Analysis of nutritional composition and *in-vitro* enzymatic digestibility of selected rice landraces of Tamil Nadu, India

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Rice (*Oryza sativa* L.) - an important cereal grain

- Cereal grains provide almost half of the calories in human diet
- ‘Rice is life’ in Asia, where 90 per cent of world’s rice is grown and consumed by 60 per cent of population
- Rice provides 20% of the world’s dietary energy supply, while wheat supplies 19% and maize (corn) 5%.

Rice Quality Improvement - Challenges

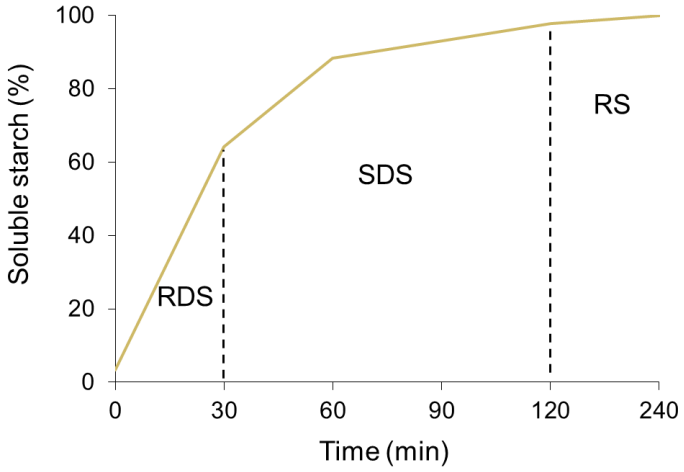
- Consumption influenced by:
  - socio-economic
  - developmental
  - cultural
  - environmental
  - dietary factor

- Limited efforts to improve the nutritional quality of rice
- Introduction of high yielding fertilizer responsive varieties led to narrow genetic base

Consumption pattern

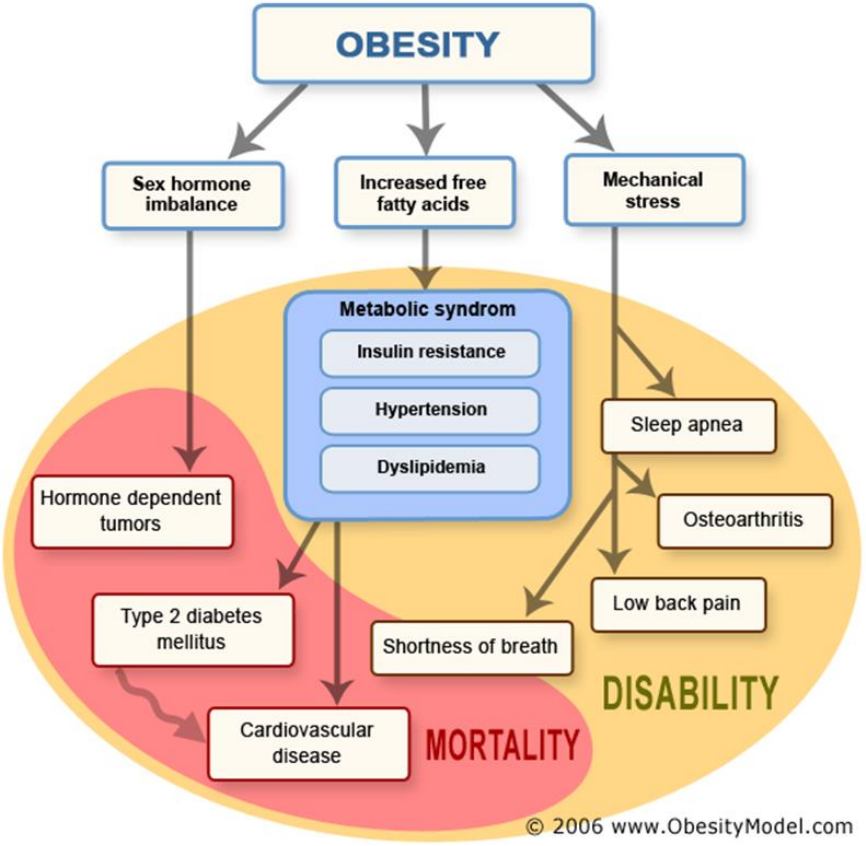
- In the past - whole coarse grains - loaded with sufficient dietary fibre

