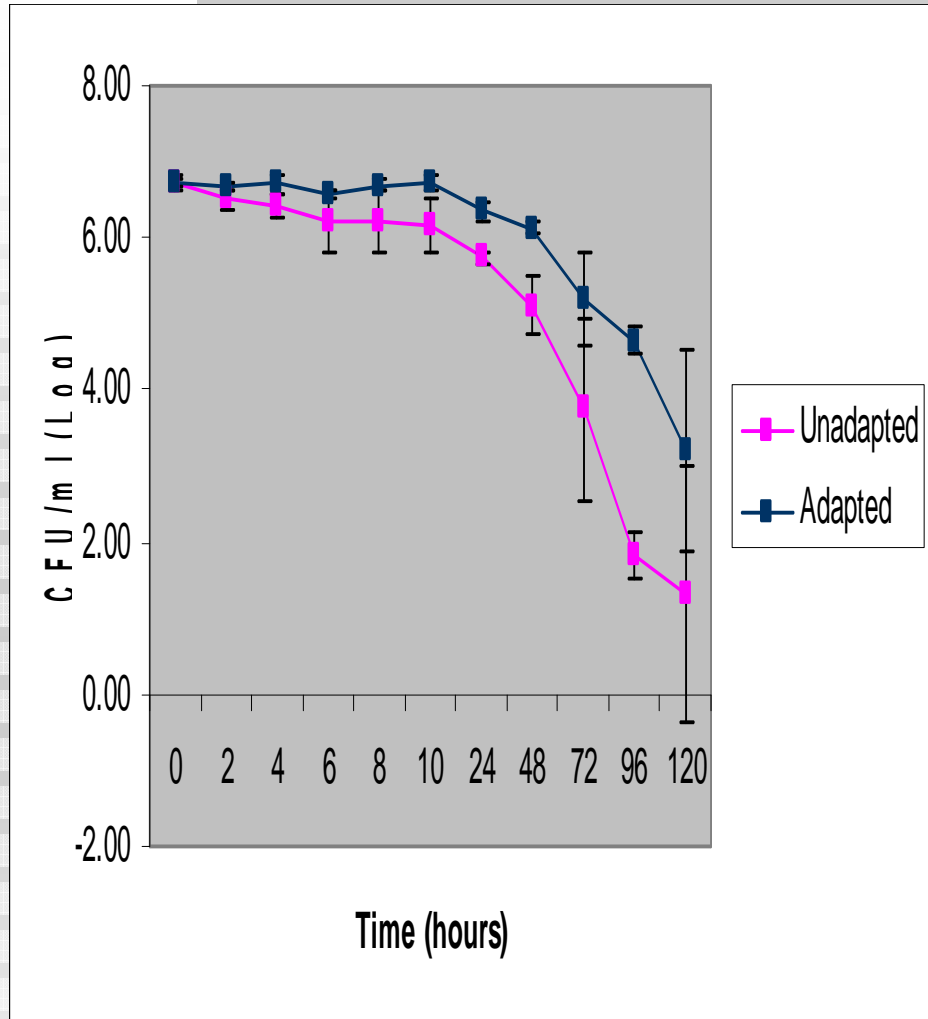
RESULTS..Acidified TSB

- In both *S.typhimurium* and *S.stanley*, acid adapted cells retained higher viability than unadapted cells in acidified TSB at both 4°C and 37°C

- Overall, inactivation of *Salmonella* spp. was enhanced with increase in incubation temperature

- Adaptation appeared to have a more significant effect on the survival of *S.stanley*

(a)



(b)

