

XRD ANALYSIS OF VEERAM AND ITS INTERMEDIATES OBTAINED IN THE PURIFICATION PROCESS INVOLVED IN MERCURIAL PREPARATIONS

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INTRODUCTION

Siddha system of medicine, which has a greater antiquity, is popularly practiced in southern part of India. This system has evolved through the sect of intellectuals of spirituality and in the ideal philosophy of the Dravidian society. In today's situation, the toxicity manifestation and related health problems produced in human and to the environment by heavy metals like mercury, lead, arsenic etc. are considered to be of great threat to the society. Many researchers have conducted a number of pharmacological and toxicological experiments and revealed that the toxicity of the crude drug is quite different from that of the finished products of Siddha drugs. Many people are skeptical about the use of Siddha medicine for health care due to lack of scientific documentation. In our Siddha system of medicine *Veeram*¹ being the main ingredient of several formulations plays a vital role. *Veeram* based preparations are prescribed in the treatment of syphilis, liver disorder, skin diseases, Rheumatoid Arthrities and cancer^{2,3}. Books on Siddha *Materia Medica* equate *Veeram* with mercuric chloride.

This toxic *Veeram* is converted into non-toxic human compatible form by this treatment with different plant juices such as bitter gourd juice, lemon juice and tender coconut⁴. Milk is also used as purifying agent. With a view to understand the mechanism of this purification process with organic agents, XRD analysis was carried out before and after purification. Attempts made to study chemical changes mercury undergoes during this process.

MATERIALS AND METHODS

Veeram was procured from Chennai and Thanjavur market raw drug dealers and authenticated using the database (7487-94-7 CAS Data Base Reference) Purifying agents such as bitter gourd, lemon and tender coconut were purchased from vegetable market, Thanjavur, Tamil Nadu and milk was procured from SASTRA Dairy Farm, SASTRA University, Thanjavur.

Veeram was treated with these organic agents individually and all the samples were subjected to XRD analysis. Raw *Veeram* was also analysed for comparison purpose.

XRD analysis

The X-ray diffraction pattern of the raw *Veeram* and *Veeram* samples purified by various purifying agents obtained were recorded using Bruker D8 X-ray diffractometer, Germany at a scan rate of 1 step/second. The powdered sample was irradiated with Cu-K α radiation and the analysis was performed from 10° to 60° (2 θ) with a step size of 0.001°.

RESULTS AND DISCUSSION

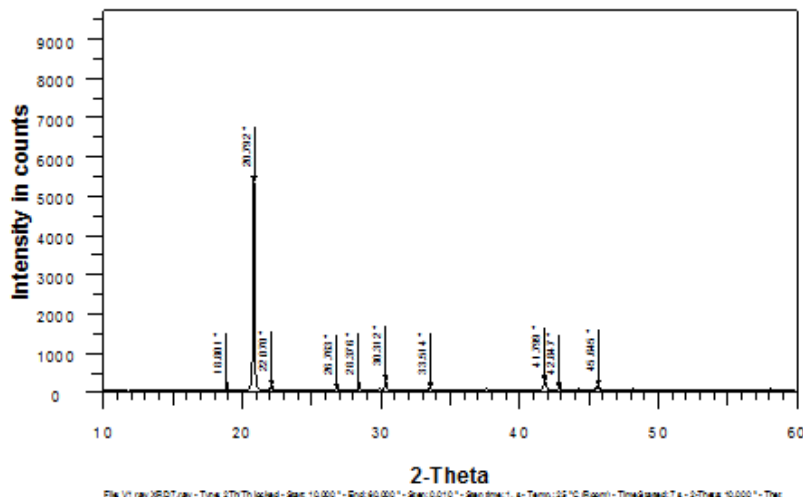
Among the mercurial compounds mercuric chloride (*Veeram*) is more toxic. But it has been used since thousands of years in traditional medicine. In the present work the data obtained on the XRD analysis of raw *Veeram* and its intermediates obtained in the purification process involved in mercurial preparations is presented and discussed.