- At present, they are replaced with refined carbohydrates devoid of any dietary fibre which is resulted in obesity



	Diet (percent of energy)				Diet (grams per day)	
	Fat	Refined Sugar	Starch	Protein	Salt	Fiber
Hunter-gatherers						
(pre-agricultural revolution)	15–20	0	50–70	15–20	1	40
Peasant farmers						
(post-agricultural revolution)	10–15	5	60–75	10–15	5–15	60–120
Modern affluent societies						
(post-industrial revolution)	40+	20	25–30	12	10	20

Obesity affects multiple targets in human metabolism



Resistant Starches – source of dietary fibre in rice

- Resistant starch escapes from digestion in the small intestine but are fermented in the large intestine by bacterial microflora
- It has potential health benefits and functional properties similar to dietary fibre
- Very less in modern day varieties of rice

Landraces – Source of genetic variation

- Contributions to breeding programs not fully appreciated
- Lack of genetic information for biochemical components and its digestibility
- 21 rice landraces from Cauvery-delta region of Tamilnadu, India
- Thanjavur/Tanjore
  the rice bowl of Tamil Nadu

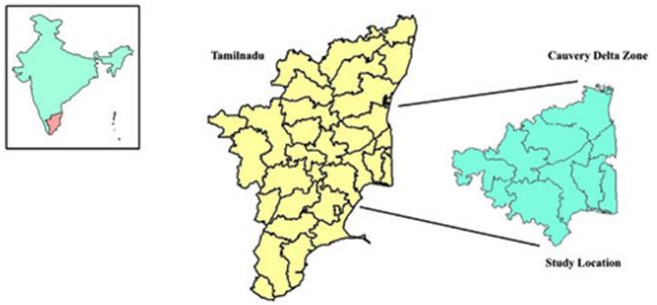


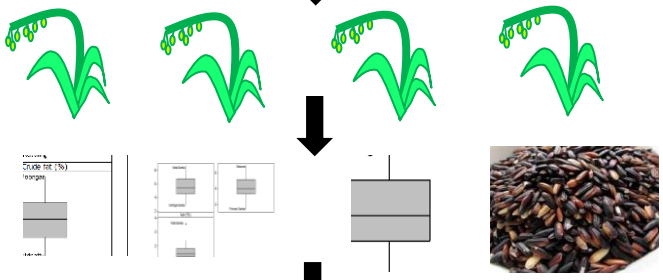
Fig 1. Cauvery Delta Zone Highlighted from Tamil Nadu

List of landraces used in this study

S.No	Land races
1.	Poongar
2.	Varappu Kudaichan
3.	Manavari
4.	Vellai Kattai
5.	Kaliyam Samba
6.	Nootripattu
7.	Godavari Samba
8.	Karthigai Samba
9.	Ganthasala
10.	Ponmani Samba
11.	Mattaikar
12.	Thattaravella
13.	Pavizham
14.	Chinthamani
15.	Mangam Samba
16.	Thulandam
17.	Kallundaikar
18.	Chinna nellu
19.	Vellai Samba
20.	Kavuni
21.	Katta Samba

Materials and methods

Collection of land races



Collected seeds were multiplied in Paddy Breeding Station, TNAU, Coimbatore, India