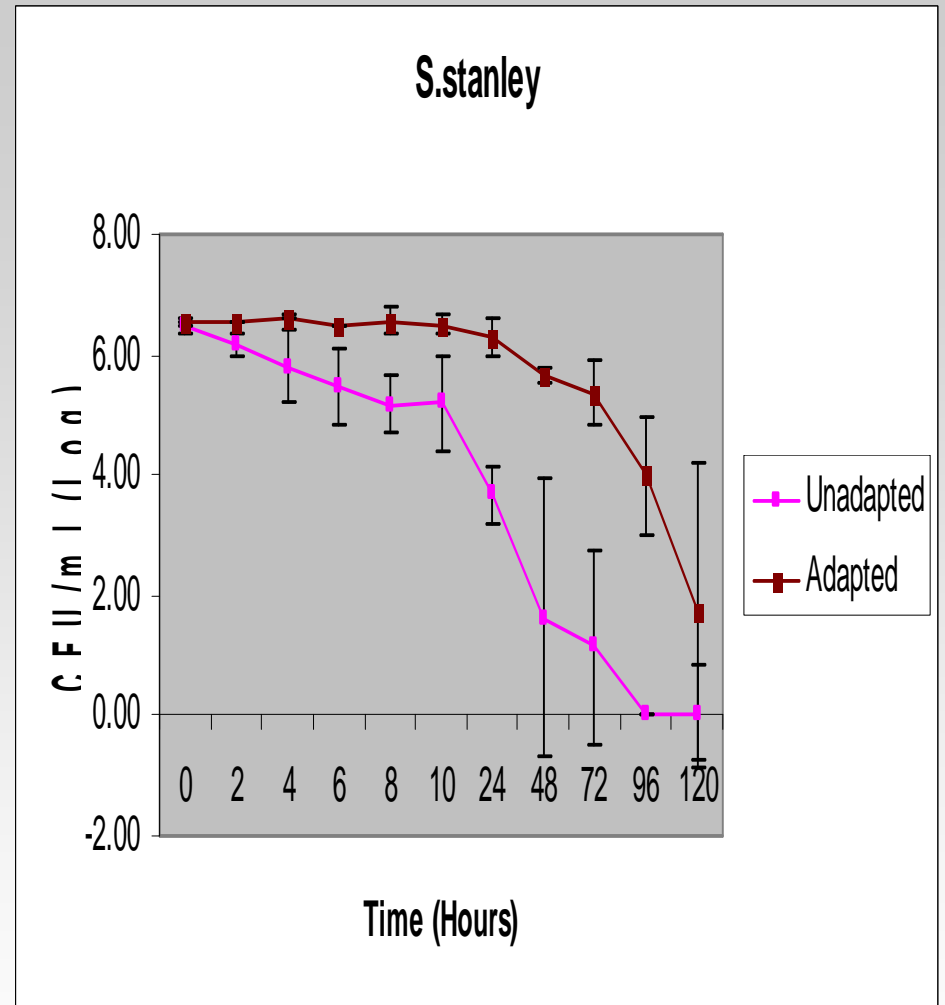
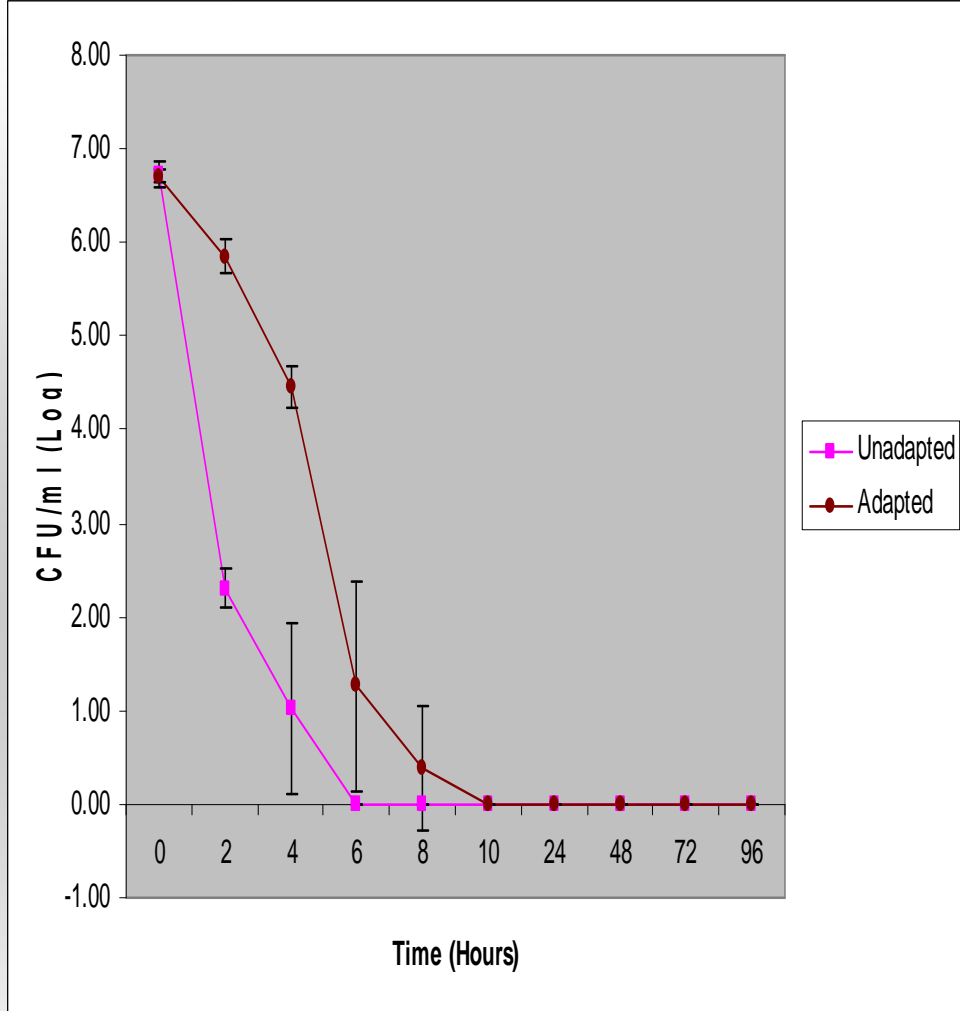


Fig: Changes in viable population of *S.typhimurium* (a) and *S.stanley* (b) in TSB (pH 4.0) at 4°C.

(a)



(b)

