Diversity in Cucumber (*Cucumis sativus* L.) Genotypes Based on Morphological Yield Traits with Protein Profiling

ABSTRACT

In this research, fortyfour genotypes with two control~~check~~ varieties of cucumber (*Cucumis sativus* L.) were studied that were collected from different geographical regions of India. Biodiversity is one of the most important factors in the survival and improvement of any species. Therefore, germplasm collection is the first step for plant improvement. To investigate their genetic and morphological relationships morphological traits of genotypes of cucumbers were evaluated with control~~check~~ varieties. We found that the traits, the total yield varied during first season from 48.80-144.48 (q/ha) with average of 89.81(q/ha). During second season, it varied from 46.30-202.00 (q/ha) with an average of 104.90 (q/ha). The single fruit weight varied during first season from 182.98 to 371.87 g~~rm~~. with average of 287.89 gm?. During second season, it varied from 180.16 to 380.11 gm. with an average of 281.75gm. Fruit length varied during first season from 6.43 to 25.28 cm. with average of 16.22 cm. During second season, it varied from 6.06 to 25.26 cm. with an average of 16.25 cm. The number of fruits per plant varied during first season from 3.30-8.30 with average of 5.60. During second season, it varied from 2.80-10.56 with an average of 6.69. The distinct genotypes found in this study based on morpho-molecular characters will great interest to cucumber breeder for selection of diverse parent or production of mapping population.

Keywords: Cucumber *(Cucumis sativus* L.), Genetic diversity, Morphological Agronomic traits

Introduction:

Cucumbers (2n=2x=14), belonging to the Cucurbitaceae family, are one of the most imperative vegetables (Jeffery, 1980). They can be used in salads or in processed forms (pickled, salty). The primary origions of diversity cucumber varieties have reported In~~d~~dia (Wehner and Robinson, 1991). Cucumber is believed to have been domesticated in India for 3000 years and in Eastern Iran and China probably for 2000 years. Improvement of crop depends on the magnitude of genetic variability in economic traits, therefore, the evaluation and utilization of genetic variability in desired direction becomes extremely important in any yield improvement programme. The extent of genetic variability in a specific breeding population depends on the genotypes included in it and its selection history. In this regard, it is necessary to survey the available useful variability and nature of association among the various plant characters. The phenotypic expression of the plant characters is mainly controlled by the genetic ~~makeup~~ of the plant and the environment, in which it is growing. Additional the genetic variance of some quantitative trait is collected of additive variance (heritable) and non-additive variance and comprise dominance and epistasis (non-allelic interaction). Therefore, it becomes necessary to partition the observed phenotypic variability into its heritable and non-heritable components with suitable parameters such as phenotypic and genotypic coefficient of variation, heritability and genetic advance

MATERIALS AND METHODS

The present investigation was conducted with two season during July-October, 2014 and February-June, 2015 at Vegetable Research Centre, Department of Vegetable Science in G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand. Pantnagar is situated in the foot hills of Himalayan region (Shivalik hills) and falls under humid subtropical climate zone in narrow belt called Tarai. Geographically, Vegetable Research Centre is situated at the latitude of 29.5°N, longitude 79.3°E and at an altitude of 243.84 meters above the mean sea level. Total 46 genotypes of cucumber (*Cucumis sativus* L.) were used as experimental material in present experiment. Information about the trial plan should be given. Agro Climatic Conditions the climate of Pantnagar is humid Sub-Tropical with maximum temperature raging from 32^{o}C to 42^{o}C in summer and minimum temperature raging from 3^{o}C to 14^{o}C in winter. The monsoon generally Starts from the third week of June and recedes by the end of September.

