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APPENDICES

ศูนย์วิทยทรัพยากร  
จุฬาลงกรณ์มหาวิทยาลัย

## APPENDIX A

### ANALYTICAL DATA

**Table 14** Data for evaluation of the formulations  
Radioactivity distribution (%strip count) for Tc 99m Succimer  
Injection using assay system I.

14.1 Storage time = 0 month, 15 minutes after labeling

Distance (cm)	Rx 1			Rx 2			Rx 3		
	Rf	CPM	%	Rf	CPM	%	Rf	CPM	%
1	-0.17	20	0.01	-0.17	2	0.00	-0.17	16	0.00
2	-0.06	0	0.00	-0.06	0	0.00	-0.06	0	0.00
3	0.06	7025	4.34	0.06	12933	3.78	0.06	13428	4.03
4	0.17	3290	2.03	0.17	7994	2.33	0.17	10100	3.03
5	0.28	3400	2.10	0.28	10423	3.04	0.28	11559	3.47
6	0.40	4094	2.53	0.39	15223	4.45	0.39	17904	5.38
7	0.51	9543	5.90	0.50	27899	8.15	0.51	36624	11.00
8	0.63	132864	82.15	0.61	265653	77.59	0.62	242015	72.67
9	0.74	1103	0.68	0.72	1847	0.54	0.73	1223	0.37
10	0.85	381	0.24	0.83	251	0.07	0.84	101	0.03
11	0.97	43	0.03	0.94	132	0.04	0.96	45	0.01
12	1.08	-24	-0.01	1.06	33	0.01	1.07	3	0.00

14.2 Storage time = 0 month, 30 minutes after labeling

Distance (cm)	Rx 1			Rx 2			Rx 3		
	Rf	CPM	%	Rf	CPM	%	Rf	CPM	%
1	-0.15	8	0.00	-0.15	0	0.00	-0.14	0	0.00
2	-0.05	0	0.00	-0.05	5	0.00	-0.05	1	0.00
3	0.05	10645	3.89	0.05	14444	3.88	0.05	946	0.46
4	0.15	7219	2.64	0.15	7634	2.05	0.14	5739	2.77
5	0.25	6232	2.28	0.24	9315	2.50	0.24	9540	4.61
6	0.34	7416	2.71	0.34	13955	3.75	0.34	8597	4.15
7	0.44	9937	3.63	0.44	18044	4.84	0.43	12404	5.99
8	0.54	30882	11.28	0.53	85555	22.97	0.53	33335	16.10
9	0.64	199422	72.85	0.63	221499	59.46	0.63	135329	65.35
10	0.74	1288	0.47	0.73	1576	0.42	0.72	971	0.47
11	0.83	324	0.12	0.83	240	0.06	0.82	79	0.04
12	0.93	232	0.08	0.92	116	0.03	0.91	28	0.01
13	1.03	34	0.01	1.02	32	0.01	1.01	-17	-0.01

## 14.3 Storage time = 0 month, 60 minutes after labeling

Distance (cm)	Rx 1			Rx 2			Rx 3		
	Rf	CPM	%	Rf	CPM	%	Rf	CPM	%
1	-0.17	0	0.00	-0.16	0	0.00	-0.16	0	0.00
2	-0.06	35	0.01	-0.05	7	0.00	-0.05	41	0.01
3	0.06	16678	4.17	0.05	7415	3.07	0.05	13205	4.14
4	0.17	10499	2.63	0.16	4696	1.94	0.16	9528	2.98
5	0.28	12735	3.19	0.27	5588	2.31	0.27	10840	3.40
6	0.39	11342	2.84	0.38	8034	3.33	0.38	12796	4.01
7	0.50	14212	3.56	0.49	10811	4.48	0.49	18753	5.87
8	0.61	22756	5.69	0.60	17260	7.15	0.60	33351	10.45
9	0.72	306053	76.56	0.71	184478	76.39	0.71	218258	68.36
10	0.83	4057	1.01	0.82	2468	1.02	0.82	2086	0.65
11	0.94	971	0.24	0.92	610	0.25	0.92	365	0.11
12	1.06	396	0.10	1.03	137	0.06	1.03	55	0.02

## 14.4 Storage time = 0 month, 90 minutes after labeling

Distance (cm)	Rx 1			Rx 2			Rx 3		
	Rf	CPM	%	Rf	CPM	%	Rf	CPM	%
1	-0.16	4	0.00	-0.16	0	0.00	-0.17	0	0.00
2	-0.05	0	0.00	-0.05	82	0.02	-0.06	90	0.04
3	0.05	12766	3.61	0.05	12426	3.00	0.06	14485	7.01
4	0.16	9568	2.71	0.16	10631	2.56	0.17	5670	2.75
5	0.27	11296	3.19	0.27	13098	3.16	0.28	7651	3.71
6	0.38	13719	3.88	0.38	20499	4.94	0.39	11267	5.46
7	0.49	26984	7.63	0.48	37136	8.95	0.50	28962	14.03
8	0.60	276505	78.19	0.59	317716	76.59	0.61	137637	66.66
9	0.71	2344	0.66	0.70	2707	0.65	0.72	689	0.33
10	0.82	295	0.08	0.81	383	0.09	0.83	90	0.04
11	0.93	152	0.04	0.91	95	0.02	0.94	-22	-0.01
12	1.04	-17	0.00	1.02	50	0.01	1.06	-31	-0.02



## 14.5 Storage time = 0 month, 120 minutes after labeling

Distance (cm)	Rx 1			Rx 2			Rx 3		
	Rf	CPM	%	Rf	CPM	%	Rf	CPM	%
1	-0.17	0	0.00	-0.15	0	0.00	-0.16	0	0.00
2	-0.06	125	0.02	-0.05	296	0.13	-0.05	1878	0.73
3	0.06	11331	2.25	0.05	12768	5.70	0.05	16670	6.49
4	0.17	13959	2.77	0.15	5069	2.26	0.16	6598	2.57
5	0.28	19074	3.79	0.26	6208	2.77	0.26	8642	3.36
6	0.39	25821	5.13	0.36	6451	2.88	0.37	9736	3.79
7	0.50	37116	7.37	0.46	10080	4.50	0.47	13393	5.21
8	0.61	392205	77.86	0.56	167942	75.02	0.58	182932	71.17
9	0.72	3194	0.63	0.66	12926	5.77	0.68	15302	5.95
10	0.83	437	0.09	0.77	1736	0.78	0.79	1682	0.65
11	0.94	458	0.09	0.87	333	0.15	0.89	182	0.07
12	1.06	16	0.00	0.97	61	0.03	1.00	7	0.00

## 14.6 Storage time = 0 month, 24 hours after labeling

Distance (cm)	Rx 1			Rx 2			Rx 3		
	Rf	CPM	%	Rf	CPM	%	Rf	CPM	%
1	-0.17	0	0.00	-0.17	17	0.00	-0.17	48	0.01
2	-0.06	19	0.00	-0.06	0	0.00	-0.06	0	0.00
3	0.06	32169	7.57	0.06	20865	4.49	0.06	20792	3.43
4	0.17	22433	5.28	0.17	15339	3.30	0.17	17585	2.90
5	0.28	28173	6.63	0.29	23717	5.11	0.29	26128	4.31
6	0.39	43738	10.29	0.40	40797	8.79	0.41	49288	8.14
7	0.51	294058	69.21	0.52	263721	56.79	0.52	134361	22.18
8	0.62	2781	0.65	0.63	95992	20.67	0.64	354128	58.46
9	0.73	736	0.17	0.75	1569	0.34	0.76	1783	0.29
10	0.84	801	0.19	0.86	1748	0.38	0.87	945	0.16
11	0.96	-14	0.00	0.98	546	0.12	0.99	680	0.11
12	1.07	-33	-0.01	1.09	43	0.01	1.10	60	0.01