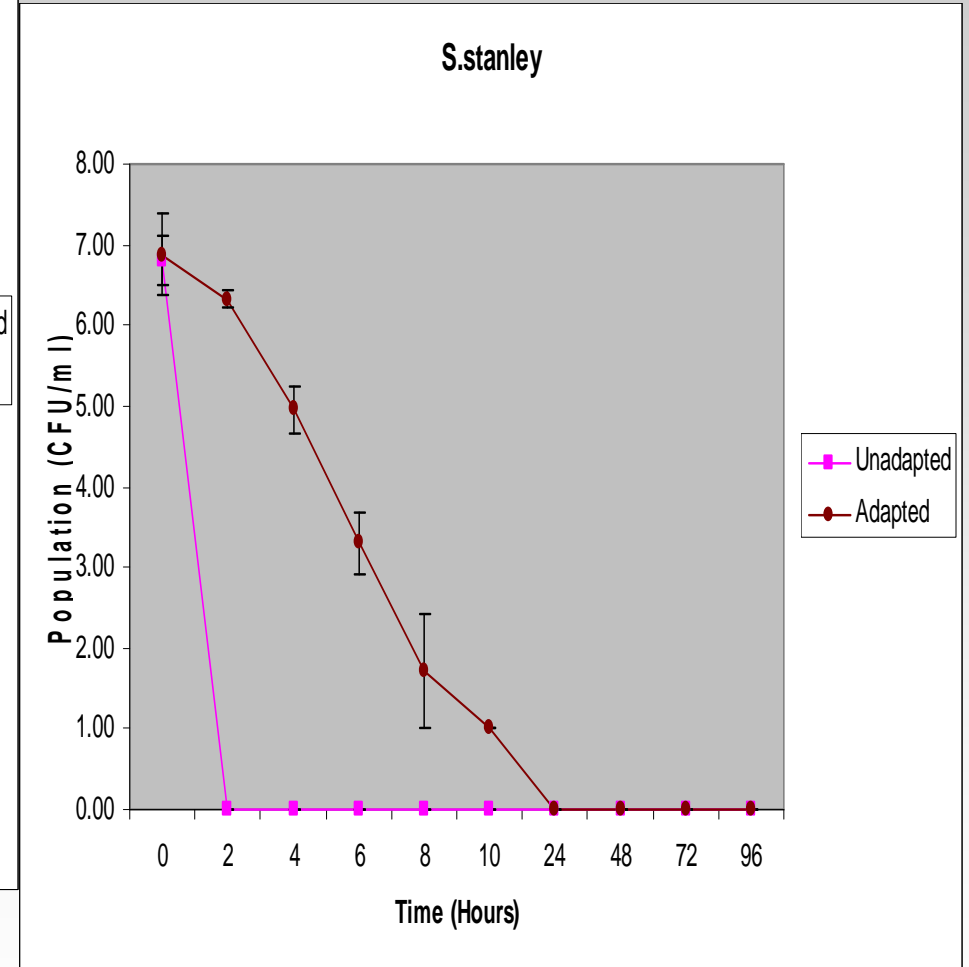


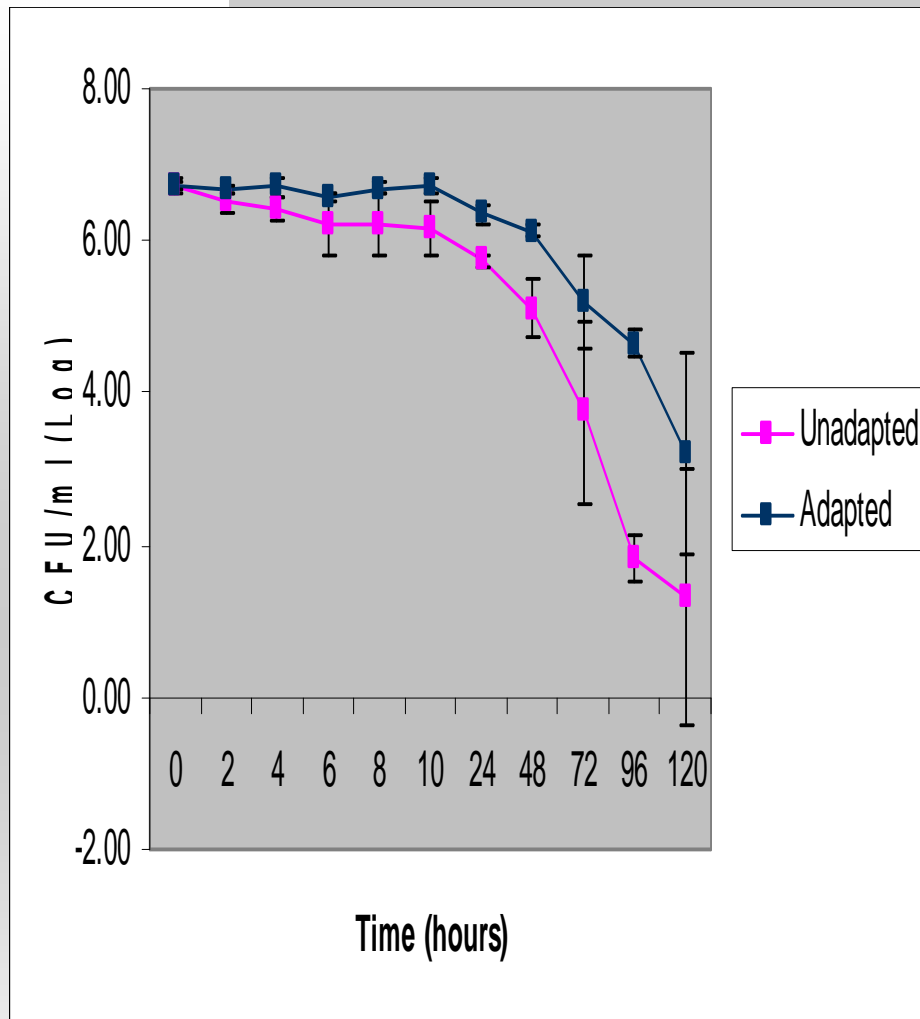
Fig: Changes in viable population of *S. typhimurium* and *S. stanley* in TSB (pH 4.0) at 37°C.