Mature seeds were harvested for grain quality analysis

Remaining seeds were stored in Ramiah gene Bank

Grain analysis

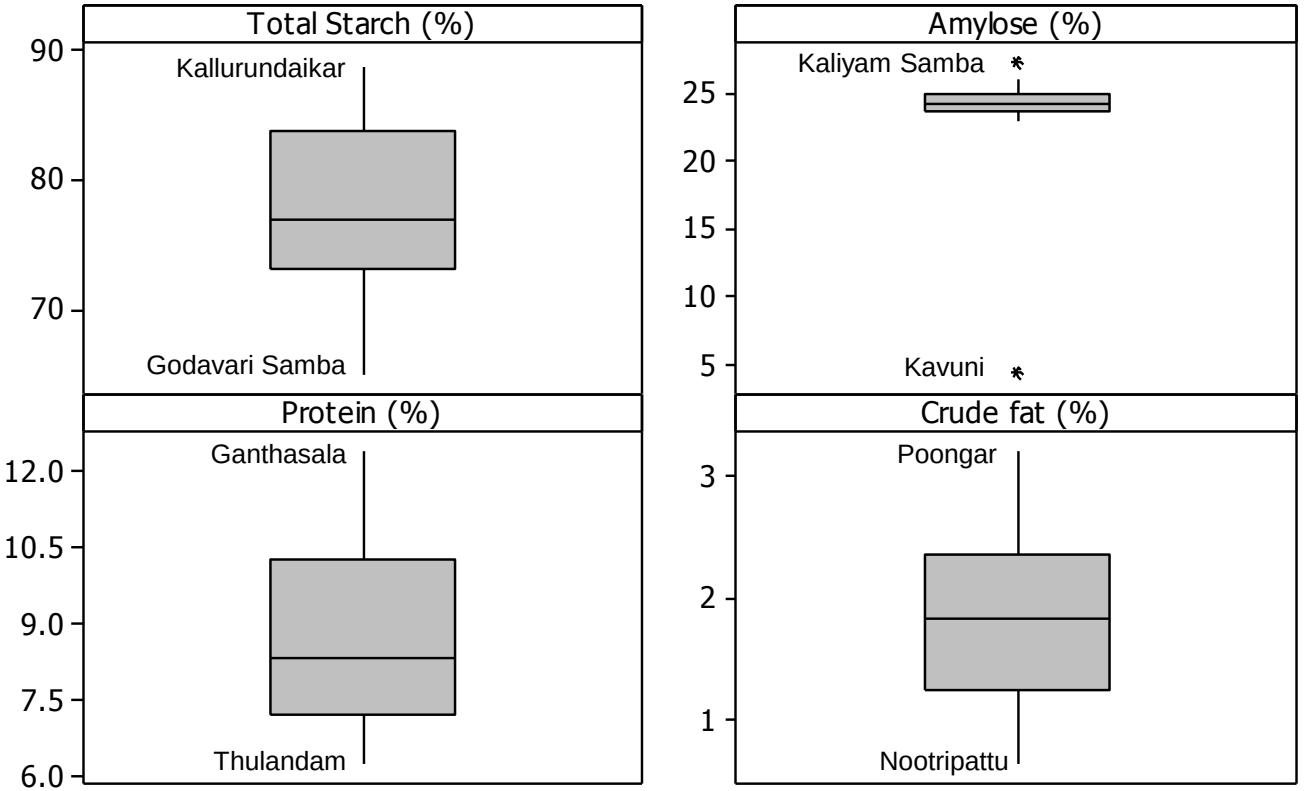
- Starch
- Amylose
- Protein
- TDF
- Fat
- Total phenol
- Ash

