monkey. It his hoped that others will search for the agent and that the muscles of fatal cases of paralytic disease in the young will be thoroughly examined histologically.

Human Saliva as a Germination Inhibitor

DVORA YARDENI

Department of Botany,
Hebrew University, Jerusalem

Dold and Weigman demonstrated in 1935–36 that human saliva contains a factor bacteriostatic and bacteriocidal to pathogenic bacteria.

Since various authors have shown that many antibiotics act as germination inhibitors on plant seeds (see *2*), we wished to find out if this is true also for human saliva.

Saliva was obtained from a number of persons of normal health not less than 1–3 hrs after eating and was used immediately after collection.

TABLE 1

INHIBITION CAUSED BY UNDILUTED HUMAN SALIVA

Age	Cases	Germination index
54	1	0 (0, 0)
"	1	0 (0, 0)
"	1	0 (0, 50)
"	1	0 (0, 62)
53	2	12 (7, 80)
"	2	14 (6, 50)
"	2	0 (0, 0)
"	2	6 (8, 60)
"	2	58 (15, 40)
"	2	0 (0, 0)
33	20	0 (0, 0)
6	23	0 (0, 0)
22	7	5 (12, 33)
22	24	16 (21, 14)
15	8	50 (50, 87)
"	8	56 (37, 50)
48	18	52 (40, 85)
16	25	71 (50,100)
36	11	60 (48, 44)
28	3	66 (30,100)
"	3	76 (30, 52)
25	12	68 (50, 52)
20	6	65 (52,100)
"	6	83 (24, 73)
"	6	80 (65, 50)
"	6	82 (50, 70)
26	10	66 (26, 50)
45	13	80 (71, 80)
21	4	80 (29, 77)
44	5	84 (50,100)
20	14	72 (33, 70)
15	15	72 (30, 50)
68	16	64 (33, 60)

The test method was the same as that described by Konis (*3*). We used 50 wheat seeds/Petri dish and 7–8 ml of saliva. The countings were made 48 hrs after the beginning of each experiment.

The numbers given in our tables are germination indices, *i.e.* % of germinated seeds related to the germination percentage of the water controls = 100. The first number in parentheses gives the length of the radicle related to the radicle length of the water controls = 100; the second, the corresponding data for the coleoptiles.

TABLE 2

INHIBITION AND DILUTION

Case	Concentrations (%)	Germination index
1	100	0 (0, 0)
	50	0 (0, 8)
	25	62 (21,100)
2	100	12 (6, 89)
	50	94 (63,100)
	25	98 (63,100)
3	100	64 (33,100)
	50	70 (50,100)
	25	92 (70,100)
4	100	82 (29,100)
	50	90 (55,100)
	25	94 (77,100)
5	100	84 (51,100)
	50	96 (64,100)
6	100	84 (28, 73)
	50	88 (66,100)
	25	96 (77,115)
7	100	5 (13, 33)
	50	90 (19, 66)
	25	88 (59, 72)
8	100	48 (50, 88)
	50	40 (33,100)
	25	66 (76,100)
9	50	82 (35, 75)
10	100	66 (46, 57)
	50	82 (50, 51)
	25	98 (74, 96)
11	100	90 (50, 57)
	50	60 (53, 81)
	25	100 (70, 80)
12	100	68 (54, 54)
	50	92 (83, 61)
	25	96 (85, 70)
13	100	80 (71, 80)
	50	96 (84,100)
14	100	72 (33, 76)
	50	100 (63, 76)
15	100	72 (30, 50)
16	100	64 (30, 60)
17	100	82 (30, 60)
	50	88 (58, 80)
	25	84 (80, 80)
18	100	46 (39, 85)
19	100	90 (60, 71)
	75	88 (75, 93)
20	100	0 (0, 33)
21	70	22 (16, 0)
22	20	76 (180,155)
23	75	0 (0, 0)

The conclusions drawn from the results given in Table 1 are:

(1) In all cases the saliva exerted a germination-inhibiting influence.

(2) Wherever there was a germination of the saliva-

treated grains, the growth of the radicles was strongly inhibited.