RESULTS..Acidified TSB

- Organic acid was used as an acidulant to reflect type of acid present in fermented food
- In both *S.typhimurium* and *S.stanley*, acid adapted cells retained higher viability than unadapted cells in acidified TSB at both 4°C and 37°C
- Overall, inactivation of *Salmonella* spp. was enhanced with increase in incubation temperature
- Adaptation appeared to have a more significant effect on the survival of *S.stanley*

RESULTS

(a)



(b)

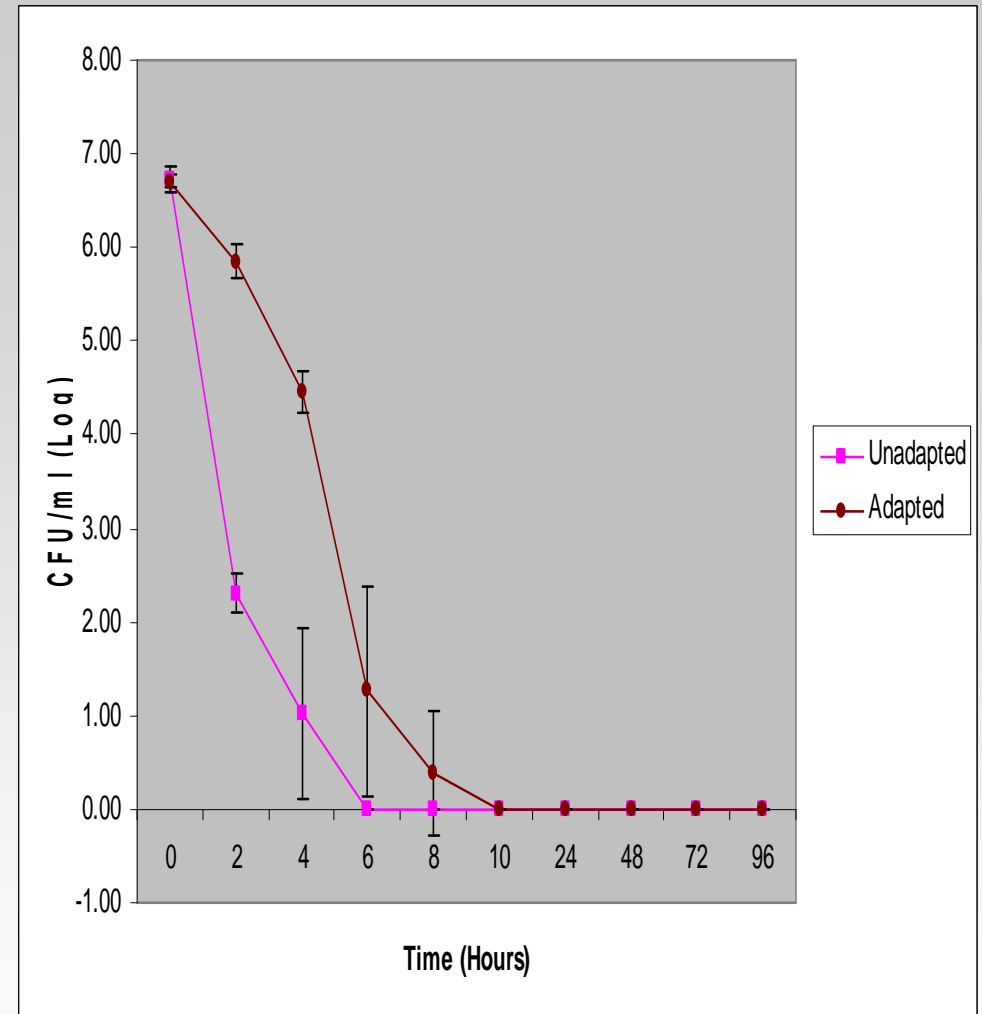


Fig: Changes in population of unadapted and adapted *S.typhimurium* inoculated into TSB (pH 4.0) incubated at 4°C (a) and 37°C (b)

