



BIOMETRICAL AND QUALITY STUDIES IN TOMATO (*Lycopersicon esculentum* Mill.)

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Results of different characters the same were subjected to statistical and biochemical analysis. In fruits volume was found to range from V8 (24.333, 24.400 cm³ to V23 (80.633, 81.733 cm³) cultivars during 1998-99 and 1999-2000, respectively. A considerable range of variation was observed in yield of fruits varied from 1.177 to 2.367 kg per plant in treatments V26 to V5 during 1998-99. It ranged from 1.123 to 2.780 kg per plant yield in V26 to V16 treatment in 1999-2000, respectively. Storage life of fruit varied from 7.367 (V22) to 10.767 days (V18) and 7.900(V26) to 10.567 (V18) during 1998-99 and 1999-2000, respectively. In preservation findings puri and ketchup were found the best products prepared by the pulp of KS-1 (V3) Azad T2 (V15), K.S.-166(V17) and K.S -183 (V21). Different products gave desirable taste in tomato in ketchup and puree.

I. INTRODUCTION

India has achieved self sufficiency and a good degree of stability in food grain production which has created and urgent need for providing health-security to our population by adequate supplementing of vegetables-nutrition for balanced diet . vegetable are the most important component of a balance diet . we can grow a wide variety of vegetable throughout the year. India is the world's second largest producer of vegetable after china producing about 54.36 million tonnes and number of vegetable grown in the country is quite large but per capita availability of these are quite low. As per dietary recommendation of blanced diet a minimum supply of 285 g of vegetable per capita per day is required . [1] Among them tomato is one of the most important ,popular and wiedy grown vegetable in the world ranking second in important to potato in many countries put it tons the list of canned vegetables. A large quantities of tomt to fruits are used to prepare soup, juice, ketchup, puree, paste powder etc, products.[2]

Tomato is also popular because it supplies vitamin 'C' and adds variety of colours and flavour to the foods . Green tomato are also used for pickles and preserves . Its seed contains oil and extracted pulp residues are also used in canning industry for preparing various product [3].

The popularity of tomato has increased tremendously in recent year in our country . No dining table can be seen without tomato . it is always present in the form of vegetable or salad or Ketchup utilization of tomato in industry has increased its cultivation all over world. In our country different varieties/selections are grown through out the year. Determinate type of How tomatoes has gained an important prospects for different purposes . varying nature

of genotypes gives a lot of scop for future industry [4]. Tomato *Lycopersicon esculentum* L. (Lycos, wolf ,persica , peach esculantum, edible), belong to the family solanaceae . It's a herbaceous annual plant with bisexual flowers . The fruit is true berry . It is self pollinated crop but in some cases as high as 30 per cent cross pollination has been reported . Depending upon the growth habit, the tomato plant have been categorized into (1) indeterminate and (2) determinate types. The plant of first type terminate in a vegetative bud wheres , that of the determinate types terminate in flower bud and is appropriately called "Self topping " or self pruning "type .Many varieties of determinate type tomato plant do not have adequate foliage to protect their fruits .The determinate varieties can be harvested in 2-3 harvest. Present investigation on heritability, genetic advance correlation, product etc. in determinate were though essential . therefore,this project was studied with following objectives,

- 1.To work out heritability and genetic in quantitative characters.
2. To estimate correlation among different traits .
3. To find out phenotypic, genotype and environmental path. coefficient analysis with direct and indirect effect
4. Studies on different products prepared form fruits for quality aspects (1) ketchup (2) purie.

METHODOLOGY

Different method applied in research work have been kept in mind but the details with references have been given in the material and method .

VEGETATIVE CHARACTER:

- ❖ Height of plant
- ❖ Diameter of stem
- ❖ Number of primary branches

FRUIT CHARACTER

- ❖ Days required for fruit development
- ❖ Length of fruit
- ❖ Width of fruit
- ❖ Volume of fruit
- ❖ Number of fruit / plant
- ❖ Weight of fruits
- ❖ Yield of fruits
- ❖ Preparation of preserves
- ❖ Quality attributes

Statistical analysis for deriving the results of heritability, correlation, path coefficient and genetic divergence were applied with proper formulas.