The mean relative humidity remained almost 60-80% by the third week of April to Second week of June and then there is an increase in relative humidity from last week of June to October i.e. 80-90 %. Frost can be expected from last week of December to end of February. The weekly averages of various weather parameters that prevailed during the course of investigation recorded at the meteorological Observatory of N.E. Borlaug Crop Research Centre of the university are presented. ~~The present investigation was conducted with two season during July-October, 2014 and February-June, 2015 at Vegetable Research Centre, Department of Vegetable Science in G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand. Pantnagar is situated in the foot hills of Himalayan region (Shivalik hills) and falls under humid subtropical climate zone in narrow belt called Tarai. Geographically, Vegetable Research Centre is situated at the latitude of 29.5°N, longitude 79.3°E and at an altitude of 243.84 meters above the mean sea level. Total 46 genotypes of cucumber (*Cucumis sativus* L.) were used as experimental material in present experiment.~~ The genotypes were diverse with respect to morphological and important economical traits. The expression of a complex character like yield is a sum total of the contribution of many simple inherited characters and, therefore direct selection for it may not be their consider but are interlinked and in this interlinked complex genetic system, selection practice for an individual characters might subsequently bring about a simultaneous change in other, thus an understanding of the association between the component characters and their relative contribution to yield is essential to bring a rational improvement in their desirable traits.

Experimental materials

The main experimental material for the present study comprised of 46 divergent genetic stock of cucumber including two control~~control~~ as collected from different part of country maintained in the Department of Vegetable Science, G. B. Pant University of Agriculture and Technology, Pantnagar, U.S. Nagar, Uttarakhand. The materials for the present thesis research experiment are listed in table 1.

Table 1: List and source of various genotypes of cucumbers.

S.L. No	Genotypes	Source
1.	PCUC-199	Saung, Tehari, U.K.
2.	PCUC -832	Mukhautia, Raibareilly, U.P.
3.	PCUC-44	Palampur, H.P.
4.	PCUC -23	Kanatal, Tehari, U.K.
5.	PCUC -104	Kanatal, Tehari, U.K.
6.	PCUC-193	Ghosi, Mau, U.P.
7.	PCUC-4302	Sultanpur, U.P.
8.	PCUC-26	Aashapur Varanasi, U.P.
9.	PCUC-83	Faridpur, Bareilly, U.P.
10.	PCUC-08	Ghosi, Mau, U.P.
11.	PCUC-202	Hanuman ganj, Allahabad, U.P.
12.	PCUC-25	Chumal, Champawat, U.K.
13.	Euc-1-07	Chumal, Champawat, U.K.
14.	PCPGR-04	Palampur HP
15.	PCPGR-06	Jammu, Kasmir
16.	PCPGR-07	Jammu, Kasmir
17.	PCPGR-13	Palampur, H.P.

18.	PCPGR-15	Baruasagar, Jhansi, U.P.
19.	PCPGR-19	Chumal, Champawat, U.K.
20.	PCPGR-20	Chetia, Siddarth Nagar, U.P.
21.	PCPGR-21	NBPGR, New Delhi
22.	PCPGR-22	Baruasagar, Jhansi, U.P.
23.	PCPGR-24	Sikandrabad, Bulandshahar, U.P.
24.	PCPGR-29	Rampur, U.P.
25.	PCPGR-34	Bharatipur, Jabalpur, MP
26.	PCPGR-45	Givathikapurawa, Faizabad, U.P.
27.	PCPGR-103	Sekha, Aligarh, U.P.
28.	PCPGR-138	Chetia, Siddarth Nagar, U.P.
29.	PCPGR-196	JiapurPadly, Nainital, U.K.
30.	PCPGR-264	Kalyanmadarasa, Faizabad, U.P.
31.	PCPGR-748	Sultanpur, U.P.
32.	PCPGR-4343	Sultanpur, U.P.
33.	PCPGR-5370	Sultanpur, U.P.
34.	PCPGR-6006	Dhaniakot, Almora, U.K.
35.	PCPGR-6762	Barogh , Lucknow, U.P.
36.	PCPGR-7013	Sitapur, U.P.
37.	PCPGR-7027	Sitapur, U.P.
38.	PCPGR-7176	Dhaniakot, Almora, U.K.
39.	PCPGR-7207	Dineshpur,U S nagar, U K
40.	PCPGR-7557	Dilipnagar , U S Nagar, U.K.
41.	PCPGR-7566	Akhandnagar, Sultan pur, U.P.
42.	PCPGR-7647	Majhra, Nainital, U.K.
43.	PCPGR-7657	Pusa IARI, New Delhi
44.	PCPGR-7795	Majhra, Nainital, U.K.
45.	POINTSETTE (Check)	NBPGR, New Delhi
46.	Pant Khira-1 (Check)	Pantnagar, Udhamsingh Nagar, U.K.