Based on the data of 2-theta and hkl values it is concluded that,

- The raw mercuric chloride and treated mercuric chloride are matching with the orthorhombic system with the primitive lattice (Ref no:89-7109 PCPDF-WIN)
- In the raw *Veeram* (mercuric chloride), there is a peak at 18 which revealed the presence of some impurities which is getting reduced when it is treated with bitter gourd, milk and lemon juice.
- This further confirms our inference that the raw *Veeram* is mercuric chloride.
- The crystal size was calculated using Scherrer equation. Increased size observed in our data may be due to agglomeration of several crystallites and increase in crystallite size may be attributed to the heat generated during the purification process. The diffraction peaks of mercuric chloride are sharper in milk intermediates while other intermediates also showed peaks.

Table 1: Shows the 2 θ values and hkl

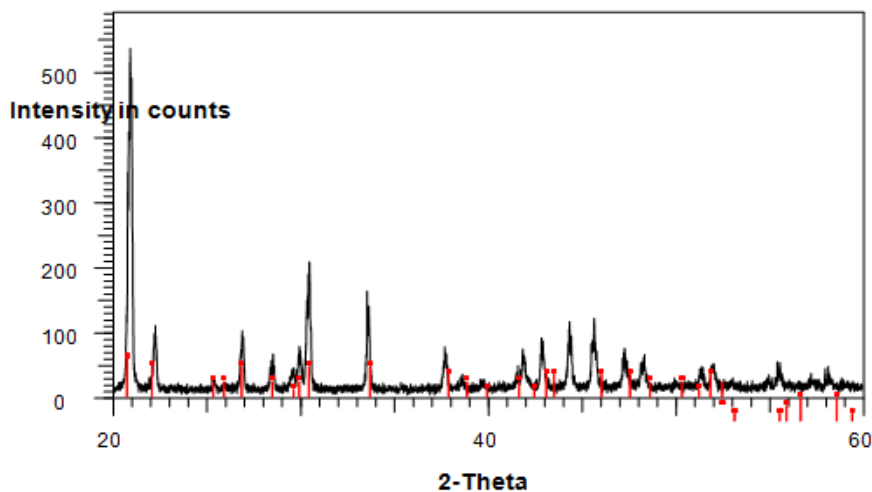
2-theta	hkl indices
20.8	2 1 0
22.1	1 0 1
25.2	2 0 1
26.8	1 1 1
28.4	4 0 0
29.5	2 1 1
29.8	3 0 1
30.3	0 2 0
33.5	3 1 1
37.6	1 2 1
38.6	4 1 1
39.6	2 2 1
41.8	0 0 2
42.8	3 2 1
44.2	2 0 2
45.6	2 1 2
47.2	3 0 2
48.2	2 3 0



Sample Name	Left Angle	Right Angle	Left Int.	Right Int.	Obs. Max	d (Obs. Max)	Max
Int.	Net Height	FWHM	Chord Mid.	I. Breadth	Gravity C.	d (Gravity C.)	Raw
Area	Net Area						
	2-Theta °	2-Theta °	Cps	Cps	2-Theta °	Angstrom	Cps
Theta °	Cps	2-Theta °	2-Theta °	2-Theta °	2-Theta °	Angstrom	Cps x 2-
	Cps x 2-Theta °						
	20.550	21.030	164	132	20.794	4.26841	5378
	5231	0.126	20.792	0.141	20.786	4.26998	810.0
	738.9						

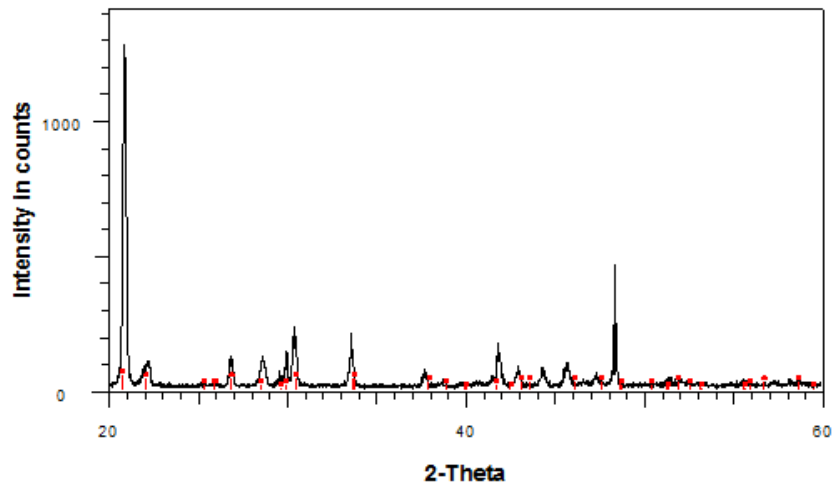
XRD ANALYSIS DATA

VEERAM PURIFIED WITH BITTER GOURD (BV1)