RESULTS AND DISSCUSSION

The findings of the study are being discussed as below :

Table-1

Trearmnt	Name of Cultivars	Plant Height(cm)	
		1989-1999	1999-2000
V ₁	Vaishali	1.200Max.	1.233Max.
V ₂	Pusa	1.103	1.227
V ₃	KS-1	1.113	1.107
V ₄	7906	1.133	1.203
V ₅	KS-6	1.06	1.057
V ₆	7903	0.96	0.973
V ₇	Ajay	0.947	0.963
V ₈	Ajit	0.96	0.98
V ₉	Ajanta	0.92	0.94
V ₁₀	Aruna	0.927	0.937

V ₁₁	Sun-230	1.013	1.01
V ₁₂	Rupali	1.023	0.97
V ₁₃	Rashmi	1.08	1.023
V ₁₄	K.T.H-1	0.973	0.97
V ₁₅	Azad T-2	1.01	1.013
V ₁₆	Azad T-2	0.900Min.	0.940Min.
V ₁₇	K.S-166	1.017	0.983
V ₁₈	KS-176	0.94	0.973
V ₁₉	K.S.-171	0.843	0.913
V ₂₀	KS-178	0.917	0.95
V ₂₁	KS-183	0.95	0.967
V ₂₂	KS-184	0.943	0.973
V ₂₃	7902	1.01	1.033
V ₂₄	.4-2	0.95	0.937
V ₂₅	7901	0.947	0.943
V ₂₆	KS-189	0.933	0.957
V ₂₇	KS-191	0.93	0.97
G.M		0.98	1.0054
C.D		0.0659	0.07

Table-2

Trearmnt	Name of Cultivars	No. of leaves/Plant	
		1998-99	1999-2000
V ₁	Vaishali	9.2	9
V ₂	Pusa	9.367 Max.	9.033 Max.
V ₃	KS-1	8.733	8.5
V ₄	7906	9.333	8.3
V ₅	KS-6	7.3	8.5
V ₆	7903	7.3	6.667 Min.

V ₇	Ajay	7.767	7.567
V ₈	Ajit	7.4	7.8
V ₉	Ajanta	7.533	7.733
V ₁₀	Aruju na	7.4	7.567
V ₁₁	Sun- 230	8.6	8.4
V ₁₂	Rupali	9.133	8.367
V ₁₃	Rashm i	8.767	9.133
V ₁₄	K.T.H- 1	8.467	8.433
V ₁₅	Azad T-2	7.4	6.7
V ₁₆	Azad T-2	6.933	6.933
V ₁₇	K.S- 166	7.433	7.033
V ₁₈	KS- 176	7.167	6.933
V ₁₉	K.S.- 171	7.5	7.533
V ₂₀	KS- 178	7.5	7.067
V ₂₁	KS- 183	6.467 Min.	7.233
V ₂₂	KS- 184	6.7	6.967
V ₂₃	7902	8.5	8.567
V ₂₄	.4-2	9.4	8.733
V ₂₅	7901	9	8.933
V ₂₆	KS- 189	8.4	8.467
V ₂₇	KS- 191	8.3	8.3
G.M		7.977 8	8.037
C.D		0.509 4	0.5693

V ₄	7906	42.13 3	42.533
V ₅	KS-6	40.26 7	40.467
V ₆	7903	22.9	23.9
V ₇	Ajay	32.56 7	32.533
V ₈	Ajit	41.5	41.433
V ₉	Ajanta	33.5	33.167
V ₁₀	Aruju na	20.9	21.133
V ₁₁	Sun- 230	24.33	24.367
V ₁₂	Rupali	21.13 3	21.467
V ₁₃	Rashm i	18.7	18.8
V ₁₄	K.T.H- 1	35.53 3	32.4
V ₁₅	Azad T-2	25.83 3	24.967
V ₁₆	Azad T-2	35.76 7	36.867
V ₁₇	K.S- 166	27.5	27.733
V ₁₈	KS- 176	31.2	30.333
V ₁₉	K.S.- 171	34.46 7	34.233
V ₂₀	KS- 178	25.4	25.2
V ₂₁	KS- 183	34	34.267
V ₂₂	KS- 184	30.43 3	34.6
V ₂₃	7902	17.66 7 Min.	18.700 Min.
V ₂₄	.4-2	24.6	24.433
V ₂₅	7901	33.13 3	32.933
V ₂₆	KS- 189	27.86 7	27.233
V ₂₇	KS- 191	22.43 3	22.833
G.M		29.99 14	30.1148
C.D		2.048 6	0.604

Table-3

Trearm ent	Name of Cultivars	No. of Fruits/Plant	
		1998- 99	1999- 2000
V ₁	Vaisha li	25.33	25.2
V ₂	Pusa	32.5	32.533
V ₃	KS-1	45.50 0 Max.	45.5 Max.