In vitro enzymatic hydrolysis

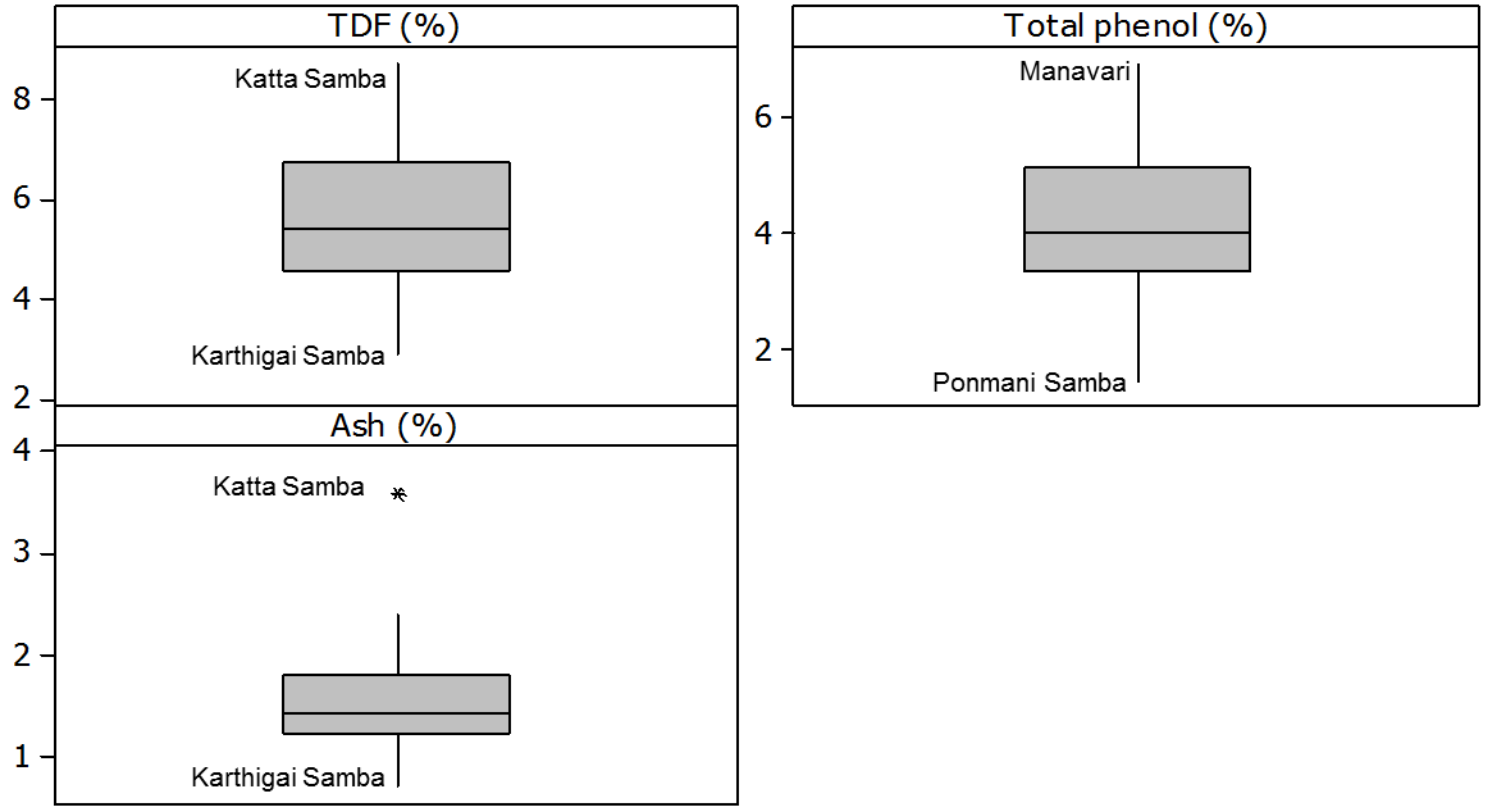
- RDS
- SDS
- RS
- HI

Starch granule size distribution