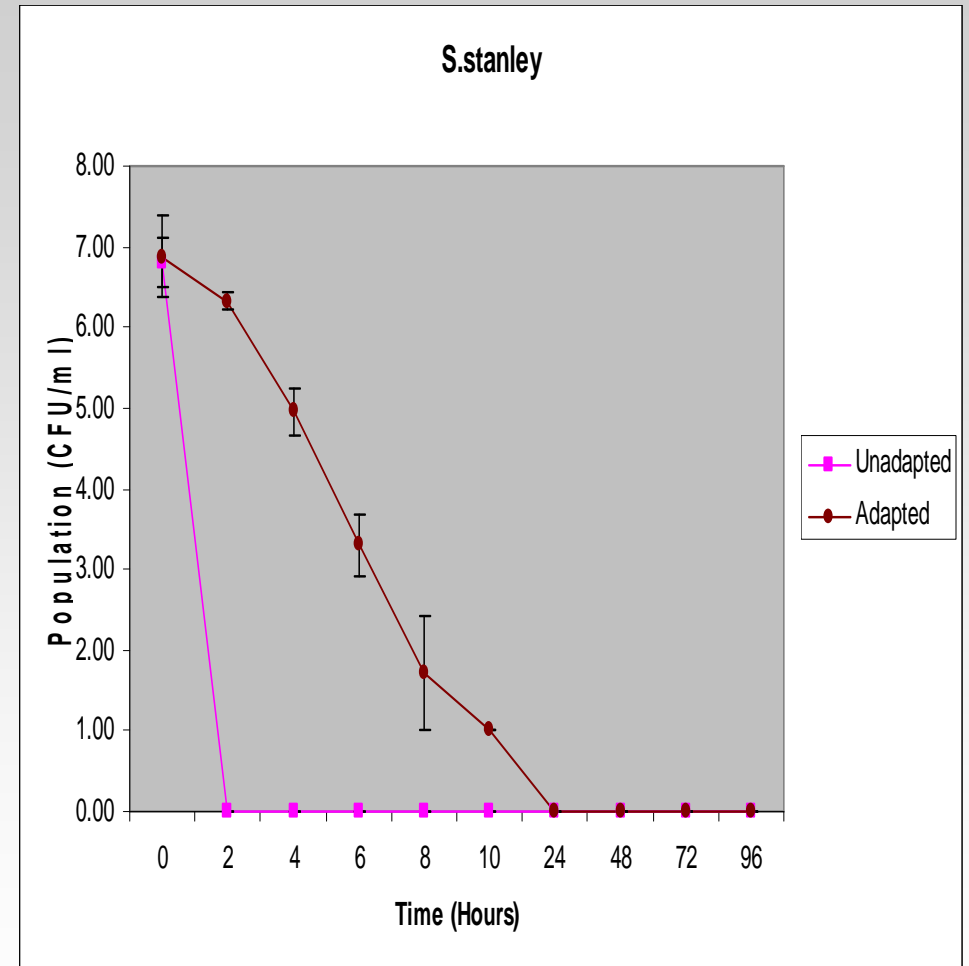
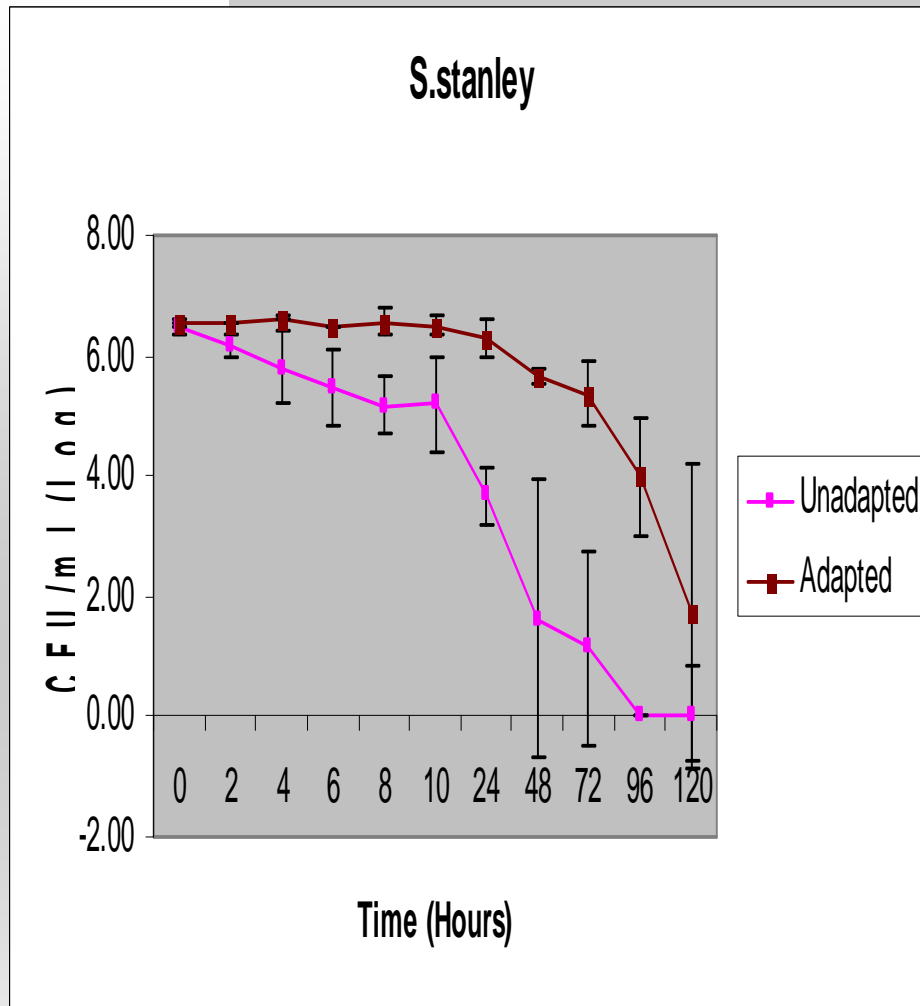
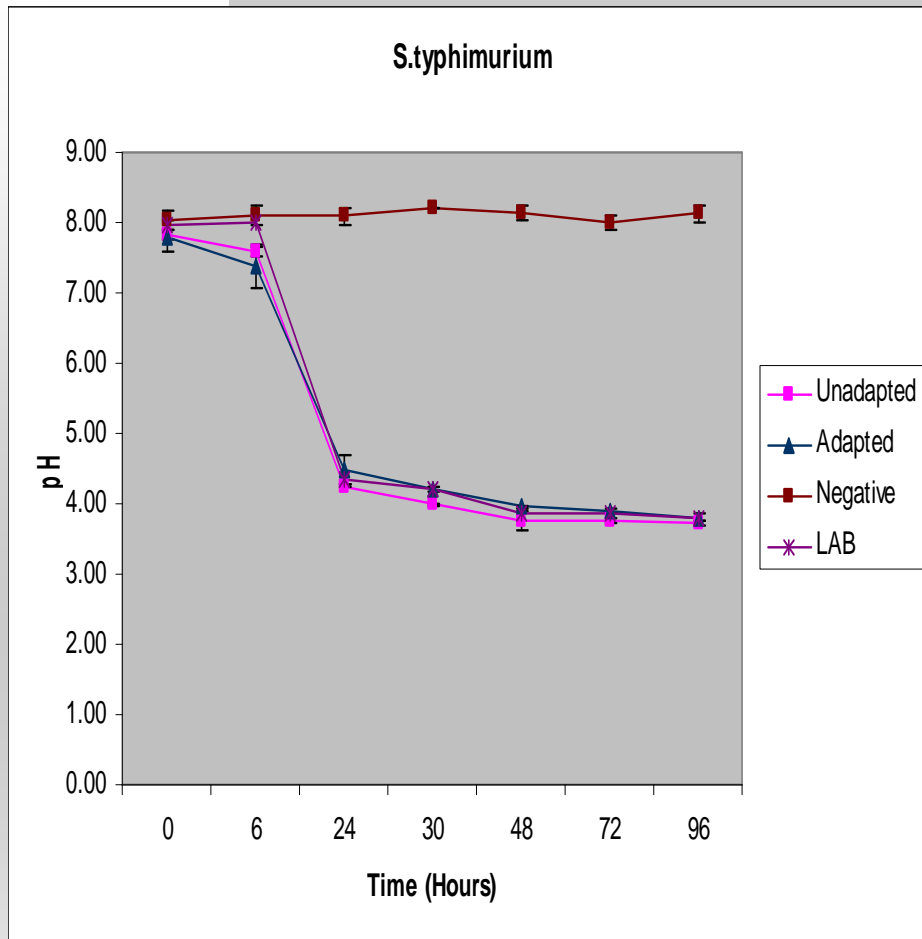