## 14.7 Storage time = 1 month, 15 minutes after labeling

Distance (cm)	Rx 1			Rx 2			Rx 3		
	Rf	CPM	%	Rf	CPM	%	Rf	CPM	%
1	-0.15	0	0.00	-0.15	12	0.00	-0.15	117	0.04
2	-0.05	58	0.01	-0.05	0	0.00	-0.05	0	0.00
3	0.05	9464	1.58	0.05	15072	2.68	0.05	8634	2.85
4	0.15	14185	2.36	0.15	11374	2.02	0.15	5099	1.68
5	0.25	12176	2.03	0.25	17467	3.10	0.25	7025	2.32
6	0.35	18439	3.07	0.35	25421	4.52	0.35	8792	2.90
7	0.45	29874	4.98	0.45	53784	9.56	0.45	15038	4.96
8	0.56	500810	83.42	0.54	423527	75.25	0.55	249001	82.09
9	0.66	9120	1.52	0.64	12015	2.13	0.65	7117	2.35
10	0.76	3350	0.56	0.74	3190	0.57	0.75	1570	0.52
11	0.86	1793	0.30	0.84	541	0.10	0.85	433	0.14
12	0.96	946	0.16	0.94	304	0.05	0.95	371	0.12
13	1.06	16	0.00	1.04	6	0.00	1.05	31	0.01

## 14.8 Storage time = 1 month, 30 minutes after labeling

Distance (cm)	Rx 1			Rx 2			Rx 3		
	Rf	CPM	%	Rf	CPM	%	Rf	CPM	%
1	-0.16	23	0.00	-0.16	2	0.00	-0.15	0	0.00
2	-0.05	0	0.00	-0.05	0	0.00	-0.05	15	0.00
3	0.05	11746	2.33	0.05	16729	2.71	0.05	17732	3.40
4	0.16	14348	2.84	0.16	21138	3.42	0.15	22029	4.23
5	0.26	15288	3.03	0.27	43215	6.99	0.25	29994	5.75
6	0.36	25623	5.07	0.37	72491	11.73	0.35	44201	8.48
7	0.47	425745	84.31	0.48	450238	72.85	0.45	181899	34.90
8	0.57	7786	1.54	0.59	11310	1.83	0.55	218092	41.84
9	0.68	2140	0.42	0.69	1876	0.30	0.65	4956	0.95
10	0.78	889	0.18	0.80	644	0.10	0.75	1179	0.23
11	0.89	1021	0.20	0.90	261	0.04	0.85	719	0.14
12	0.99	54	0.01	1.01	21	0.00	0.95	315	0.06
13	1.09	192	0.04	1.12	-5	0.00	1.05	57	0.01

14.9 Storage time = 1 month, 60 minutes after labeling

Distance (cm)	Rx 1			Rx 2			Rx 3		
	Rf	CPM	%	Rf	CPM	%	Rf	CPM	%
1	-0.13	16	0.00	-0.13	0	0.00	-0.13	19	0.01
2	-0.04	0	0.00	-0.04	156	0.06	-0.04	0	0.00
3	0.04	11049	2.44	0.04	8993	3.41	0.04	17243	4.72
4	0.13	3825	0.84	0.13	3619	1.37	0.13	6664	1.83
5	0.21	4927	1.09	0.21	4186	1.59	0.21	6660	1.82
6	0.29	4126	0.91	0.29	4421	1.68	0.30	6624	1.81
7	0.38	4005	0.88	0.38	5629	2.13	0.38	8054	2.21
8	0.46	6072	1.34	0.46	6916	2.62	0.47	11103	3.04
9	0.54	11540	2.54	0.54	12690	4.81	0.56	32118	8.80
10	0.63	392303	86.48	0.63	204511	77.49	0.64	269764	73.91
11	0.71	11161	2.46	0.71	9586	3.63	0.73	6090	1.67
12	0.79	4384	0.97	0.79	3015	1.14	0.81	528	0.14
13	0.88	54	0.01	0.88	73	0.03	0.90	8	0.00
14	0.96	72	0.02	0.96	89	0.03	0.98	45	0.01
15	1.04	80	0.02	1.04	28	0.01	1.07	51	0.01

14.10 Storage time = 1 month, 90 minutes after labeling

Distance (cm)	Rx 1			Rx 2			Rx 3		
	Rf	CPM	%	Rf	CPM	%	Rf	CPM	%
1	-0.16	14	0.00	-0.16	0	0.00	-0.15	2	0.00
2	-0.05	0	0.00	-0.05	16	0.00	-0.05	0	0.00
3	0.05	8549	2.53	0.05	11100	3.42	0.05	13727	3.09
4	0.16	4071	1.20	0.16	6618	2.04	0.15	9102	2.05
5	0.27	4174	1.23	0.26	8752	2.70	0.26	10984	2.48
6	0.38	5513	1.63	0.36	8716	2.69	0.36	12669	2.86
7	0.48	6559	1.94	0.47	11053	3.41	0.46	18312	4.13
8	0.59	10734	3.17	0.57	26997	8.33	0.57	36777	8.29
9	0.70	292001	86.36	0.68	229930	70.91	0.67	329492	74.26
10	0.81	4833	1.43	0.78	18199	5.61	0.77	10326	2.33
11	0.91	1451	0.43	0.89	2435	0.75	0.88	1959	0.44
12	1.02	130	0.04	0.99	318	0.10	0.98	257	0.06
13	1.13	-8	0.00	1.09	-9	0.00	1.08	-2	0.00

## 14.11 Storage time = 1 month, 120 minutes after labeling

Distance (cm)	Rx 1			Rx 2			Rx 3		
	Rf	CPM	%	Rf	CPM	%	Rf	CPM	%
1	-0.16	0	0.00	-0.16	0	0.00	-0.15	9	0.00
2	-0.05	9	0.00	-0.05	11	0.00	-0.05	0	0.00
3	0.05	49597	4.74	0.05	30454	5.94	0.05	30227	5.66
4	0.16	30283	2.90	0.16	14092	2.75	0.15	15390	2.88
5	0.27	33617	3.21	0.26	19595	3.82	0.25	16411	3.08
6	0.38	40795	3.90	0.37	29942	5.84	0.35	26146	4.90
7	0.49	867907	82.99	0.47	381381	74.44	0.45	140824	26.39
8	0.60	17295	1.65	0.58	27394	5.35	0.56	295380	55.35
9	0.71	3339	0.32	0.68	5675	1.11	0.66	5694	1.07
10	0.82	2308	0.22	0.79	1466	0.29	0.76	1586	0.30
11	0.92	484	0.05	0.89	1947	0.38	0.86	1581	0.30
12	1.03	-4	0.00	1.00	247	0.05	0.96	234	0.04
13	1.14	25	0.00	1.11	39	0.01	1.06	30	0.01