Agro Climatic Conditions:

~~Agro Climatic Conditions the climate of Pantnagar is humid Sub Tropical with maximum temperature raging from 32°C to 42°C in summer and minimum temperature raging from 3°C to 14°C in winter. The monsoon generally Starts from the third week of June and recedes by the end of September.~~

Table 2: Average weekly meteorological data during cropping period from July 2014- Oct. 2014 and Feb. 2015–June 2015

Month	Date	Year	Temperature (C)		Relative Humidity (%)		Rainfall (mm)	Wind Velocity (Km./Hr.)	Sun Shine Hrs.	Evap.(mm)
			Max.	Min.	Max.	Min.				

Jun	19-25	2014	37.6	24.1	64	34	00.0	5.5	8.5	10.7
Jun- July	26-02	2014	39.4	23.6	67	46	00.1	4.6	7.5	10.9
July	03-09	2014	35.2	24.6	85	66	00.9	5.6	5.6	5.7
July	10-16	2014	36.4	25.1	87	68	11.3	6.4	2.6	6.8
July	17-23	2014	33.4	24.3	89	64	04.8	6.4	2.6	6.9
July	24-31	2014	34.1	23.2	90	64	0.36.5	6.7	3.8	10.2
August	01-07	2014	35.6	25.4	89	63	05.4	5.6	6.5	7.6
August	08-14	2014	34.6	24.3	86	64	03.4	4.9	5.4	5.4
August	15-21	2014	35.4	24.6	91	68	00.0	6.5	7.2	6.4
August	22-28	2014	37.1	25.4	86	59	01.3	7.2	3.4	7.2
Aug.-Sep.	29-04	2014	35.1	25.1	89	66	01.2	6.4	5.1	7.5
Sep.	05-11	2014	34.1	24.3	92	69	0.0.0	7.2	4.6	5.7
Sep.	12-18	2014	33.5	24.9	91	65	00.0	6.4	8.4	6.2
Sep.	19-25	2014	34.3	23.5	86	67	00.1	7.2	4.5	3.4
Oct.	01-07	2014	32.2	22.6	90	60	5.60	2.5	4.9	3.0
Oct.	08-14	2014	31.4	17.9	87	55	0.00	4.2	8.3	3.2
Oct.	15-21	2014	29.1	15.5	91	51	0.00	2.5	8.7	3.1
Oct.	22-28	2014	29.3	16.6	88	55	0.00	1.7	3.9	2.4
Oct.-Nov.	29-04	2014	28.5	13.5	91	46	0.00	1.9	5.6	2.7
Nov.	05-11	2014	29.2	12.8	91	46	0.00	2.8	8.2	2.5
Jan.-Feb.	29-04	2015	20.2	8.1	89	62	0.00	06	5.1	1.7
Feb.	05-11	2015	22.3	7.4	94	54	0.00	3.5	7.1	2.3
Feb.	12-18	2015	23.7	9.8	88	51	0.00	3.5	4.6	1.9
Feb.	19-25	2015	27.1	13.4	90	55	7.00	4.1	4.8	2.4
Feb.- March	26-04	2015	22.8	13	92	61	61.1	6.2	5.2	2.6
March	05-11	2015	25.8	10.2	89	45	0.00	5.5	8.3	2.8
March	12-18	2015	26.8	12.7	90	51	1.20	5.3	6.8	3.0
March	19-25	2015	30.4	13.7	88	45	0.00	4.1	9.6	3.7
March-April	26-01	2015	30.9	17.7	86	44	26.2	5.5	7.4	4.1
April	02-08	2015	29.4	15.0	89	45	18.9	4.8	6.9	4.1
April	09-15	2015	31.9	16.6	82	36	0.00	4.9	7.7	4.9
April	16-22	2015	35.3	18.5	74	35	0.00	6.0	8.7	6.1
April	23-29	2015	37.7	19.2	65	34	0.20	8.8	9.0	7.3
April- May	30-06	2015	35.4	18.3	70	29	18.8	5.7	10.4	7.4
May	7-13	2015	37.9	24.5	69	39	09.0	6.7	08.7	7.5
May	14-20	2015	36.8	22.5	70	37	001.8	6.5	10.7	7.6
May	21-27	2015	41.1	22.5	67	31	000.9	6.7	09.4	7.8
May-Jun	28-03	2015	39.6	22.2	63	31	000.0	6.3	08.3	9.3
Jun	04-10	2015	40.9	24.5	62	30	000.0	7.8	09.7	10.6
Jun	11-17	2015	38.0	25.5	62	38	000.8	8.8	07.4	10.7
Jun	18-24	2015	35.1	26.5	73	53	072.2	7.2	06.2	6.4
Jun- July	25-01	2015	32.0	23.8	90	76	324.8	8.5	05.0	5.5