Table-4

Trearm ent	Name of Cultivars	Length of fruit(cm)	
		1998-99	1999-2000
V ₁	Vaisha li	4.333	4.2
V ₂	Pusa	4.333	4.3
V ₃	KS-1	3.7	3.567
V ₄	7906	4.1	3.9
V ₅	KS-6	4.4	4.467
V ₆	7903	4.267	4.167
V ₇	Ajay	3.633	4.167
V ₈	Ajit	3.267	3.2
V ₉	Ajanta	4.2	3.433
V ₁₀	Aruju na	4.233	4.267
V ₁₁	Sun-230	3.6	3.5
V ₁₂	Rupali	4.367	4.1
V ₁₃	Rashm i	4.267	4.2
V ₁₄	K.T.H-1	5.667	6.3
V ₁₅	Azad T-2	3.7	3.667
V ₁₆	Azad T-2	3.6	4.233
V ₁₇	K.S-166	4.2	3.8
V ₁₈	KS-176	4.167	3.9
V ₁₉	K.S.-171	3.533	3.9
V ₂₀	KS-178	3.6	3.633
V ₂₁	KS-183	3.5	3.467
V ₂₂	KS-184	3.6	3.267
V ₂₃	7902	3.6	3.433
V ₂₄	.4-2	4.333	4.533
V ₂₅	7901	4.267	4.267
V ₂₆	KS-189	3.767	9.267
V ₂₇	KS-	3.9	4.333

	191		
G.M		4.0284	4.0049
C.D		0.4303	0.4273

Table-5

Trearme nt	Name of Cultivars	Weight of fruit(gm)	
		1998-99	1999-2000
V ₁	Vaisha li	60.733	61.15
V ₂	Pusa	39.953	39.44
V ₃	KS-1	40.183	41.42
V ₄	7906	42.163	42.137
V ₅	KS-6	41.04	40.533
V ₆	7903	62	62.667
V ₇	Ajay	52.603	61.7
V ₈	Ajit	25.5	52.33
V ₉	Ajanta	34.33	35.133
V ₁₀	Aruju na	49.983	49.25
V ₁₁	Sun-230	36.867	36.153
V ₁₂	Rupali	70.517	70.523
V ₁₃	Rashm i	80.48	81.123
V ₁₄	K.T.H-1	63.667	63.623
V ₁₅	Azad T-2	44.187	44.55
V ₁₆	Azad T-2	43.78	44.267
V ₁₇	K.S-166	49.833	50.157
V ₁₈	KS-176	50.153	50.09
V ₁₉	K.S.-171	40.4	40.583
V ₂₀	KS-178	42.097	42.55
V ₂₁	KS-183	38.28	39.983
V ₂₂	KS-184	34.42	33.327
V ₂₃	7902	65.797	81.513

V ₂₄	.4-2	53.55	53.567
V ₂₅	7901	32.747	33.05
V ₂₆	KS-189	40.6	40.87
V ₂₇	KS-191	45.417	44.417
G.M		48.537 4	47.462
C.D		0.823	10.538 1

Table-6

Trearm ent	Name of Cultivars	Volume of fruit(cm3)	
		1998-99	1999-2000
V ₁	Vaishali	60.967	60.967
V ₂	Pusa	47.033	47.2
V ₃	KS-1	41.233	40.967
V ₄	7906	42.333	42.767
V ₅	KS-6	41.168	40.667
V ₆	7903	64.733	64.667
V ₇	Ajay	34.6	35.633
V ₈	Ajit	24.33	24.4
V ₉	Ajanta	35.967	36.733
V ₁₀	Aruna	51.9	51.833
V ₁₁	Sun-230	8.867	39.333
V ₁₂	Rupali	8.433	67.933
V ₁₃	Rashmi	78.33	78.467
V ₁₄	K.T.H-1	62.233	60.1
V ₁₅	Azad T-2	42.233	41.867
V ₁₆	Azad T-2	42.167	45
V ₁₇	K.S-166	50	50.833
V ₁₈	KS-176	52.3	51.433
V ₁₉	K.S.-171	41.533	40.8
V ₂₀	KS-	44.33	46.8