## 14.12 Storage time = 1 month, 24 hours after labeling

Distance (cm)	Rx 1			Rx 2			Rx 3		
	Rf	CPM	%	Rf	CPM	%	Rf	CPM	%
1	-0.15	0	0.00	-0.15	0	0.00	-0.15	0	0.00
2	-0.05	13	0.00	0.0	144	0.03	-0.05	25	0.00
3	0.05	17364	3.43	0.05	13065	2.53	0.05	9053	1.79
4	0.15	9220	1.82	0.15	13035	2.53	0.15	11534	2.28
5	0.24	10642	2.10	0.24	13402	2.60	0.25	13731	2.72
6	0.34	12421	2.46	0.34	29499	5.72	0.35	28972	5.73
7	0.44	161119	31.86	0.44	237921	46.10	0.45	360899	71.42
8	0.53	290941	57.52	0.53	200297	38.81	0.54	79819	15.80
9	0.63	2382	0.47	0.63	8069	1.56	0.64	982	0.19
10	0.73	659	0.13	0.73	205	0.04	0.74	84	0.02
11	0.83	495	0.10	0.83	186	0.04	0.84	78	0.02
12	0.92	409	0.08	0.92	139	0.03	0.94	17	0.00
13	1.02	-11	0.00	1.02	28	0.01	1.04	-25	0.00

## 14.13 Storage time = 2 months, 15 minutes after labeling

Distance (cm)	Rx 1			Rx 2			Rx 3		
	Rf	CPM	%	Rf	CPM	%	Rf	CPM	%
1	-0.16	0	0.00	-0.16	1	0.00	-0.16	69	0.04
2	-0.05	427	0.31	-0.05	0	0.00	-0.05	76	0.04
3	0.05	1062	0.78	0.05	2642	1.38	0.05	4347	2.33
4	0.16	461	0.34	0.16	2244	1.17	0.16	4349	2.33
5	0.27	633	0.47	0.26	4928	2.57	0.27	2575	1.38
6	0.37	944	0.69	0.37	7597	3.96	0.38	3486	1.87
7	0.48	1450	1.07	0.47	16601	8.66	0.49	5866	3.15
8	0.59	129270	94.96	0.58	155685	81.23	0.60	164748	88.41
9	0.69	1435	1.05	0.68	1758	0.92	0.71	414	0.22
10	0.80	332	0.24	0.79	157	0.08	0.82	168	0.09
11	0.90	136	0.10	0.89	75	0.04	0.93	172	0.09
12	1.01	-22	-0.02	1.00	-19	-0.01	1.04	81	0.04

## 14.14 Storage time = 2 months, 30 minutes after labeling

Distance (cm)	Rx 1			Rx 2			Rx 3		
	Rf	CPM	%	Rf	CPM	%	Rf	CPM	%
1	-0.17	6	0.00	-0.16	37	0.01	-0.15	125	0.04
2	-0.06	0	0.00	-0.05	0	0.00	-0.05	140	0.04
3	0.06	2176	1.33	0.05	8350	3.01	0.05	15403	4.47
4	0.17	2116	1.30	0.16	5665	2.04	0.15	10660	3.09
5	0.28	2137	1.31	0.27	9528	3.43	0.26	15171	4.40
6	0.39	2488	1.53	0.38	14683	5.29	0.36	24223	7.02
7	0.50	149364	91.63	0.48	46329	16.68	0.46	32149	9.32
8	0.61	3975	2.44	0.59	190990	68.78	0.56	243051	70.48
9	0.72	490	0.30	0.70	1666	0.60	0.66	2782	0.81
10	0.83	134	0.08	0.81	306	0.11	0.77	523	0.15
11	0.94	112	0.07	0.91	136	0.05	0.87	393	0.11
12	1.06	5	0.00	1.02	-18	-0.01	0.97	244	0.07

14.15 Storage time = 2 months, 60 minutes after labeling

Distance (cm)	Rx 1			Rx 2			Rx 3		
	Rf	CPM	%	Rf	CPM	%	Rf	CPM	%
1	-0.17	0	0.00	-0.17	13	0.01	-0.17	84	0.03
2	-0.06	0	0.00	-0.06	0	0.00	-0.06	94	0.03
3	0.06	1482	1.00	0.06	2396	1.32	0.06	3090	1.10
4	0.17	851	0.58	0.17	2297	1.27	0.17	2798	1.00
5	0.28	1024	0.69	0.28	2510	1.38	0.28	3679	1.31
6	0.39	1677	1.14	0.39	3946	2.17	0.39	6922	2.46
7	0.50	2338	1.59	0.50	6792	3.74	0.51	13935	4.96
8	0.61	137214	93.04	0.61	155735	85.78	0.62	244121	86.83
9	0.72	2310	1.57	0.72	6874	3.79	0.73	5723	2.04
10	0.83	430	0.29	0.83	864	0.48	0.84	479	0.17
11	0.94	140	0.09	0.94	100	0.06	0.96	136	0.05
12	1.06	11	0.01	1.06	27	0.01	1.07	94	0.03

14.16 Storage time = 2 months, 90 minutes after labeling

Distance (cm)	Rx 1			Rx 2			Rx 3		
	Rf	CPM	%	Rf	CPM	%	Rf	CPM	%
1	-0.15	0	0.00	-0.15	12	0.00	-0.15	71	0.17
2	-0.05	3	0.00	-0.05	0	0.00	-0.05	81	0.19
3	0.05	2130	1.52	0.05	8248	3.02	0.05	1270	3.01
4	0.15	1484	1.06	0.15	7197	2.63	0.15	1016	2.41
5	0.26	1695	1.21	0.25	7411	2.71	0.25	1346	3.19
6	0.36	1705	1.22	0.35	10855	3.97	0.35	1670	3.96
7	0.46	2282	1.63	0.45	16107	5.90	0.45	2538	6.02
8	0.56	128811	91.90	0.55	175330	64.18	0.55	7200	17.08
9	0.66	1465	1.05	0.65	46271	16.94	0.65	26484	62.84
10	0.77	392	0.28	0.75	1165	0.43	0.75	201	0.48
11	0.87	132	0.09	0.85	279	0.10	0.85	110	0.26
12	0.97	72	0.05	0.95	304	0.11	0.95	159	0.38
13	1.07	0	0.00	1.05	0	0.00	1.05	0	0.00

14.17 Storage time = 2 months, 120 minutes after labeling

Distance (cm)	Rx 1			Rx 2			Rx 3		
	Rf	CPM	%	Rf	CPM	%	Rf	CPM	%
1	-0.16	0	0.00	-0.16	-12	-0.04	-0.16	77	0.17
2	-0.05	13	0.05	-0.05	0	0.00	-0.05	76	0.16
3	0.05	258	0.96	0.05	610	2.14	0.05	1099	2.38
4	0.16	219	0.81	0.16	543	1.90	0.16	1324	2.87
5	0.27	255	0.95	0.27	571	2.00	0.27	1710	3.71
6	0.37	289	1.07	0.38	737	2.58	0.38	3443	7.47
7	0.48	599	2.22	0.48	2479	8.68	0.48	37289	80.90
8	0.59	25040	92.99	0.59	23482	82.23	0.59	651	1.41
9	0.69	86	0.32	0.70	98	0.34	0.70	97	0.21
10	0.80	38	0.14	0.81	1	0.00	0.81	152	0.33
11	0.90	59	0.22	0.91	41	0.14	0.91	92	0.20
12	1.01	12	0.04	1.02	5	0.02	1.02	83	0.18