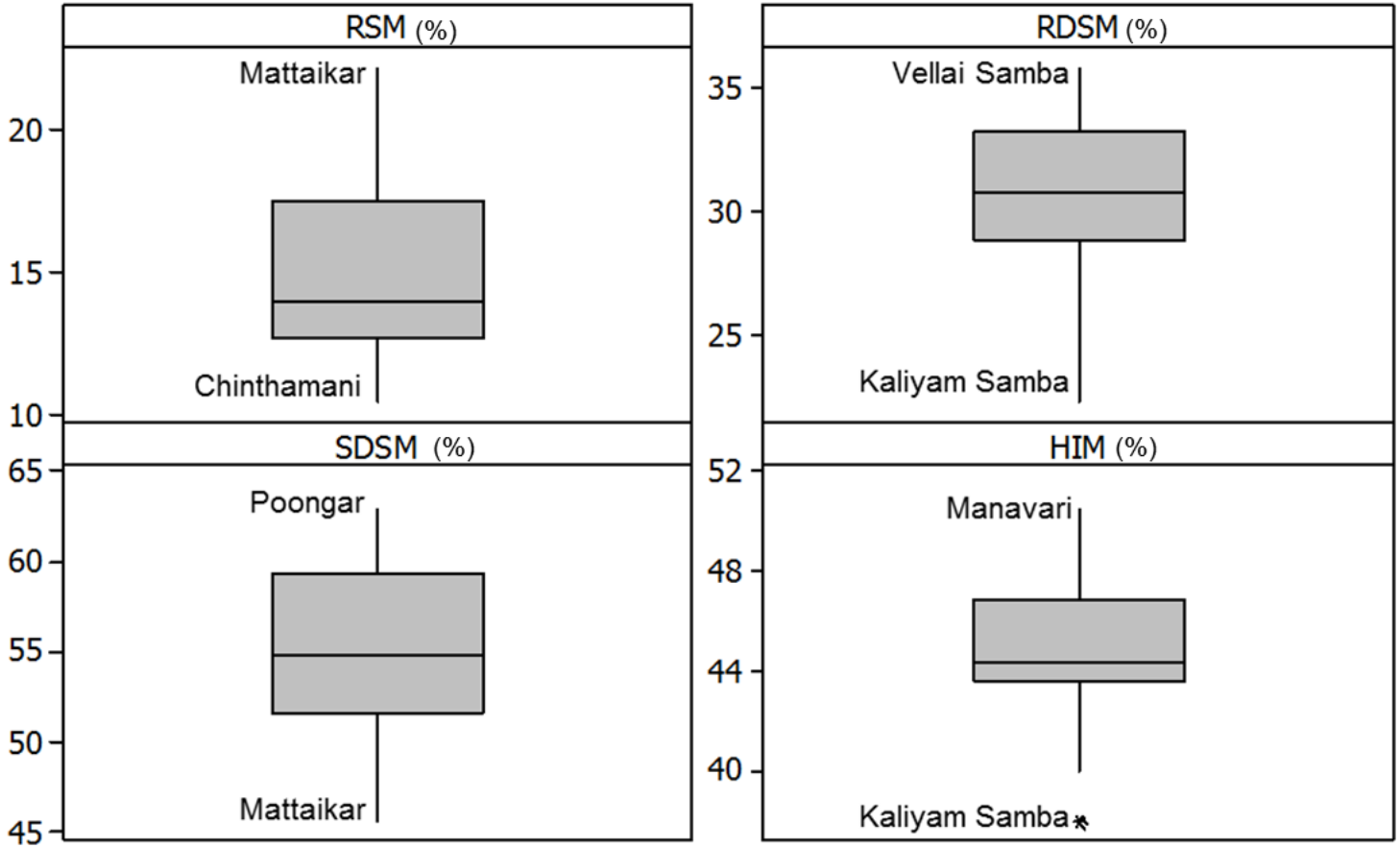
Variation in grain constituents



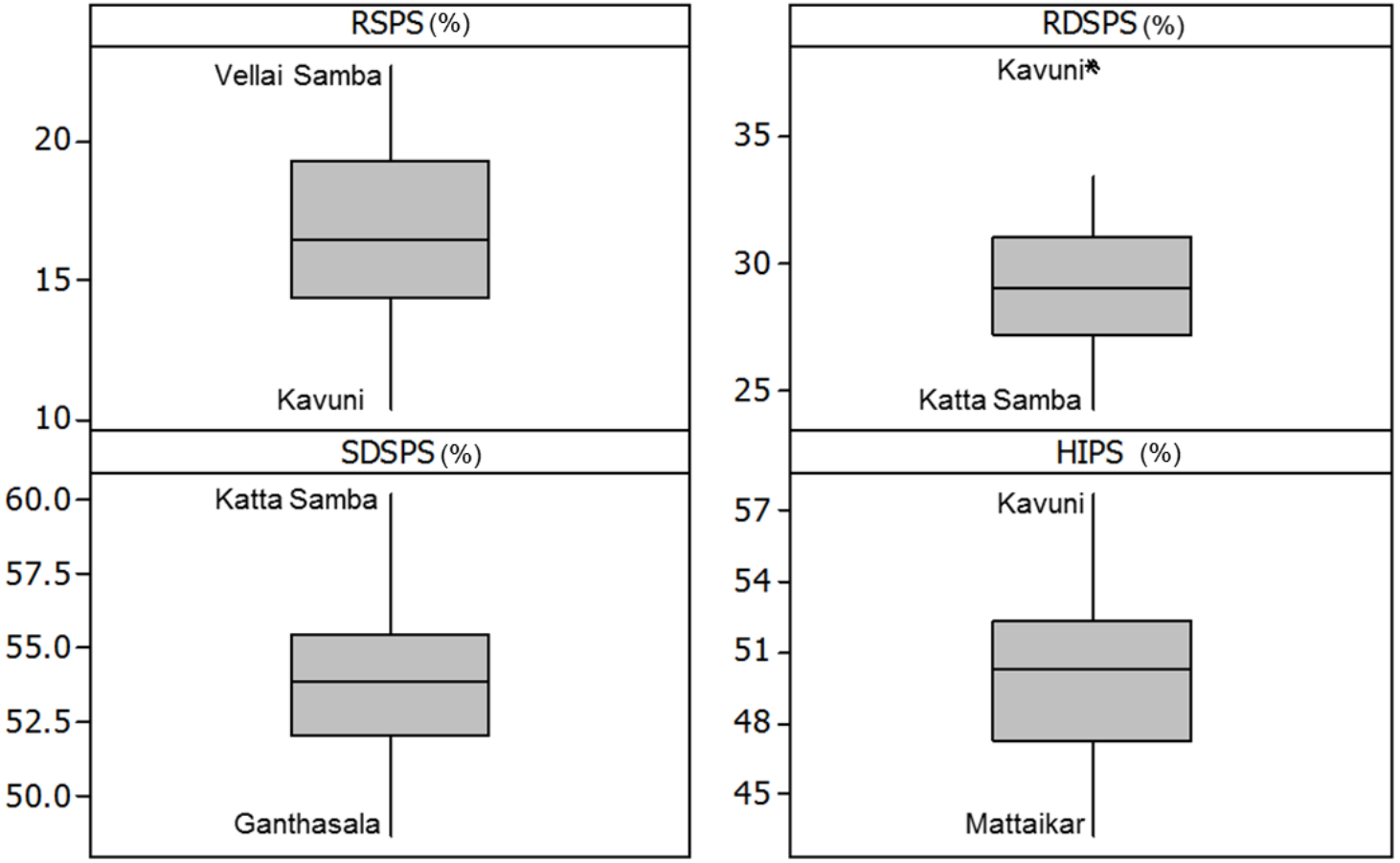