Fig 2: Changes in population of unadapted and adapted *S. stanley* inoculated into TSB (pH 4.0) incubated at 4°C (a) and 37°C (b).

Effect of adaptation on survival of Salmonella in cassava

- Increase in viable population of LAB starters and decrease in pH during cassava fermentation
- Regardless of adaptation, viable population of Salmonella showed a slight increase during the early stages of the fermentation
- Similar inactivation rates for adapted and unadapted cells when inoculated at the beginning of fermentation
- In fermented cassava, acid adapted cells had higher viable populations than unadapted

(a)



(b)

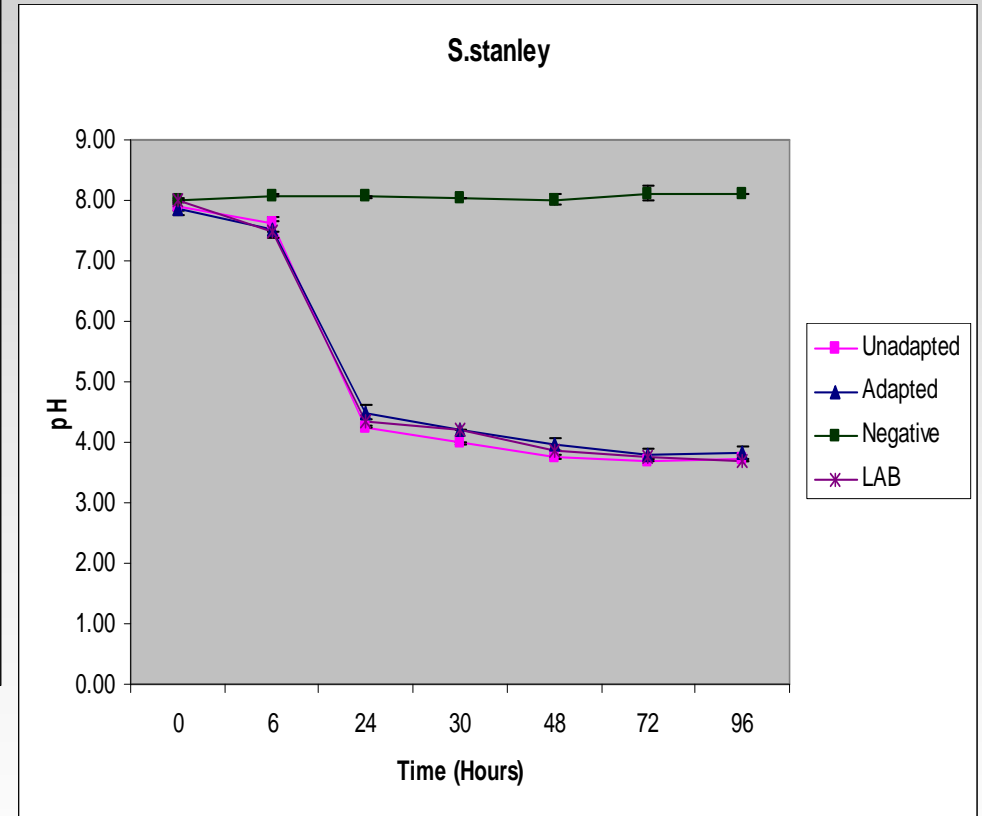
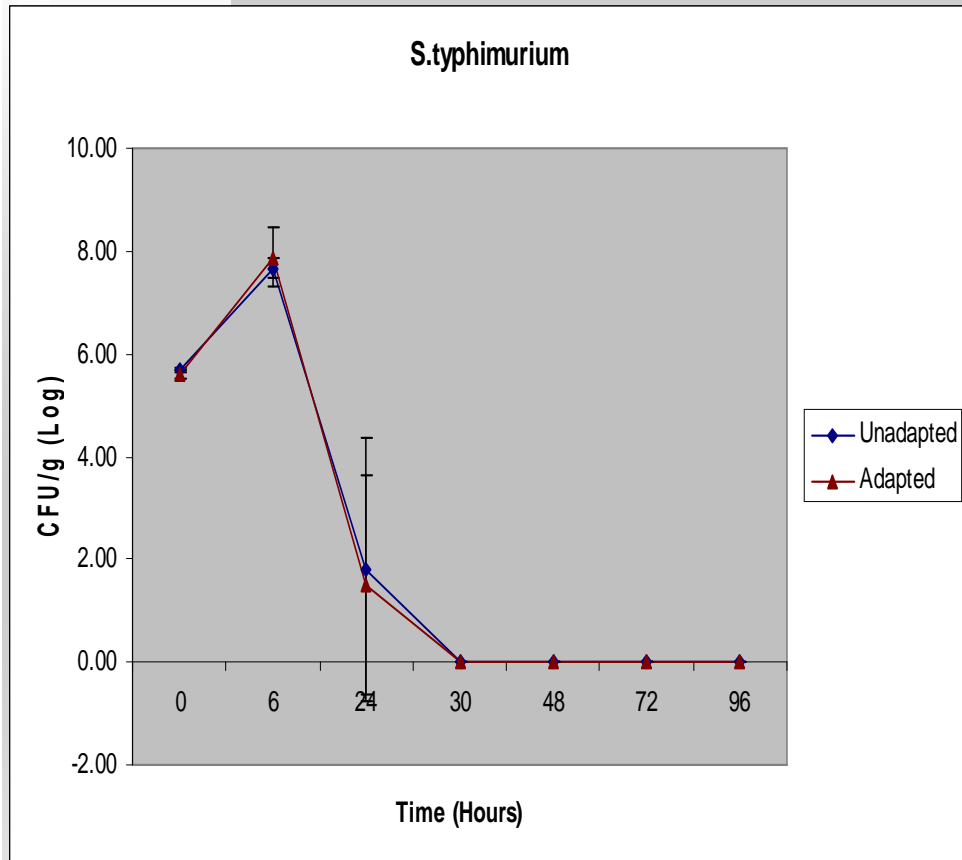