14.18 Storage time = 2 months, 24 hours after labeling

Distance (cm)	Rx 1			Rx 2			Rx 3		
	Rf	CPM	%	Rf	CPM	%	Rf	CPM	%
1	-0.16	15	0.04	-0.16	0	0	-0.15	72	0.19
2	-0.05	0	0.00	-0.05	19	0.05	-0.05	85	0.22
3	0.05	825	2.34	0.05	970	2.43	0.05	770	2.02
4	0.16	483	1.37	0.16	1123	2.82	0.15	1272	3.33
5	0.27	487	1.38	0.26	919	2.31	0.26	1145	3.00
6	0.37	658	1.87	0.36	1436	3.60	0.36	1938	5.07
7	0.48	1150	3.26	0.47	2853	7.16	0.46	3696	9.67
8	0.59	31102	88.30	0.57	32091	80.56	0.57	28716	75.16
9	0.69	232	0.66	0.68	189	0.47	0.67	190	0.50
10	0.80	72	0.20	0.78	79	0.20	0.77	84	0.22
11	0.90	120	0.34	0.89	138	0.35	0.88	157	0.41
12	1.01	1	0.00	0.99	19	0.05	0.98	84	0.22

## 14.19 Storage time = 3 months, 15 minutes after labeling

Distance (cm)	Rx 1			Rx 2			Rx 3		
	Rf	CPM	%	Rf	CPM	%	Rf	CPM	%
1	-0.17	0	0.00	-0.17	6	0.00	-0.17	13	0.00
2	-0.06	5	0.00	-0.06	0	0.00	-0.06	0	0.00
3	0.06	7421	2.11	0.06	8544	1.80	0.06	11394	3.82
4	0.17	3452	0.98	0.17	6193	1.30	0.17	6030	2.02
5	0.28	3980	1.13	0.28	9123	1.92	0.28	8866	2.98
6	0.39	6545	1.86	0.39	16751	3.52	0.39	12770	4.29
7	0.50	13167	3.74	0.50	54066	11.37	0.51	80306	26.95
8	0.61	316053	89.69	0.61	379693	79.85	0.62	178323	59.85
9	0.72	1272	0.36	0.72	872	0.18	0.73	150	0.05
10	0.83	226	0.06	0.83	167	0.04	0.84	53	0.02
11	0.94	222	0.06	0.94	115	0.02	0.96	27	0.01
12	1.06	57	0.02	1.06	-2	0.00	1.07	1	0.00

## 14.20 Storage time = 3 months, 30 minutes after labeling

Distance (cm)	Rx 1			Rx 2			Rx 3		
	Rf	CPM	%	Rf	CPM	%	Rf	CPM	%
1	-0.16	0	0.00	-0.16	13	0.00	-0.16	27	0.01
2	-0.05	4	0.00	-0.05	0	0.00	-0.05	0	0.00
3	0.05	12664	2.68	0.05	13182	3.19	0.05	16376	6.22
4	0.16	11070	2.34	0.16	10664	2.58	0.16	7450	2.83
5	0.27	14046	2.97	0.27	13970	3.38	0.27	9986	3.79
6	0.38	19289	4.08	0.38	22481	5.44	0.38	14895	5.65
7	0.49	184157	38.93	0.48	129921	31.45	0.48	55217	20.96
8	0.60	229927	48.60	0.59	221705	53.67	0.59	158863	60.30
9	0.71	1226	0.26	0.70	838	0.20	0.70	434	0.16
10	0.82	294	0.06	0.81	127	0.03	0.81	65	0.02
11	0.92	408	0.09	0.91	184	0.04	0.91	86	0.03
12	1.03	-1	0.00	1.02	6	0.00	1.02	34	0.01



## 14.21 Storage time = 3 months, 60 minutes after labeling

Distance (cm)	Rx 1			Rx 2			Rx 3		
	Rf	CPM	%	Rf	CPM	%	Rf	CPM	%
1	-0.21	0	0.00	-0.17	0	0	-0.16	0	0.00
2	-0.07	16	0.01	-0.06	11	0.00	-0.05	25	0.01
3	0.07	18812	7.14	0.06	19926	6.30	0.05	24331	8.42
4	0.21	16917	6.42	0.17	15823	5.00	0.16	15747	5.45
5	0.34	22597	8.57	0.28	23822	7.53	0.27	18913	6.55
6	0.48	198274	75.20	0.39	45011	14.23	0.38	31855	11.03
7	0.62	4740	1.80	0.51	207349	65.56	0.49	194842	67.47
8	0.75	1385	0.53	0.62	3398	1.07	0.60	2312	0.80
9	0.89	494	0.19	0.73	708	0.22	0.71	514	0.18
10	1.03	359	0.14	0.84	139	0.04	0.82	136	0.05
11	1.16	16	0.01	0.96	75	0.02	0.93	100	0.03
12	1.30	36	0.01	1.07	1	0.00	1.04	21	0.01

## 14.22 Storage time = 3 months, 90 minutes after labeling

Distance (cm)	Rx 1			Rx 2			Rx 3		
	Rf	CPM	%	Rf	CPM	%	Rf	CPM	%
1	-0.17	0	0.00	-0.16	0	0	-0.16	0	0.00
2	-0.06	16	0.00	-0.05	16	0.00	-0.05	0	0.00
3	0.06	11035	2.34	0.05	12466	2.28	0.05	13635	2.85
4	0.17	9899	2.10	0.16	10196	1.86	0.16	12466	2.60
5	0.28	9536	2.02	0.27	11802	2.16	0.27	14323	2.99
6	0.39	13917	2.95	0.38	19610	3.59	0.38	20818	4.35
7	0.50	31327	6.63	0.49	58330	10.67	0.49	100704	21.04
8	0.61	393871	83.37	0.60	432747	79.16	0.60	316165	66.05
9	0.72	2027	0.43	0.71	1278	0.23	0.71	317	0.07
10	0.83	341	0.07	0.82	154	0.03	0.82	192	0.04
11	0.94	408	0.09	0.93	97	0.02	0.93	39	0.01
12	1.06	48	0.01	1.04	8	0.00	1.04	28	0.01

## 14.23 Storage time = 3 months, 120 minutes after labeling

Distance (cm)	Rx 1			Rx 2			Rx 3		
	Rf	CPM	%	Rf	CPM	%	Rf	CPM	%
1	-0.16	0	0.00	-0.16	0	0.00	-0.16	20	0.00
2	-0.05	29	0.01	-0.1	26	0.01	-0.05	0	0.00
3	0.05	11434	3.26	0.05	13973	3.37	0.05	13870	2.86
4	0.16	12995	3.71	0.16	13000	3.13	0.16	18983	3.91
5	0.27	13081	3.73	0.27	17381	4.19	0.27	25907	5.34
6	0.38	19213	5.48	0.38	30370	7.32	0.37	43931	9.05
7	0.49	287798	82.16	0.48	330461	79.69	0.48	364852	75.16
8	0.60	4031	1.15	0.59	7731	1.86	0.59	16779	3.46
9	0.71	1259	0.36	0.70	1406	0.34	0.69	733	0.15
10	0.82	212	0.06	0.81	168	0.04	0.80	85	0.02
11	0.92	227	0.06	0.91	113	0.03	0.90	104	0.02
12	1.03	5	0.00	1.02	46	0.01	1.01	11	0.00