Variation in grain constituents



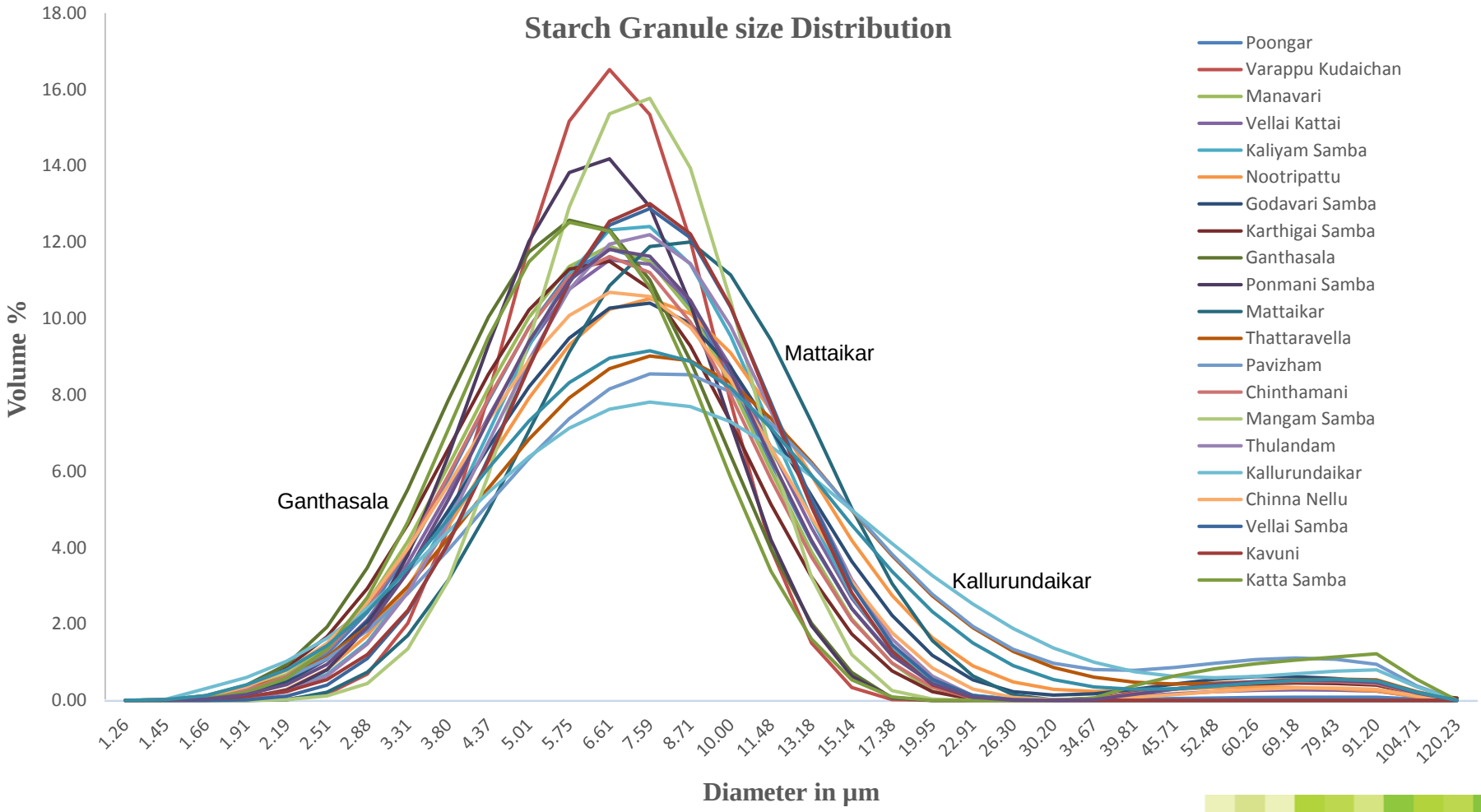
Variation in *in-vitro* enzymatic digestibility – meal sample