Table 1: Average weekly meteorological data during cropping period from July 2014- Oct. 2014 and Feb. 2015–June 2015

RESULTS AND DISCUSSION

Estimation of variability

The general mean and range of variation for different character are given in table 2.

Days to first male flower: Days to first male flower varied during fist season from 28.87 days to 47.43 days with average of 38.13 days. During second season, it varied from 31.76 days to 51.13 days with an average of 41.13 days. Pooled analysis of tow season data showed that the first male flower was varied from 30.32 days to 46.68 days with an average of 39.62. Node number to first male flower: Node number to first male flower varied during fist season from 2.33 to 7.66 nodes with average of 5.39 nodes. During second season, it varied from 2.33 nodes to 7.66 nodes with an average of 5.44 nodes. Pooled analysis of tow season data showed that the node number to first

male flower varied from 3.33 nodes to 7.50 nodes with an average of 5.42. Days to first female flower: Days to first female flowers varied during fist season from 35.19-52.30 days with average of 43.27 days. During second season, it varied from 30.76- 55.70 days with an average of 46.05 days. Pooled analysis of both season data showed that the days to first female flower was varied from 33.78-53.35 days with an average of 44.66. Node number to first female flower: Node number to first male flower varied during first season from 3.00-11.00 nodes with average of 7.03 nodes. During second season, it varied from 1.00- 9.00 nodes with an average of 7.04 nodes. Pooled analysis of both season data showed that the node to first female flower was varied from 2.33-9.50

Table 3: The general mean and range of variation during first season, second season and pooled