## 14.24 Storage time = 3 months, 24 hours after labeling

Distance (cm)	Rx 1			Rx 2			Rx 3		
	Rf	CPM	%	Rf	CPM	%	Rf	CPM	%
1	-0.16	0	0.00	-0.16	3	0	-0.16	0	0.00
2	-0.05	10	0.00	-0.05	0	0	-0.05	28	0.01
3	0.05	26938	6.78	0.05	23753	4.63	0.05	18850	3.57
4	0.16	16775	4.22	0.16	15912	3.10	0.16	21933	4.15
5	0.27	13693	3.45	0.27	19361	3.78	0.27	23719	4.49
6	0.38	20785	5.23	0.38	36061	7.03	0.38	45992	8.70
7	0.49	305623	76.96	0.49	410372	80.04	0.49	414418	78.38
8	0.60	8919	2.25	0.60	5637	1.10	0.60	2720	0.51
9	0.71	2796	0.70	0.71	1166	0.23	0.71	482	0.09
10	0.82	757	0.19	0.82	190	0.04	0.82	236	0.04
11	0.93	789	0.20	0.93	261	0.05	0.93	312	0.06
12	1.04	57	0.01	1.04	11	0.00	1.04	58	0.01

**Table 15** Data for the Studies on the factors affecting the quality of the formulations (first batch).

Radioactivity distribution (%strip count) for Tc 99m Succimer Injection using assay system method II.

15.1 Storage time = 3 months, 15 minutes after labeling

Distance (cm)	Rx 1			Rx 2			Rx 3		
	Rf	CPM	%	Rf	CPM	%	Rf	CPM	%
0.5	-0.24	125	0.02	-0.24	145	0.03	-0.24	151	0.05
1	-0.18	131	0.02	-0.18	158	0.03	-0.18	199	0.06
1.5	-0.12	124	0.02	-0.12	157	0.03	-0.12	156	0.05
2	-0.06	130	0.02	-0.06	167	0.03	-0.06	202	0.06
2.5	0.00	50568	7.18	0.00	12515	2.61	0.00	18792	5.61
3	0.06	89905	12.77	0.06	75898	15.82	0.06	81267	24.26
3.5	0.12	82877	11.77	0.12	64522	13.45	0.12	52247	15.60
4	0.18	56710	8.06	0.18	57828	12.05	0.18	46715	13.94
4.5	0.24	56529	8.03	0.24	54230	11.30	0.24	35055	10.46
5	0.30	159623	22.68	0.29	110537	23.04	0.29	34696	10.36
5.5	0.36	56938	8.09	0.35	64631	13.47	0.35	34664	10.35
6	0.42	89969	12.78	0.41	17023	3.55	0.41	14194	4.24
6.5	0.48	39564	5.62	0.47	14318	2.98	0.47	11023	3.29
7	0.54	3149	0.45	0.53	2066	0.43	0.53	1255	0.37
7.5	0.60	9216	1.31	0.59	2029	0.42	0.59	955	0.29
8	0.65	5124	0.73	0.65	1819	0.38	0.65	1644	0.49
8.5	0.71	1849	0.26	0.71	730	0.15	0.71	557	0.17
9	0.77	566	0.08	0.76	221	0.05	0.76	446	0.13
9.5	0.83	258	0.04	0.82	157	0.03	0.82	191	0.06
10	0.89	151	0.02	0.88	169	0.04	0.88	154	0.05
10.5	0.95	187	0.03	0.94	127	0.03	0.94	155	0.05
11	1.01	184	0.03	1.00	170	0.04	1.00	145	0.04
11.5				1.06	129	0.03	1.06	147	0.04

15.2 Storage time = 3 months, 180 minutes after labeling

Distance (cm)	Rx 1			Rx 2			Rx 3		
	Rf	CPM	%	Rf	CPM	%	Rf	CPM	%
0.5	-0.23	160	0.03	-0.23	138	0.04	-0.23	179	0.05
1	-0.17	179	0.04	-0.17	156	0.04	-0.17	172	0.04
1.5	-0.11	144	0.03	-0.11	145	0.04	-0.11	200	0.05
2	-0.06	169	0.03	-0.06	199	0.05	-0.06	149	0.04
2.5	0.00	18208	3.57	0.00	10371	2.75	0.00	17595	4.57
3	0.06	86943	17.03	0.06	72484	19.22	0.06	91453	23.75
3.5	0.11	67799	13.28	0.11	56014	14.85	0.11	60115	15.61
4	0.17	54666	10.71	0.17	44648	11.84	0.17	45172	11.73
4.5	0.23	44710	8.76	0.23	45818	12.15	0.23	35493	9.22
5	0.29	75297	14.75	0.29	59145	15.68	0.28	32037	8.32
5.5	0.34	51308	10.05	0.34	45789	12.14	0.34	52879	13.73
6	0.40	11219	2.20	0.40	12924	3.43	0.40	21092	5.48
6.5	0.46	75597	14.81	0.46	14238	3.78	0.45	16590	4.31
7	0.52	3848	0.75	0.52	4733	1.26	0.51	3103	0.81
7.5	0.57	2918	0.57	0.57	2085	0.55	0.57	1477	0.38
8	0.63	6430	1.26	0.63	3130	0.83	0.63	2238	0.58
8.5	0.69	5488	1.08	0.69	1815	0.48	0.68	1664	0.43
9	0.75	3086	0.60	0.75	1709	0.45	0.74	1591	0.41
9.5	0.80	1261	0.25	0.80	864	0.23	0.80	1065	0.28
10	0.86	306	0.06	0.86	207	0.05	0.85	221	0.06
10.5	0.92	237	0.05	0.92	166	0.04	0.91	221	0.06
11	0.98	229	0.04	0.98	175	0.05	0.97	183	0.05
11.5	1.03	199	0.04	1.03	173	0.05	1.02	188	0.05