	178	3	
V ₂₁	KS-183	37.133	37.433
V ₂₂	KS-184	34.8	33.5
V ₂₃	7902	80.633	81.733
V ₂₄	.4-2	50.033	50.433
V ₂₅	7901	31.467	31.67
V ₂₆	KS-189	38.867	39.2
V ₂₇	KS-191	53.033	53.467
G.M		47.9901	47.8765
C.D		0.9953	1.8231

Table-7

Trearm ent	Name of Cultivars	Storage life of fruit(days)	
		1998-99	1999-2000
V ₁	Vaishali	9.667	10.2
V ₂	Pusa	8.367	8.5
V ₃	KS-1	9.1	8.667
V ₄	7906	9.6	8.967
V ₅	KS-6	9.5	8.867
V ₆	7903	9.1	9.267
V ₇	Ajay	9.8	9.7
V ₈	Ajit	9.335	9.9
V ₉	Ajanta	10.6	10.233
V ₁₀	Aruna	10.297	10
V ₁₁	Sun-230	9.7	9.7
V ₁₂	Rupali	10.467	9.933
V ₁₃	Rashmi	9.6	9.4
V ₁₄	K.T.H-1	10.067	10.267
V ₁₅	Azad T-2	10.5	10
V ₁₆	Azad T-2	9.233	8.833

V ₁₇	K.S-166	9.73 3	9.667
V ₁₈	KS-176	10.7 67	10.567
V ₁₉	K.S.-171	9.33	9.5
V ₂₀	KS-178	10.4	9.867
V ₂₁	KS-183	9.53 3	9.967
V ₂₂	KS-184	7.36 7	8.233
V ₂₃	7902	10.3	9.733
V ₂₄	.4-2	9.8	9.8
V ₂₅	7901	9.73 3	9.6
V ₂₆	KS-189	7.6	7.9
V ₂₇	KS-191	9.6	8.767
G.M		9.46 79	9.5951
C.D		0.58 39	0.5496 8

V ₁₄	K.T.H-1	73.1	74.45
V ₁₅	Azad T-2	76.76	85.25
V ₁₆	Azad T-2	85.15	86.95
V ₁₇	K.S-166	82.1	83.45
V ₁₈	KS-176	79.15	80.6
V ₁₉	K.S.-171	76.4	77.25
V ₂₀	KS-178	77	78.75
V ₂₁	KS-183	80.1	82.65
V ₂₂	KS-184	78.5	79.75
V ₂₃	7902	79.55	78.85
V ₂₄	.4-2	80.15	81.1
V ₂₅	7901	81.25	80.75
V ₂₆	KS-189	79.25	79
V ₂₇	KS-191	81.7	82.25

Table-8

Trearm ent	Name of Cultivars	Mark % in KETCH' UP	
		1998-99	1999-2000
V ₁	Vaishali	75.1	77.12
V ₂	Pusa	76.25	76.45
V ₃	KS-1	47.15	77.8
V ₄	7906	78.85	79.15
V ₅	KS-6	79.1	78.4
V ₆	7903	77.95	78.1
V ₇	Ajay	75.4	79.25
V ₈	Ajit	77.75	77.8
V ₉	Ajanta	77.25	76.75
V ₁₀	Arujuna	72	74.25
V ₁₁	Sun-230	73.9	74
V ₁₂	Rupali	75.2	76.15
V ₁₃	Rashmi	74.45	75.65

Table-9

Trearm ent	Name of Cultivars	Mark % in PUREE	
		1998-99	1999-2000
V ₁	Vaishali	74.15	73.85
V ₂	Pusa	77.9	78.65
V ₃	KS-1	76.2	75.1
V ₄	7906	77.8	76.95
V ₅	KS-6	72.25	74.35
V ₆	7903	77.2	76.45
V ₇	Ajay	76.95	77.7
V ₈	Ajit	77.9	78.9
V ₉	Ajanta	76.4	77.75
V ₁₀	Arujuna	73.8	74.1
V ₁₁	Sun-230	74.76	75.15
V ₁₂	Rupali	75.2	76.25
V ₁₃	Rashmi	75.95	75.95

