under similar conditions show an average gain of 7 ± 6 g between peaks of 2 consecutive cycles (Mrosovsky et al.[2], see figure 1 therein), indicating that this slight increase in weight after castration was probably due to a growth component underlying the body weight cycle. The non-cycling animal averaged 119 ± 4 g before castration and 129 ± 9 g for 216 days after the 2 post-castration cycles.

Thus it appears that the body weights of dormice, unlike those of other mammals, are unaffected by castration. It is clear that infradian cycles of body weight can persist in the absence of gonadal hormones. Although both body weight and reproductive condition vary on an infradian basis, the changes in body weight appear to be programmed independently from changes in gonadal frunction.

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Evidence for a constant number of available sweet receptor sites at threshold concentrations of sugars

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Summary. Intensity/time plots of sweetness produced by different molecules allow putative 'accession efficiencies' of these molecules and their affinities with the taste receptor to be calculated. Results suggest that affinities of the different molecules are in the same order as threshold concentrations and that a constant number of available receptors exist for a related family of structures near threshold concentrations.

Although recent studies of intensity/time relationships in sweet substances[1,2] have invoked the concept of a localized concentration and approach of stimuli to taste receptors[3], there is still a lack of evidence about multistage effects in taste chemoreception. The approach of sapid substances to receptors has been envisaged[1,2] as an irreversible orderly queue by means of which stimuli cause a cyclic open-shut process at the ionophor trigger and on the basis of this model, separate mechanisms may account for the intensity and persistence of response. Intensity may be viewed as the resultant of numbers of queues occupied and the stereochemical 'fit' of the stimulus with the ionophor trigger, whereas persistence of response represents the time for queues to empty and is thus related to queue length. The queue model naturally leads to questions about the accession of sapid molecules to receptors and the intrinsic activity of sweet pharmacophores, and it now seems possible to apply psychophysical data to illuminate receptor function. Moskowitz[4] has demonstrated that taste response (R) obeys power functions of the form $R = kc^n$ where k is a constant, c is concentration of stimulus and n is the exponent of taste. Log/log plots of R and c give straight lines of intercept (log k) and slope n. Moskowitz[4] observed that k increased with increasing temperature while n remained constant. He therefore suggested that k represented the ability of molecules to reach receptors whereas n reflected a more profound interaction between stimulus and receptor depending on chemical structure. In accordance with this suggestion it has recently been shown[5] that the artificial sweetener, saccharin has a similar intercept to sugars at $^1/_{1000}$ of their concentration while the exponent, n, for saccharin was actually lower than the sugars. This may be interpreted as a relatively massive accession efficiency of the lipophilic saccharin molecule, facilitating its approach to the taste cell membrane, in contrast to the poor accession efficiences of the sugars as a group which is in turn reflected as a relatively high threshold for these hydrophilic structures.

We have calculated 'accession efficiences' from intercepts of log/log plots as shown in the table for a number of sweet molecules. Accession efficiency may be regarded as the fraction of sapid molecules presented to receptors which actually accede. Therefore multiplication of 'accession efficiency' by threshold concentration should give moles of sweetener actually acceding at threshold. The table indicates that the sweet molecules fit into families in which the same numbers of molecules accede at threshold despite their varying 'accession efficiency'. The 2 sugar alcohols, sorbitol and xylitol, form one such family, the sugars galactose and fructose form another, and the sugars sucrose, maltose, lactose, glucose and xylose form a third, although this 3rd family may be divided into two with the monosaccharides in one group and the disaccharides in another. These observations signify a constant number of available receptors for molecules in a structurally related group at threshold concentrations and presumably derive from conformational analogy in sugars or their derivatives which possess a sweet pharmacophore. The large difference in the result for galactose and fructose reflects the absence of such conformational definition because these sugars exist in at least 4.1% and 28.0% furanose forms respectively at normal tasting temperatures[7].