## 15.3 Storage time = 3 months, 180 minutes after labeling

Distance (cm)	Rx 1			Rx 2			Rx 3		
	Rf	CPM	%	Rf	CPM	%	Rf	CPM	%
0.5	-0.24	184	0.03	-0.24	258	0.07	-0.24	257	0.07
1	-0.18	195	0.03	-0.18	290	0.08	-0.18	310	0.08
1.5	-0.12	249	0.04	-0.12	262	0.07	-0.12	259	0.07
2	-0.06	226	0.04	-0.06	227	0.06	-0.06	316	0.08
2.5	0.00	7783	1.31	0.00	10030	2.62	0.00	19275	4.89
3	0.06	64621	10.90	0.06	50167	13.12	0.06	73777	18.72
3.5	0.12	60738	10.25	0.12	55956	14.64	0.12	71873	18.24
4	0.18	57160	9.64	0.18	43153	11.29	0.18	42777	10.86
4.5	0.24	57132	9.64	0.24	47350	12.39	0.24	35682	9.05
5	0.30	75153	12.68	0.29	54730	14.32	0.29	39172	9.94
5.5	0.36	128675	21.71	0.35	64155	16.78	0.35	61090	15.50
6	0.42	23222	3.92	0.41	21614	5.65	0.41	21122	5.36
6.5	0.48	82001	13.84	0.47	17475	4.57	0.47	15458	3.92
7	0.54	6383	1.08	0.53	3897	1.02	0.53	2317	0.59
7.5	0.60	5285	0.89	0.59	2767	0.72	0.59	1547	0.39
8	0.65	12620	2.13	0.65	4387	1.15	0.65	3755	0.95
8.5	0.71	5596	0.94	0.71	1899	0.50	0.71	1395	0.35
9	0.77	3575	0.60	0.76	2045	0.53	0.76	2086	0.53
9.5	0.83	863	0.15	0.82	424	0.11	0.82	385	0.10
10	0.89	357	0.06	0.88	325	0.09	0.88	312	0.08
10.5	0.95	334	0.06	0.94	378	0.10	0.94	325	0.08
11	1.01	303	0.05	1.00	278	0.07	1.00	302	0.08
11.5				1.06	197	0.05	1.06	267	0.07

**Table 16** Data for the studies on the factors affecting the quality of the formulations (second batch).

Radioactivity distribution (%strip count) for 2nd batch of Tc 99m Succimer Injection using assay system II.

16.1 Second batch, storage time = 0 month, 15 minutes after labeling.

Distance (cm)	Rx 1			Rx 2			Rx 3		
	Rf	CPM	%	Rf	CPM	%	Rf	CPM	%
0.5	-0.22	-23	-0.01	-0.22	16	0.00	-0.22	-18	-0.01
1	-0.17	0	0.00	-0.17	-2	0.00	-0.17	10	0.00
1.5	-0.11	8	0.00	-0.11	-16	0.00	-0.11	0	0.00
2	-0.06	6	0.00	-0.06	44	0.01	-0.06	38	0.01
2.5	0.00	37679	11.92	0.00	55171	11.65	0.00	44190	12.96
3	0.06	143543	45.42	0.06	236777	50.00	0.06	176132	51.66
3.5	0.11	32048	10.14	0.11	55253	11.67	0.11	38881	11.40
4	0.17	23637	7.48	0.17	43268	9.14	0.17	24196	7.10
4.5	0.22	29160	9.23	0.22	40234	8.50	0.22	26956	7.91
5	0.28	16929	5.36	0.28	20563	4.34	0.28	16553	4.86
5.5	0.33	4761	1.51	0.33	6096	1.29	0.33	4333	1.27
6	0.39	3103	0.98	0.39	2869	0.61	0.39	4517	1.32
6.5	0.44	18896	5.98	0.44	9104	1.92	0.44	3438	1.01
7	0.50	917	0.29	0.50	1540	0.33	0.50	491	0.14
7.5	0.56	693	0.22	0.56	1020	0.22	0.56	440	0.13
8	0.61	1201	0.38	0.61	456	0.10	0.61	159	0.05
8.5	0.67	1952	0.62	0.67	557	0.12	0.67	279	0.08
9	0.72	950	0.30	0.72	402	0.08	0.72	232	0.07
9.5	0.78	424	0.13	0.78	170	0.04	0.78	54	0.02
10	0.83	118	0.04	0.83	8	0.00	0.83	36	0.01
10.5	0.89	25	0.01	0.89	-8	0.00	0.89	-12	0.00
11	0.94	5	0.00	0.94	-8	0.00	0.94	0	0.00
11.5	1.00	-14	0.00	1.00	2	0.00	1.00	22	0.01

16.2 Second batch, storage time = 0 month, 180 minutes after labeling.

Distance (cm)	Rx 1			Rx 2			Rx 3		
	Rf	CPM	%	Rf	CPM	%	Rf	CPM	%
0.5	-0.22	-11	0.00	-0.22	0	0.00	-0.22	16	0.00
1	-0.17	0	0.00	-0.17	10	0.00	-0.17	-6	0.00
1.5	-0.11	-13	0.00	-0.11	31	0.01	-0.11	4	0.00
2	-0.06	4	0.00	-0.06	-14	0.00	-0.06	28	0.01
2.5	0.00	53760	17.99	0.00	50156	15.16	0.00	42959	12.88
3	0.06	110186	36.86	0.06	159138	48.10	0.06	171836	51.52
3.5	0.11	28004	9.37	0.11	34430	10.41	0.11	33087	9.92
4	0.17	19702	6.59	0.17	21563	6.52	0.17	20090	6.02
4.5	0.22	27933	9.35	0.22	22779	6.89	0.22	21460	6.43
5	0.28	24221	8.10	0.28	20673	6.25	0.28	24457	7.33
5.5	0.33	8426	2.82	0.33	9387	2.84	0.33	10222	3.06
6	0.39	4435	1.48	0.39	4285	1.30	0.39	4237	1.27
6.5	0.44	10598	3.55	0.44	4589	1.39	0.44	3443	1.03
7	0.50	1195	0.40	0.50	1438	0.43	0.50	575	0.17
7.5	0.56	883	0.30	0.56	941	0.28	0.56	503	0.15
8	0.61	1260	0.42	0.61	429	0.13	0.61	312	0.09
8.5	0.67	3567	1.19	0.67	445	0.13	0.67	155	0.05
9	0.72	2906	0.97	0.72	291	0.09	0.72	118	0.04
9.5	0.78	1255	0.42	0.78	180	0.05	0.78	46	0.01
10	0.83	428	0.14	0.83	58	0.02	0.83	0	0.00
10.5	0.89	75	0.03	0.89	18	0.01	0.89	-17	-0.01
11	0.94	33	0.01	0.94	8	0.00	0.94	-4	0.00
11.5	1.00	50	0.02	1.00	2	0.00	1.00	-13	0.00

16.3 Second batch, storage time = 0 month, 24 hours after labeling.

Distance (cm)	Rx 1			Rx 2			Rx 3		
	Rf	CPM	%	Rf	CPM	%	Rf	CPM	%
0.5	-0.23	4	0.00	-0.22	2	0.00	-0.22	-9	0.00
1	-0.17	-13	0.00	-0.17	0	0.00	-0.17	-5	0.00
1.5	-0.11	-11	0.00	-0.11	27	0.01	-0.11	-24	-0.01
2	-0.06	-11	0.00	-0.06	25	0.01	-0.06	2	0.00
2.5	0.00	26690	6.00	0.00	33031	13.11	0.00	42841	9.42
3	0.06	119230	26.81	0.06	79135	31.42	0.06	267993	58.90
3.5	0.11	50106	11.27	0.11	31430	12.48	0.11	48509	10.66
4	0.17	42588	9.58	0.17	22002	8.74	0.17	23440	5.15
4.5	0.23	81043	18.22	0.22	29687	11.79	0.22	26810	5.89
5	0.28	54689	12.30	0.28	27064	10.75	0.28	27899	6.13
5.5	0.34	17266	3.88	0.33	11175	4.44	0.33	8574	1.88
6	0.40	9981	2.24	0.39	5077	2.02	0.39	4945	1.09
6.5	0.45	18132	4.08	0.44	8088	3.21	0.44	2368	0.52
7	0.51	1556	0.35	0.50	1197	0.48	0.50	523	0.11
7.5	0.57	2235	0.50	0.56	1008	0.40	0.56	499	0.11
8	0.63	4780	1.07	0.61	737	0.29	0.61	177	0.04
8.5	0.68	6893	1.55	0.67	916	0.36	0.67	221	0.05
9	0.74	5533	1.24	0.72	725	0.29	0.72	175	0.04
9.5	0.80	2144	0.48	0.78	286	0.11	0.78	51	0.01
10	0.85	614	0.14	0.83	63	0.03	0.83	22	0.00
10.5	0.91	445	0.10	0.89	42	0.02	0.89	-15	0.00
11	0.97	645	0.15	0.94	106	0.04	0.94	34	0.01
11.5	1.02	159	0.04	1.00	42	0.02	1.00	-29	-0.01