Fig 3: Change in pH in fermenting cassava during the cultivation of acid adapted and unadapted *S.typhimurium* (a) and *S.stanley* (b). Negative and LAB refer to changes in pH in the absence or presence of starter LAB.

Effect of adaptation on survival of Salmonella in cassava

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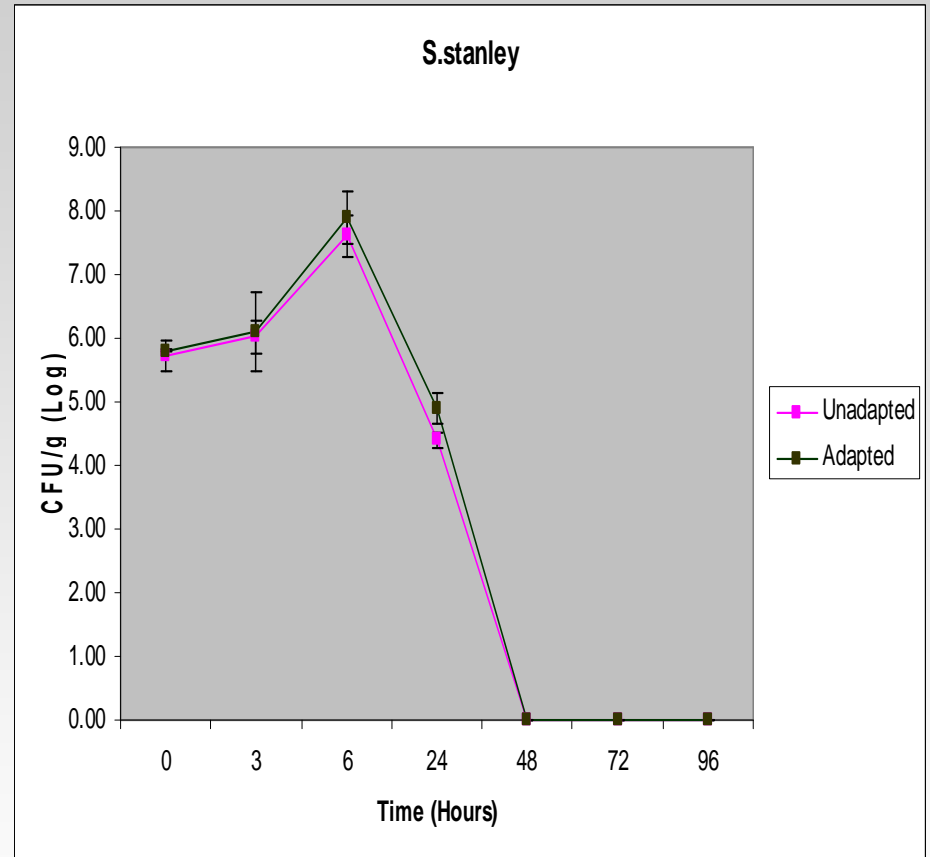
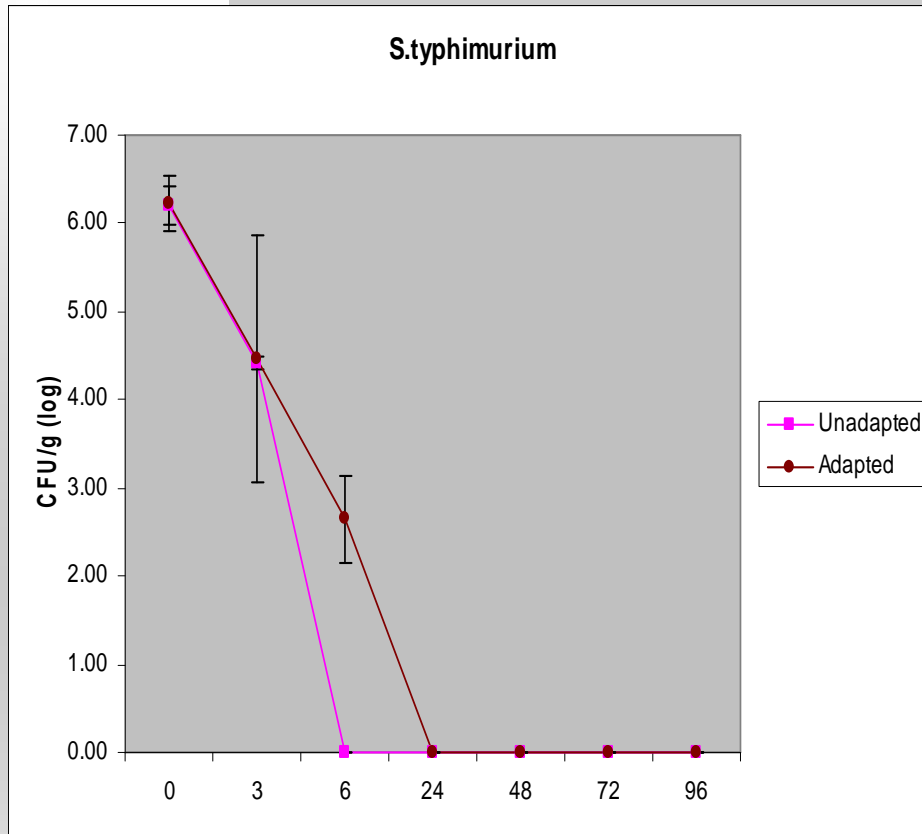