S. No.	Characters	First season		Second season		Pooled	
		General mean	Range	General mean	Range	General mean	Range
1.	Days to first male flowers	38.13	28.87-47.43	41.11	31.76- 51.13	39.62	30.32-46.68
2.	Node number to first male flower	5.39	2.33-7.66	5.44	2.33- 7.66	5.42	3.33-7.50
3.	Days to first female flowers	43.27	35.19-52.30	46.05	30.76- 55.70	44.66	33.78-53.35
4.	Node number to first female flower	7.03	3.00-11.00	7.04	1.00- 9.00	7.04	2.33-9.50
5.	Internodal length (cm)	6.03	4.00-8.00	10.23	4.28- 15.73	8.13	4.62-11.27
6.	Days to first fruit harvest	38.03	29.46-49.80	49.41	35.48-67.35	43.72	35.01-55.05
7.	Number of fruits per plant	5.60	3.30-8.30	6.69	2.80- 10.56	6.15	4.00-8.78
8.	Fruit length (cm)	16.22	6.43-25.28	16.25	6.06- 25.26	16.24	6.42-23.68
9.	Fruit diameter (cm)	3.87	2.25-8.57	3.50	2.24- 5.14	3.69	2.44-5.48
10.	Fruit weight (g)	287.89	182.98-371.87	281.75	180.16- 380.11	284.82	181.57-355.73
11.	Test weight (gm.)	20.03	10.73-27.48	31.86	19.50- 40.70	25.95	17.43-30.19
12.	Seed Index (gm.)	3.18	1.61-5.65	3.35	2.10- 4.59	3.27	2.42-4.90
13.	Primary branches/ Plant	5.33	3.00-7.66	4.80	2.00- 7.66	5.07	3.50-6.66
14.	Plant height (m.)	2.15	1.33-3.80	2.33	1.16- 3.66	2.24	1.47-3.20
15.	Yield (q/ha)	89.81	48.80-144.48	104.90	46.30- 202.00	97.35	60.56-173.24

nodes with an average of 7.04. Internodal length (cm): The Internodal length varied during first season from 4.00-8.00 cm. with average of 6.03 cm. During second season, it varied from 4.28-15.73 cm. with an average of 10.23 cm. Pooled analysis of both season data showed that the Internodal length was varied from 4.62-11.27 cm. with an average of 8.13 cm. Days to first fruit harvest: Days to first fruit harvest varied during first season from 29.46 days to 49.80 days with average of 38.03 days. During second season, it varied from 35.48 days to 67.35 days with an average of 49.41 days. Pooled analysis of both season data showed that the days to first fruit harvest was varied from 35.01 days to 55.05 days with an average of 43.72 days. Number of fruits per plant: The number of fruits per plant varied during first season from 3.30-8.30 with average of 5.60. During second season, it varied from 2.80-10.56 with an average of 6.69. Pooled analysis of both season data showed that the number of fruits per plant were varied from 4.00-8.78 with an average of 6.15. Fruit length (cm): Fruit length varied during first season from 6.43 to 25.28 cm. with average of 16.22 cm. During second season, it varied from 6.06 to 25.26 cm. with an average of 16.25 cm. Pooled analysis of both season data showed that the fruit length was varied from 6.42 to 23.68 cm. with an average of 16.24 cm. Fruit diameter (cm): The fruit diameter varied during first season from 2.25-8.57 cm. with average of 3.87 cm. During second season, it varied from 2.24- 5.14 cm. with an average of 3.50 cm. Pooled analysis of both season data showed that the fruit diameter was varied from 2.44-5.48 cm. with an average of 3.69 cm. Fruit weight (g): The single fruit weight varied during first season from 182.98 to 371.87 gm. with average of 287.89 gm. During second season, it varied from 180.16 to 380.11 gm. with an average of 281.75gm. Pooled analysis of both season data showed that the fruit weight was varied from 181.57 to 355.73 cm. with an average of 284.82 gm. Test weight (gm.): Test weight varied during first season from 10.73-27.48 gm. with average of 20.03 gm. During second season, it varied from 19.50- 40.70gm.with an average of 31.86 gm.. Pooled analysis of both season data showed that the test weight was varied from 17.43-30.19 cm. with an average of 25.95 gm. Seed Index (gm.): The seed Index varied during fist season from 1.61-5.65 gm. with average of 3.18 gm. During second season, it varied from 2.10- 4.59gm. With an average of 3.35 gm. Pooled analysis of both season data showed that the seed index as varied from 2.42-4.90 cm. with an average of 3.27 gm. Primary branches/Plant: The total number of primary branches per plant varied during first season from 3.00 to 7.66 with average of 5.33. During second season, it varied from 2.00 to 7.66with an average of 4.80. Pooled analysis of both season data showed that the primary branches per plant was varied from 3.50 to 6.66 with an average of 5.07. Plant height (m): Plant height varied during first season from 1.33-3.80 meter with average of 2.15 m. During second season, it varied from 1.16- 3.66 m with an average of 2.33 m. Pooled analysis of both season data showed that the plant height (m.) was varied from 1.47-3.20 meter with an average of 2.24 m. Yield (q/ha): The total yield varied during first season from 48.80-144.48 (q/ha) with average of 89.81(q/ha). During second season, it varied from 46.30-202.00 (q/ha) with an average of 104.90 (q/ha). Pooled analysis of two season data showed that the yield was varied from 60.56-173.24 (q/ha) with an average of 97.35 (q/ha).