**Table 17** Data of the studies on the factors affecting the quality of the formulations : Determination of optimum amount of ascorbic acid

Distance (cm)	Ascorbic acid														
	0.175 mg/vial			0.35 mg/vial			0.7 mg/vial			1.4 mg/vial			2.8 mg/vial		
	Rf	CPM	%	Rf	CPM	%	Rf	CPM	%	Rf	CPM	%	Rf	CPM	%
0.5	-0.22	-61	%	-0.23	14	0.00	-0.23	-21	-0.01	-0.23	-19	0.00	-0.23	-24	-0.01
1	-0.16	-26	-0.01	-0.17	-34	-0.01	-0.17	-75	-0.02	-0.17	-23	0.00	-0.17	44	0.02
1.5	-0.11	-29	-0.01	-0.11	-44	-0.01	-0.11	-50	-0.01	-0.11	738	0.15	-0.11	-56	-0.02
2	-0.05	-65	-0.01	-0.06	-41	-0.01	-0.06	29	0.01	-0.06	-69	-0.01	-0.06	48	0.02
2.5	0.00	22195	-0.01	0.00	21943	3.99	0.00	22995	5.57	0.00	14056	2.93	0.00	23686	9.40
3	0.05	148355	4.73	0.06	159036	28.89	0.06	143773	34.81	0.06	160699	33.49	0.06	69466	27.58
3.5	0.11	62282	31.61	0.11	68637	12.47	0.11	54054	13.09	0.11	67613	14.09	0.11	47824	18.98
4	0.16	51192	13.27	0.17	67686	12.30	0.17	49559	12.00	0.17	61454	12.81	0.17	50030	19.86
4.5	0.22	80116	10.91	0.23	126485	22.98	0.23	78159	18.92	0.23	95256	19.85	0.23	29122	11.56
5	0.27	57745	17.07	0.29	62607	11.37	0.29	35934	8.70	0.29	40932	8.53	0.29	14593	5.79
5.5	0.32	16366	12.30	0.34	14838	2.70	0.34	10055	2.43	0.34	10424	2.17	0.34	5434	2.16
6	0.38	6679	3.49	0.40	6588	1.20	0.40	5809	1.41	0.40	5189	1.08	0.40	3989	1.58
6.5	0.43	15619	1.42	0.46	16741	3.04	0.46	9486	2.30	0.46	15410	3.21	0.46	5393	2.14
7	0.48	3872	3.33	0.52	1464	0.27	0.52	960	0.23	0.52	4152	0.87	0.52	1026	0.41
7.5	0.54	855	0.83	0.57	1239	0.23	0.57	688	0.17	0.57	1635	0.34	0.57	678	0.27
8	0.59	814	0.18	0.63	909	0.17	0.63	616	0.15	0.63	858	0.18	0.63	253	0.10
8.5	0.65	1398	0.17	0.69	933	0.17	0.69	547	0.13	0.69	487	0.10	0.69	204	0.08
9	0.70	1278	0.30	0.75	984	0.18	0.75	276	0.07	0.75	524	0.11	0.75	100	0.04
9.5	0.75	448	0.27	0.80	431	0.08	0.80	146	0.04	0.80	391	0.08	0.80	92	0.04
10	0.81	231	0.10	0.86	50	0.01	0.86	64	0.02	0.86	40	0.01	0.86	13	0.01
10.5	0.86	57	0.05	0.92	4	0.00	0.92	4	0.00	0.92	56	0.01	0.92	34	0.01
11	0.91	47	0.01	0.98	-50	-0.01	0.98	19	0.00	0.98	-60	-0.01	0.98	67	0.03
11.5	0.97	-57	0.01	1.03	4	0.00	1.03	19	0.00	1.03	52	0.01	1.03	-101	-0.04

## APPENDIX B

### STATISTICS

In general, analysis of variance, or ANOVA, is a statistical procedure used to determine whether means from two or more samples are drawn from populations with the same mean. This technique expands on the tests for two means, such as t-test

#### **One way analysis of variance (one way ANOVA)**

The simplest type of analysis of variance is that known as one-way analysis of variance, in which one source of variation, or factor, is investigated. In a typical situation we want to use analysis of variance to test the null hypothesis that three or more treatments are equally effective. The measurements (or observations) along with the means and totals that can be computed from them, may be displayed for convenience as follows

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**Table 18** Table of sample value for one-way ANOVA

	Treatments				
	1	2	3	.....	k
	$x_{11}$	$x_{12}$	$x_{13}$	.....	$x_{1k}$
	$x_{21}$	$x_{22}$	$x_{23}$	.....	$x_{2k}$
	$x_{31}$	$x_{32}$	$x_{33}$	.....	$x_{3k}$
	:	:	:	:	$\bar{x}_k$
	$x_{n1^1}$	$x_{n2^2}$	$x_{n3^3}$	.....	$x_{nk^k}$
Total	$T_1$	$T_2$	$T_3$	$T_k$	$T_{..}$
Mean	$\bar{x}_1$	$\bar{x}_2$	$\bar{x}_3$	$\bar{x}_k$	$\bar{x}_{..}$

$$T = \sum_{j=1}^k T_j = \sum_{j=1}^k \sum_{i=1}^{n_{ji}} x_{ij} = \text{total of all observations}$$

$$\bar{x} = \frac{T_{..}}{N}, ; N = \sum_{j=1}^k n_j$$

### Hypotheses

We may test the null hypothesis that all population or treatment means are equal against the alternative that the members of at least one pair are not equal.

We may state the hypotheses formally as follows:

The null hypothesis  $H_0 : \mu_1 = \mu_2 = \dots \mu_k$

The alternative hypothesis  $H_A : \text{not all } \mu_j \text{ are equal}$

The analysis of variance for testing the hypothesis is performed as in the following table:

**Table 19** ANOVA table (one-way)

Source of variation	Sum of squares	Degree of freedom	Mean square	Variance ratio
Among samples	$SSA = \sum_{j=1}^k n_j(\bar{x}_j - \bar{x}_{..})^2$ $\sum_{j=1}^k \frac{T_j^2}{n_j} - \frac{T_{..}^2}{N}$	$k - 1$	$MSA$ $= SSA/(k - 1)$	$V.R. = \frac{MSA}{MSW}$
Within samples	$SSW = \sum_{j=1}^k \sum_{i=1}^{n_j} (x_{ij} - \bar{x}_j)^2$ $\sum_{j=1}^k \sum_{i=1}^{n_j} x_{ij}^2 - \sum_{j=1}^k \frac{(T_j)^2}{n_j}$	$N - k$	$MSW$ $= SSW/(N - k)$	
Total	$SST = \sum_{j=1}^k \sum_{i=1}^{n_j} (x_{ij} - \bar{x}_{..})^2$ $\sum_{j=1}^k \sum_{i=1}^{n_j} x_{ij}^2 - \frac{T_{..}^2}{N}$	$N - 1$		

### Statistical Decision

To reach a decision we must compare our computed V.R. with the critical value of F, which will be obtained from the F Distribution table.