(3) The growth of the coleoptiles is less affected than that of the radicles. This stands out clearly in cases where there was definite growth of the coleoptiles but

TABLE 3

INHIBITION CAUSED BY BOILED SALIVA

Cases	Fresh saliva	Boiled saliva
2	0 (0, 0)	0 (0, 0)
2	58 (10,90)	66 (10,90)
2	84 (25,90)	88 (50,90)
6	10 (10,50)	20 (10,40)

none of the radicles. (These seeds are designated as not germinated.)

(4) The degree of inhibition varied individually.

(5) The inhibition caused by the saliva of the same individual taken at different times differs sometimes.

(6) The inhibition does not depend on sex or age, nor does it show any relation to the condition of the teeth (*4*).

When dilutions of the saliva are used, the inhibition decreases strongly (Table 2). The growth of the radicles, however, is inhibited even in the higher dilutions,

TABLE 4

VOLATILITY TEST

Cases	Germination index of fresh saliva	Volatility effect
2	0 (0,0)	84 (98,100)

whereas the coleoptiles are less affected. It is a strange fact that in some cases the inhibition is stronger in a 50% dilution than in the original saliva.

When the fact that human saliva acts as a germination inhibitor had been established, the nature of the inhibiting agent was investigated. Osmotic pressure and pH, which in some cases are partly or mainly responsible for the inhibition (*2*), could be excluded, as an os-

TABLE 5

INHIBITION AFTER DIALYSIS

Cases	Germination index of fresh saliva	Germination index of dialyzed saliva
2	6 (8, 60)	80 (50, 50)
1	0 (0, 60)	76 (88, 96)
6	64 (54,100)	82 (50,100)

motic pressure of 1 atm and a pH of 6.4–7.0 do not cause any inhibition of germination (*2, 3*).

The inhibiting factor is heat resistant, as boiling does not affect the inhibition (Table 3). The inhibition factor is nonvolatile (Table 4). The volatility test was conducted in the usual way (*3*) by putting the saliva into a large Petri dish into which a small Petri dish containing the test seeds was placed.

The inhibiting factor is mostly removed by dialysis (Table 5). In these experiments the saliva was dialyzed for 70–75 hrs. All the chlorides and the rhodan present in the saliva were removed by the treatment, whereas the urea content was not changed.

References

1. EVENARI, M. *Pal. J. Bot. Jer.*, 1940, Ser. 2, 1–5.
2. EVENARI, M. *Bot. Rev.*, in press.
3. KONIS, E. *Pal. J. Bot. Jer.*, 1940, Ser. 2, 6–27.
4. ———. *Dent. Items*, 1946, **68**, 1199.

The Visibility of Moving Objects[1]

ELEK LUDVIGH

Howe Laboratory of Ophthalmology, Harvard University Medical School

The visibility of moving objects and the converse problem of the visibility of stationary objects while the observer is moving are of practical importance and have received little study. The visibility of moving objects imaged on the peripheral retina has been investigated by Low (*1*). The present author (*2*) has shown that, even when the eye is permitted to move in an effort to follow a moving object, visual acuity deteriorates rapidly with increasing angular velocity of the object. This paper is concerned with visibility at higher angular velocities than those previously considered by the author and with the practical problem of the effect on visibility of the aspect from which the object is viewed. For the present purposes visibility is understood to require the recognition of the general form of the object, not the mere detection of its presence.

Let us consider the case of a thin disc-shaped object which moves in a straight line in a plane passing through the observer's eyes. Assume further, that this straight line is parallel to a line joining the nodal points of the two eyes. The normal or line perpendicular to the disc is in this horizontal plane and is normal to the line of flight. The maximum surface is presented to the eye under these conditions at the point of nearest approach of the disc. Movement of the observer's head or adjustment of any auxiliary apparatus readily permits realization of these conditions. The disc is assumed to be of negligible thickness and will, in general, produce an elliptical retinal image because of obliquity of view. The visibility of the image, were it stationary, would be closely proportional to its area provided that the ratio of the major to minor axis is not greater than 9:1 (*2*). However, the object is not stationary, and the eye follows it by moving in the direction of the minor axis of the retinal image of the object. This movement reduces acuteness of vision, and, for present purposes, the lesser dimension of the retinal image will be considered as the dimension determining the visibility or lack thereof of the object. Take the nodal point of one eye as the origin

[1] This investigation was supported in part by a grant from the American Optical Company.