The SDS solubilized protein samples were then subjected to vertical SDS-PAGE with 12% separating and 5% stacking gels using Tris-glycine electrode buffer (Tris-glycine and SDS, pH-8.6). The samples were electrophoresed at 80V initially and increased by 100V and current 500mA, when the tracking dye passed from the stacking gel. The run was stopped when the dye was approximately 0.5 cm from the bottom of the gel, which took around 4 to 5 hours. The gel was removed with the help of spatula and dipped for 12 hours in staining solution (0.25 g Coomassie Brilliant Blue R-250, 60 g TCA, 180 ml methanol; and 60 ml glacial acetic acid). The staining solution was then replaced the next day with destaining solution (3 % NaCl). The protein profile and zymogram of banding pattern are given in respective plate 1, 2, 3, 4 and 5 with total 46 samples. The protein was divided into three zones A, B, C and each zone was allocated with a number of subzones. Zone A was nearest to origin and comprises protein bands of high molecular weight while C was the farthest from origin and thus had protein bands of low

molecular weight. A standard medium range protein molecular weight marker of known molecular weight (5 to 80 KDa) was used along with the samples. For genotype discrimination the presence and absence of protein bands, their thickness, width (Dark, Medium and Light) was the criteria for characterization of germplasm differentiation.

Discussion?