Sample Name	Left Angle	Right Angle	Left Int.	Right Int.	Obs. Max	d
(Obs. Max)	Max Int.	Net Height	FWHM	Chord Mid.	I. Breadth	Gravity
C.	d (Gravity C.)	Raw Area				
2-Theta	ressec@bdu.ac.in °	2-Theta °	Cps	G Cps	2-Theta °	Angstrom
Cps	2-Theta °	2-Theta °	2-Theta °	2-Theta °	2-Theta °	Angstrom
Theta °	Cps x 2-Theta °					
20.570	21.050	35.9	52.3	20.865	4.25400	519
	20.832	0.233	20.836	4.25985	131.3	110.1

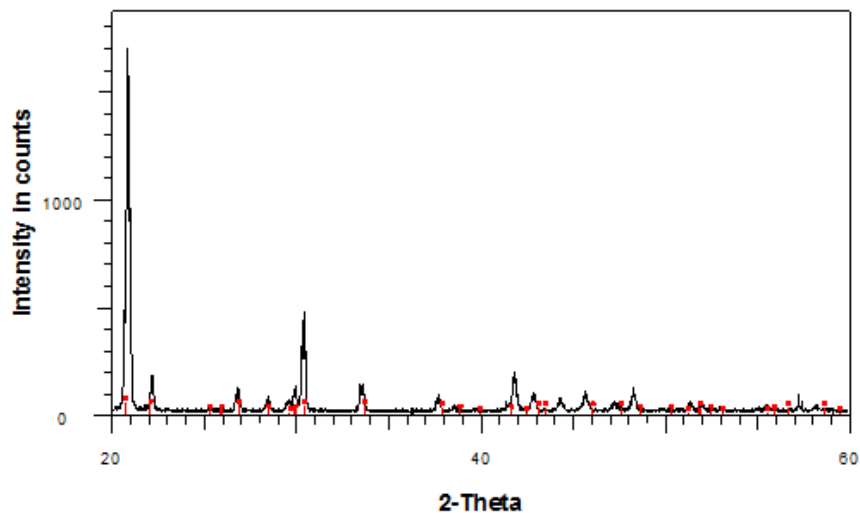
XRD ANALYSIS DATA
VEERAM PURIFIED WITH MILK (MV1)



File: MV1.raw - Type: 2Th/Th locked - Start: 20.000° - End: 60.000° - Step: 0.010° - Sample: 1 - a - Temp.: 25 °C (Room) - Time Scanned: 6s - 2-Theta: 20.000° - Theta: 10.000°
 00-00-0222 (J) - Mercury Chloride - HgCl2 - V: 4.52 Å - d: by 0.6666 - W: 1.5406 - Orthorhombic - a: 4.3220 - b: 4.7820 - c: 2.6620 - alpha: 90.000 - beta: 90.000 - gamma: 90.000

Sample Name	Left Angle	Right Angle	Left Int.	Right Int.	Obs. Max d (Obs. Max)	Max Int.	Net Height	FWHM
Chord Mid.	I. Breadth	Gravity C.	d (Gravity C.)	Raw Area	Net Area			
2-Theta °	2-Theta °	Cps	Cps	2-Theta °	Angstrom	Cps		
Cps 2-Theta °	2-Theta °	2-Theta °	2-Theta °	2-Theta °	Angstrom			
Cps x 2-Theta °	Cps x 2-Theta °							
20.550	21.040	98.4	85.9	20.781		4.27100		