V ₁₄	K.T.H-1	76.75	76.35
V ₁₅	Azad T-2	85.4	85.95
V ₁₆	Azad T-2	87.95	88.75
V ₁₇	K.S-166	80.15	81.6
V ₁₈	KS-176	81.2	82.75
V ₁₉	K.S.-171	78.65	74.75
V ₂₀	KS-178	77.8	75
V ₂₁	KS-183	80.45	79.95
V ₂₂	KS-184	80.95	81
V ₂₃	7902	79.1	80.75
V ₂₄	.4-2	78.9	79.6
V ₂₅	7901	79.7	76.25
V ₂₆	KS-189	80.65	81.75
V ₂₇	KS-191	80.5	78.15

The Variability has been given character wise as per the findings of different aspects. In vegetative growth parameters plant height was found in V₁ and V₉ and V₁ and V₁₉ treatment with 0.9890 and 1.0054 general mean during 1998-99 and 1999-2000 respectively. Number of branches per plant was found maximum in V₁ and V₃ treatments during 1998-99 and 1999-2000, respectively. Plant height and number of branches per plant have considerable range of variation [5].

The maximum number of leaves was found in V₂₄ and V₁₃ genotypes whereas these were minimum in V₂₁ and V₁₅ treatments with 8.0370 and 7.9778 general mean value during both the years of present investigations, respectively. Similarly, number of fruits per plant was found maximum in V₃ and minimum in V₂₃ treatment during present investigations of 1998-99 and 1999-2000, respectively. In the above sequence V₂₄ and V₁₃ was followed by V₄, V₈ and V₅ genotypes during 1998-99 and 1999-2000, respectively [6].

It was found that length and width of fruit was observed minimum in V₈ and V₂₇ and maximum in V₁₄ and V₆ during 1998-99 and 1999-2000, respectively. And it was followed by V₆, V₁₂, V₁, V₂, V₂₄ and V₁₃, V₅, V₁₀ in 1998-99 and V₅, V₂₇, V₂ and V₁₉, V₁₁, V₁₂, V₁₈, V₁₃, V₁₇ in 1999-2000, respectively [7].

Weight and volume of fruit aspects were found maximum in V₁₃ and V₂₃ treatments and minimum in V₈ and V₈ genotypes during 1998-99, respectively. Weight of fruit was followed by V₁₂, V₂₃, V₁₄, and V₁₃, V₁₂, V₁₄

during both the years of present investigations, respectively [8].

Yield / Plant was found to range from V₂₆ to V₅ and V₂₆ to V₁₆ with 1.6112 and 1.7246 general means during 1998-99 and 1999-2000, respectively. Storage life of fruits was found maximum in V₁₈ and V₁₈ in 1999-99 and 1999-2000 respectively. [9]

Heritability, Genetic Advance and Covariance

Heritability, genetic advance and covariance had a range of variation from 75.28043 in length of fruit to 99.71537 percent in number of fruits per plant during 1998-99. Covariance was found maximum 28.79142 and 29.29815 in volume of fruit and weight of fruit in 1998-99 and 1999-2000, respectively. Phenotypic covariance was found 29.14010 and 29.31642 in weight of fruits during 1998-99 and 1999-2000 respectively [10].

Phenotypic Correlation

In phenotypic correlation plant height had positive with number of branches (0.6392), number of leaves per plant (0.5293), width of fruit (0.1703), weight of fruit (0.2346), volume of fruit (0.2774) and yield per plant (0.2000) during 1998-99. Number of fruits per plant had positive correlation with only per plant (0.5983 and 0.4924) during 1998-99 and 1999-2000, respectively. [11]

Genotypic Correlation

Correlations gave good results genotypic correlation plant height was found to have a positive correlation with number of branches per plant (0.7196), number of leaves per plant (0.6412), number of fruits per plant (0.0735), length of fruit (0.2733), width of fruit (0.2171), weight of fruit (0.3127), volume of fruit (0.3064) and yield per plant (0.2674) during 1998-99. Number of fruits per plant also had positive correlations with all the parameters except length of fruit, width of fruit and weight of fruit during both years of the investigations. [12]

Environmental correlation

Environmental correlation results that plant height had positive and significant correlation with number of branches per plant, number of leaves per plant, length of fruit, volume of fruit, volume of fruit and storage life in days during both years of investigation. Number of fruit per plant exhibited positive association with volume of fruit in both years. Weight of fruit had positive correlation with volume of fruit and storage life of fruit during 1999-2000.