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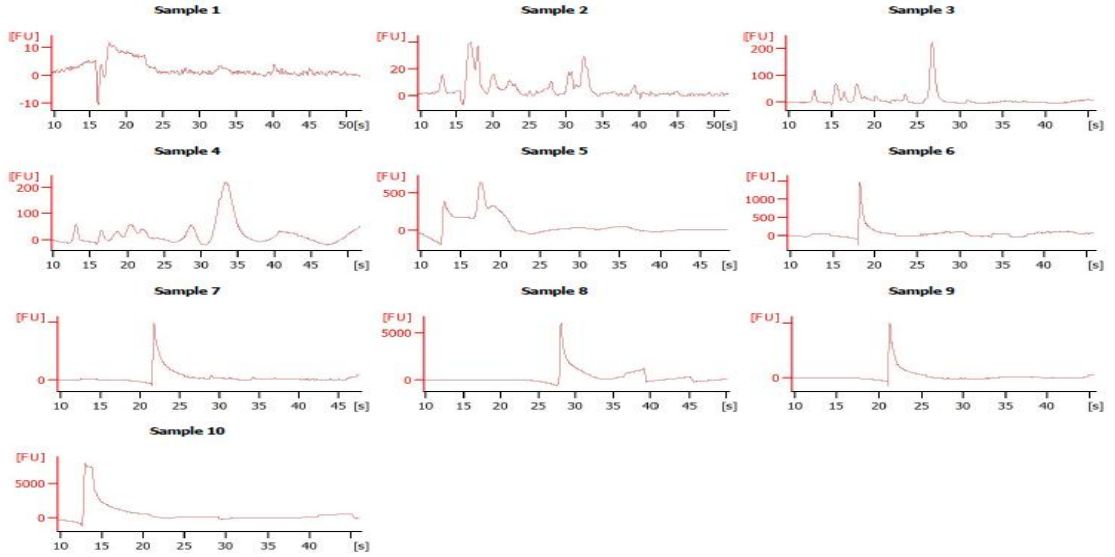
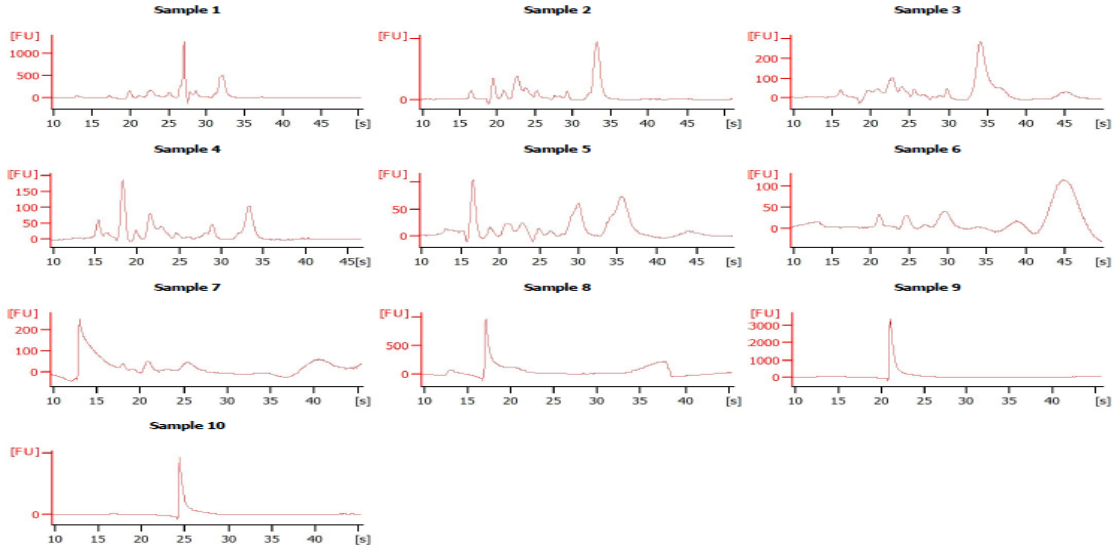
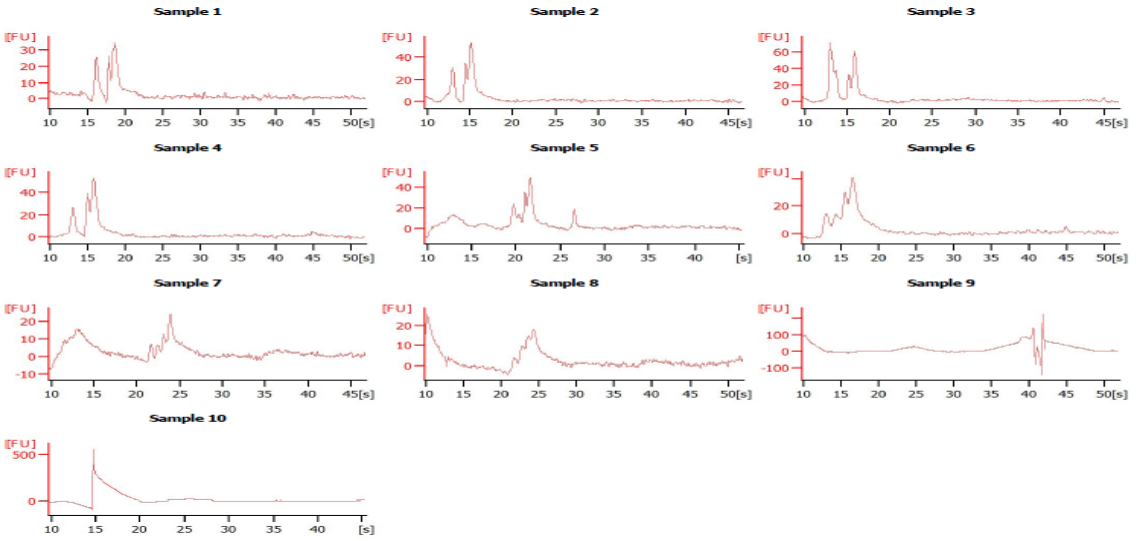
Electrophoresis Plate 1