In this study, the calculations were performed using Microsoft Excel<sup>R</sup> computer program at a significant level of 0.05. All probability values were provided by the program.

## Two-way analysis of variance

In this method an observation is categorized on the basis of two criteria—the block to which it belongs as well as the treatment group to which it belongs. The two-way ANOVA table can be computed as in table 20 and 21. The statistical decision is similar to the one-way analysis of variance.

**Table 20** Table for the sample value for the two-way ANOVA

	Treatments					Total	Mean
	1	2	3	.....	k		
	$x_{11}$	$x_{12}$	$x_{13}$	.....	$x_{1k}$	$T_1$	$\bar{x}_1$
	$x_{21}$	$x_{22}$	$x_{23}$	.....	$x_{2k}$	$T_2$	$\bar{x}_2$
	$x_{31}$	$x_{32}$	$x_{33}$	.....	$x_{3k}$	$T_3$	$\bar{x}_3$
	:	:	:	:	:	:	
	$x_{n1}$	$x_{n2}$	$x_{n3}$	.....	$x_{nk}$	$T_n$	$\bar{x}_n$
Total	$T_1$	$T_2$	$T_3$		$T_k$	$T_{..}$	
Mean	$\bar{x}_1$	$\bar{x}_2$	$\bar{x}_3$		$\bar{x}_k$		$\bar{x}_{..}$

Table 21 Two-way ANOVA table

Source	SS	d.f.	MS	V.R.
Treatments	$SSTr$	$(k - 1)$	$MSTr = \frac{SSTr}{(k - 1)}$	$MSTr / MSE$
Blocks	$SSBI$	$(n - 1)$	$MSBI = \frac{SSBI}{(n - 1)}$	
Residual	$SSE$	$(n - 1)(k - 1)$	$MSE = \frac{SSE}{(n - 1)(k - 1)}$	
Total	$SST$	$kn - 1$		

Where

$$SST = \sum_{j=1}^k \sum_{i=1}^n x_{ij}^2 - C$$

$$SSBI = \sum_{i=1}^n \frac{T_i^2}{k} - C$$

$$SSTr = \sum_{j=1}^k \frac{T_j^2}{n} - C$$

$$SSE = SST - SSBI - SSTr$$

For more calculation details see Danial, W.W. 1987. *Biostatistics : A foundation for analysis in the health sciences*. New York: John Wiley & Son

**Table 22** Example of calculation in table 4

## 22.1 Sample table

<i>Rx 1</i>	<i>Rx 2</i>	<i>Rx 3</i>
<i>month0</i>	<i>month0</i>	<i>month0</i>
88.73	86.28	89.41
88.23	87.71	87.9
85.81	89.03	85.33
86.49	86.19	86.47
85.86	85.3	86.12
79.51	86.25	89.06

Anova: One-way

## 22.2 Summary

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
month0	6	514.63	85.772	10.906
month0	6	520.76	86.793	1.799
month0	6	524.29	87.382	2.766

## 22.3 ANOVA Source of Variation

	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	7.964	2	3.982	0.772	0.480	3.682
Within Groups	77.357	15	5.157			
Total	85.321	17				

**Table 23** Example of calculation in table 5

## 23.1 Sample table

<i>Rx1</i>	<i>month0</i>	<i>month1</i>	<i>month2</i>	<i>month3</i>
15 min	88.73	89.92	97.08	93.79
30 min	88.23	90.93	95.6	91.86
60 min	85.81	91.49	96.2	85.57
90 min	86.49	90.96	94.56	90.43
120 min	85.86	88.55	95.53	88.79
24 hr	79.51	89.85	92.22	84.43

## 23.2 Anova: Two-way

<i>Summary</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
15 min	4	369.520	92.380	14.484
30 min	4	366.620	91.655	9.287
60 min	4	359.070	89.768	25.875
90 min	4	362.440	90.610	10.911
120 min	4	358.730	89.683	16.961
24 hr	4	346.010	86.503	32.362
month0	6	514.630	85.772	10.906
month1	6	541.700	90.283	1.131
month2	6	571.190	95.198	2.819
month3	6	534.870	89.145	13.147

## 23.3 ANOVA Source of Variation

	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Rows	84.414	5	16.883	4.555	0.010	2.901
Columns	274.039	3	91.346	24.643	4.771E-06	3.287
Error	55.601	15	3.707			
Total	414.053	23				



**Table 24** Example of calibration in table 8

## 24.1 Sample table

kidney month 3

	<i>Rx1</i>	<i>Rx2</i>	<i>Rx3</i>
Rat no.1	29.46	48.68	45.66
Rat no.2	30.14	46.68	47.52
Rat no.3	29.11	49.18	46.880

Anova: One-way

## 24.2 Summary

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
Column 1	3	88.71	29.570	0.274
Column 2	3	144.54	48.180	1.750
Column 3	3	140.06	46.687	0.893

## 24.3 ANOVA Source of Variation

	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	641.542	2	320.771	329.872	7.32E-07	5.143
Within Groups	5.834	6	0.972			
Total	647.377	8				

**Table 25** Example of calibration in table 9

## 25.1 Sample table

kidney Rx 1

	<i>month 1</i>	<i>month 3</i>
Rat no.1	39.84	29.46
Rat no.2	45.6	30.14
Rat no.3	43.1	29.11

Anova: One-way

## 25.2 Summary

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
Column 1	3	128.54	42.847	8.343
Column 2	3	88.71	29.570	0.274

## 25.3 ANOVA Source of Variation

	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	264.405	1	264.405	61.369	0.001	7.709
Within Groups	17.234	4	4.308			
Total	281.638	5				

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**Table 26** Example of calibration in table 12

## 26.1 Sample table

Rf 0-0.2

<i>Ascorbic acid (mg)</i>	<i>15 min</i>	<i>3 hr</i>	<i>24 hr</i>
0.175	73.94	71.17	60.49
0.35	74.69	69.9	57.63
0.7	76.88	73.57	65.43
1.4	76.3	75.23	63.45
2.8	74.84	72.66	75.83

## 26.2 Anova: Two-way

<i>Summary</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
0.175	3	205.6	68.5333	50.4396
0.35	3	202.22	67.4067	77.4234
0.7	3	215.88	71.96	34.7197
1.4	3	214.98	71.66	50.8393
2.8	3	223.33	74.4433	2.63023
15 min	5	376.65	75.33	1.4813
3 hr	5	362.53	72.506	4.28803
24 hr	5	322.830	64.566	48.398

## 26.3 ANOVA: Source of Variation

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Rows	96.035	4	24.009	1.592	0.266	3.838
Columns	311.470	2	155.735	10.328	0.006	4.459
Error	120.634	8	15.079			
Total	528.139	14				

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