Weight of fruit, was also found to have positive association with yield per plant in both years of investigations. Yield per plant had positive correlation with storage life of fruits [13].

Phenotypic Path coefficient

Number of branches number of fruit per plant and volume of fruit had positive and direct effect in 1998-99. In number of leaves per plant,

Length of fruit , width of fruit , weight of fruit and yield per plant was observed to have negative and direct effect in 1998-99. Its correlation was found positive with plant height of branches per plant and yield per plant in present in investigations [14].

Genotypic Path Coefficient

In genotypic path coefficient , plant height, number of leaves per plant , length of fruit , weight of fruit and yield per plant gave negative and direct effect during 1998-99. Direct effect had positive effect with plant height, number of branches per plant , volume of fruit and yield per plant during 1998-99 [15].

Environmental Path Coefficient

In environmental path coefficient plant height had positive and direct effect with number of branches per plant ,weight of fruit and volume of fruit during 1998-99. Number of leaves per plant and width of fruit revealed negative and direct effect during 1999-2000 [16].

Genetic divergence(D²)

In clustering genetic divergence was observed directly related to the success in hybridization for developing varieties. Its also a well known fact that genetic divergence is related to extended of heterosis exhibited by the F1 crosses of the divergent parent .

In genetic divergence for making improvement in the crops in general and in this particular D2 statistics has been applied for grouping 27 genotypes of tomato . In all 8 and 5 clusters during 1998-99 and 1999-0-2000, respectively . It suggests that the origin of these 3 genotypes is probability the same or had common ancestry. The maximum number of varieties falling in cluster III and I during 1998-99 and 1999-2000 respectively.

In clusters distance was found maximum 8549.830 between cluster II and VII,6861.315 between I and VII,6216.48 II and VIII during 1998-99. Minimum inter cluster distance was found VII and VIII (318.350) during 1998-99. In the data of second year 1999-2000, intra cluster distance was found 21258.063 during 1999-2000.[17]

Distribution of 27 varieties in cluster (1998-99).

clusters	Total number of varieties at treatment number strain/ varieties
I	T ₂₃ , T ₁₂ , T ₆ , T ₁₀
II	T ₁₃
III	T ₇ , T ₂₅ , T ₁₉ , T ₂₁ , T ₂₂ , T ₂ , T ₁₈ , T ₂₆ , T ₁₆ , T ₁₅ , T ₁₇ , T ₁₁ , T ₂₀ , T ₄ , T ₈ , T ₁₄

IV	T ₉
V	T ₂₇ , T ₂₄
VI	T ₁
VII	T ₃
VIII	T ₅

Distribution of 27 varieties in cluster (1999-2000)

cluster	Total number of varieties at treatment number strains/ varieties
I	T ₁₈ , T ₁₀ , T ₂₀ , T ₁₅ , T ₂₇ , T ₁₆ , T ₂ , T ₂₆ , T ₁₉ , T ₄ , T ₅ , T ₁ , T ₃ , T ₂₁ , T ₁₄ , T ₁₁ , T ₆ , T ₇ , T ₉ , T ₂₂ , T ₂₅ , T ₁₂ , T ₈
II	T ₁₇
III	T ₂₃
IV	T ₁₃
V	T ₂₄

Conclusion

Substantial genetic variability for number of leaves , number of branches and plant height was observed in this investigation. Similarly, height highest heritability for number of leaves length of branch and diameter of plant suggests that improvement in these character could be effected even with imposing low selections intensity . Parental lines if selected from distantly placed clusters would result in release of vast variability ,besides the substantial scope for manifestation of heterosis.

Number of leaves per plant and number of fruits per plant are the ultimate important traits were found responsible for yield . In general characters have shown substantial genetic variability and high heritability. The improvement in these traits could be made by intensive among the genotypes drawn from distantly placed clusters.

Study will be helpful to breeder , researcher and fruit and vegetable processing industry for proessable varieties of tomato in manufacturing

of processed food products ketchup and puree.

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