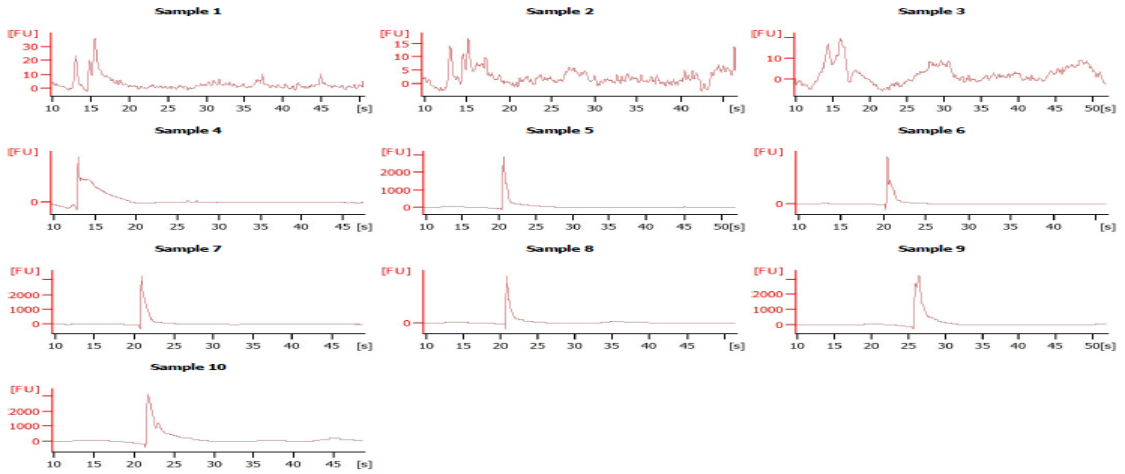
Electrophoresis Plate 2



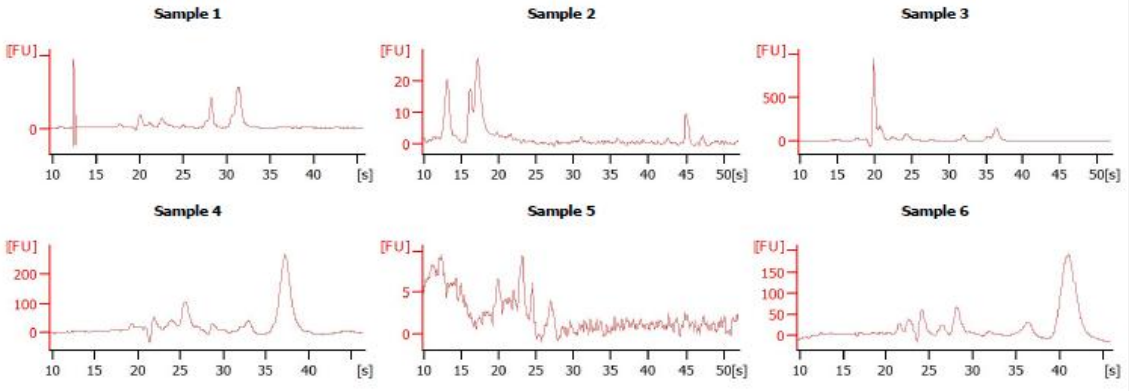
Electrophoresis Plate 3



Electrophoresis Plate 4



Electrophoresis Plate 5



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