Fig 4: Growth and inactivation behaviour of acid adapted and unadapted *S.typhimurium* (a) and *S.stanley* (b) inoculated at the beginning of cassava fermentation.

Effect of adaptation on survival of Salmonella in cassava

- Increase in viable population of LAB starters and decrease in pH during cassava fermentation
- Regardless of adaptation, viable population of Salmonella showed a slight increase during the early stages of the fermentation
- Similar inactivation rates for adapted and unadapted cells when inoculated at the beginning of fermentation
- Cells that had a prior exposure to reduced pH (adapted) showed better survival in fermented cassava

(a)



(b)

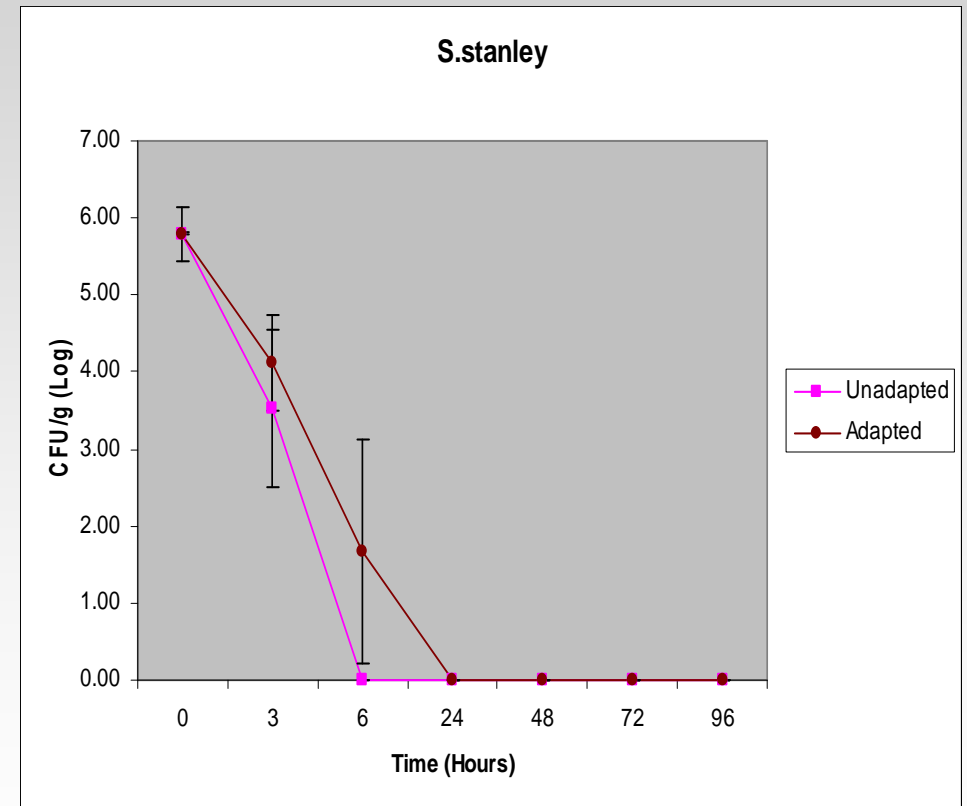


Fig 5: Growth and inactivation behaviour of acid adapted and unadapted *S.stanley* inoculated at the beginning (a) and during (b) cassava fermentation.

Conclusion

- Results indicate that prior adaptation of cells to acidic conditions enhances survival in low pH environments
- Acid adapted cells survived better in acidified broth and in fermented cassava
- Inactivation of cells in acidified broth more rapid at higher temperatures
- Acid adaptation did not appear to influence survival when cells inoculated at the beginning of the fermentation
- Further studies on changes in gene expression during adaptation to provide more information on underlying mechanisms

Acknowledgements



Thank you for listening, questions



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