Variation in *in-vitro* enzymatic digestibility – pure starch sample (%)



Variation in starch granule size distribution



Association studies

	Total Starch	Amylose	Protein	Crude fat	TDF	Total phenol	Ash	RSM	RDSM	SDSM	HIM	RSPS	RDSPS	SDSPS
Amylose	0.03													
Protein	-0.71**	-0.15												
Crude fat	-0.23	-0.42	0.50*											
TDF	-0.27	-0.11	0.59**	0.79**										
Total phenol	-0.06	-0.12	0.20	0.47	0.68**									
Ash	-0.31	-0.02	0.51	0.68**	0.89**	0.53*								
RSM	-0.29	0.19	-0.22	-0.23	-0.10	0.17	-0.15							
RDSM	0.04	0.01	-0.14	-0.08	-0.05	-0.25	0.04	0.08						
SDSM	0.13	-0.11	0.22	0.17	0.07	0.07	0.03	-0.63*	-0.81**					
HIM	-0.26	-0.13	0.41*	0.14	0.34	0.14	0.18	0.04	0.41	-0.35				
RSPS	-0.14	0.47*	-0.19	-0.35	-0.20	0.02	-0.18	0.60*	0.01	-0.36	-0.18			
RDSPS	0.06	-0.62**	0.21	0.55**	0.12	-0.10	0.00	-0.55	0.07	0.25	0.16	-0.66**		
SDSPS	0.09	0.17	-0.02	-0.23	0.10	0.09	0.21	-0.07	-0.10	0.13	0.03	-0.42*	-0.39	
HIPS	0.06	-0.51	0.22	0.38	0.07	-0.29	-0.01	-0.59	0.06	0.29	0.28	-0.72**	0.89 **	-0.19

Summary

- Kallurundaikar recorded highest total starch (88.72%)
- Amylose content ranged from 4.26 to 27.26%
- Protein content was ranged from 6.28 to 12.39%
- Mattaikar recorded the highest resistant starch (RS) content (22.19%)
- The highest total dietary fibre (TDF) was detected in Katta Samba (8.72 %)
- Land races kaliyam samba and manavari recorded lowest and highest digestibility with the hydrolysis index value of 37.93 and 50.57 respectively.

Conclusion

- Large amount of variation were detected for all the quality traits taken for this study.
- Variation utilized for the development of rice varieties with better end use quality
- The identified landraces with unique biochemical constituents especially the ones with high starch, amylose, protein, RS and TDF will be valuable in breeding specialty rice for improved digestibility by reducing its hydrolysis index.
- These landraces were conserved in Ramiah Gene Bank for future use.

Acknowledgement

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