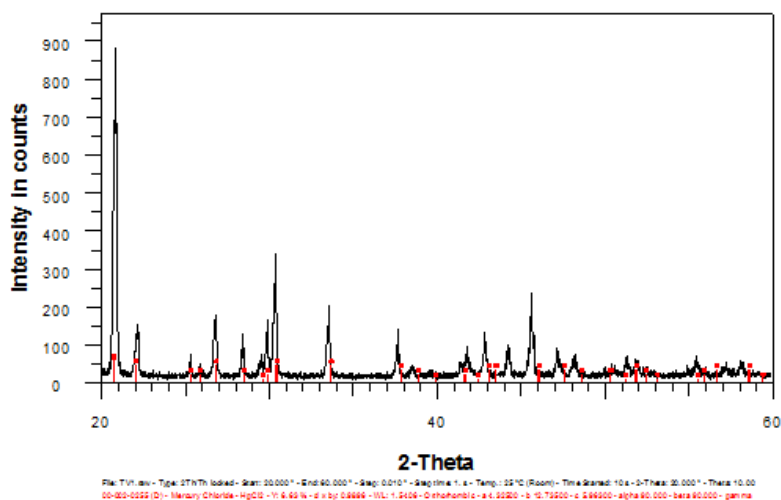
XRD ANALYSIS DATA
VEERAM PURIFIED WITH LEMON JUICE (LV1)



File: LV1.raw - Type: 2Th/Th locked - Start: 20.000° - End: 60.000° - Step: 0.010° - Sample: 1 - a - Temp.: 25 °C (Room) - Time Scanned: 6s - 2-Theta: 20.000° - Theta: 10.000°
 00-00-0222 (J) - Mercury Chloride - HgCl2 - V: 4.52 Å - d: by 0.6666 - W: 1.5406 - Orthorhombic - a: 4.3220 - b: 4.7820 - c: 2.6620 - alpha: 90.000 - beta: 90.000 - gamma: 90.000

Sample Name	Left Angle	Right Angle	Left Int.	Right Int.	Obs. Max d (Obs. Max)	Max Int.	Net Height	FWHM	Chord
Mid.	I. Breadth	Gravity C.	d (Gravity C.)	Raw Area	Net Area				
2-Theta °	2-Theta °	Gravity C.	Cps	Cps	2-Theta °	Angstrom	Cps		
Cps 2-Theta °	2-Theta °	2-Theta °	2-Theta °	2-Theta °	Angstrom				
Cps x 2-Theta °	Cps x 2-Theta °								
20.510	21.030	124	110	20.760		4.27527			
1649	1532	0.224	20.809	0.229	20.782	4.27071			

XRD ANALYSIS DATA
VEERAM PURIFIED WITH TENDER COCONUT (TV1)



Sample Name	Left Angle	Right Angle	Left Int.	Right Int.
Obs. Max	d (Obs. Max)	Max Int.	Net Height	FWHM
Chord Mid.	I. Breadth	Gravity C.	d (Gravity C.)	Raw
Area	Net Area			
2-Theta °	2-Theta °	Cps	Cps	2-Theta °
Cps	Cps	2-Theta °	2-Theta °	2-Theta °
Angstrom	Cps x 2-Theta °	Cps	Cps x 2-Theta °	
20.500	20.960	84.0	69.9	20.785
				4.27028

Table 2: Grain size data of raw *veeram* and its intermediates obtained in the purification process

Content	Grain Size (nm)
Raw Veeram	631.976
BV1	317.277
MV1	400.140
LV1	355.471
TV1	363.599

CONCLUSION

From the XRD pattern obtained it is further confirmed that *veeram* is mercuric chloride and only in the milk and lemon treated intermediates, the intensity and sharpness of the peak is comparatively less there by suggesting that this method is contributing towards suppressing the toxicity of mercuric chloride. The bitter gourd treated intermediate also showed less intensity but it showed many peaks which may be due to the interaction between molecules present in the plant and mercuric chloride. It may be concluded that these purification processes involving organic reagents has a role in the formation of complexes and in converting toxic to non-toxic form which is to be further explored using modern sophisticated instrumentation techniques. From the data obtained in the present study, it is proved majority of the impurities present in the raw material are removed which is evident by the absence of peak at 18 in all other intermediates.

ACKNOWLEDGEMENT

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