Sweet molecule	Threshold concentration T (mM/l)	'Accession efficiency' A	Moles acceding to receptor AT (mM/l)	Affinity K_m (mM/l)
Sucrose	9.6	16.71	160.4	37.4
Maltose	21.0	7.61	159.8	249.2
Lactose	28.6	5.41	154.7	716.3
Glucose	26.1	5.73	149.6	386.3
Xylose	29.0	5.19	150.5	977.8
Galactose	28.9	10.82	312.7	940.3
Fructose	15.5	20.37	315.7	124.9
Sorbitol	26.3	7.05	185.4	580.7
Xylitol	21.0	8.88	186.5	209.7

30 panellists tasted 5-ml samples (in distilled water) of each sugar (reagent grade, Sigma Chemical Co., Poole, Dorset), by the sip and swallow method, rinsing with distilled water and pausing 1 min between samples. Intensities were recorded on the Sensory Measuring Unit for Recording Flux (SMURF, i.e. a potentiometer 'dial box' connected to a Telsec Type X moving chart recorder, with which panellists turned the dial from 0 to 10 units (recorded on the chart as 0–100 units) according to the subjective intensity of sweetness). Threshold concentrations (T) were determined in a separate experiment using the method of Gregson[6]. Time/intensity plots were then determined at 5, 10, 15 and 20 times the threshold concentration of each sweetener.

A ('accession efficiency') is defined as the antilog of the intercept on the y axis obtained after plotting log intensity (i.e. log magnitude estimation) against log concentration (% w/v). Values of log A were calculated by linear regression to ensure the best fit straight line was used.

Magnitude estimation rates (MER) (units/sec) were calculated as maximum intensity/time to maximum intensity for the 4 concentrations. Affinities (K_m) were then obtained from Lineweaver-Burk type plots of reciprocal MER against reciprocal concentration (mM/l) ($-\frac{1}{K_m}$ = intercept on x axis).

'Accession efficiences' of sapid molecules may be related to their affinity for the receptor and recordings of intensity/time profiles in taste allow magnitude estimation rates (MER) to be obtained from onsets of response. Reciprocal plots of MER and concentration give Lineweaver-Burk type plots from which affinities (K_m) are calculable. The table lits K_m-values for the given sweeteners which differ from 'accession efficiences' as shown, but accord with threshold concentrations in that the sweet molecules studied are in the same order for both affinity and threshold concentration.

Previous taste studies[8,9] have illustrated molar proportionality of response and parallel gustatory effects in conformational analogues but this, to our knowledge, is the first report of molar accessibility in sweet taste chemoreception. The results are relevant to attempts to educe models of gustatory chemoreception based on occupancy theory or rate theory of stimulus/receptor interaction.

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A study on the parameters of digestion in *Periplaneta americana* L.

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Summary. An attempt was made to provide evidence for the regulatory mechanism for digestion in *Periplaneta americana* by studying possible correlations between digestive enzymes, taking midgut protease activity into consideration.

Synthesis and secretion of digestive enzymes in insects appear to be regulated by 3 possible mechanisms; a) neural, b) secretagogue, and c) hormonal. A direct stimulation by the nervous pathway seems not to be involved in most insects. In cockroaches, including *P. americana*, the innervation of the midgut is meagre[2,3] and the nerves appear to be motor ones, supplying only the gut musculature[2].

The present study was undertaken keeping the view in mind that a study of the parameters of digestive enzymes may provide clues to demonstrate the control mechanism of digestive processes. Most of the digestive processes are attributed to the midgut, and proteins are the most important constituents of the diet, therefore the determination of the midgut protease activity was chosen for the present study.

Material and methods. Adult *Periplaneta americana* of both sexes were taken from an age-regulated stock-colony maintained in the laboratory. Protease activity was determined by the method of Charney and Tomarelli[4] and protein

Table 1. Showing the effect of feeding on the midgut protease activity, after starvation for 3 days

	Normally fed	Starved (3 days)	Starved (3 days), then fed and sacrificed after 1 h	2 h	4 h	8 h	12 h
	49.0	10.0	14.5	17.5	20.0	16.5	39.5
	47.5	17.5	16.5	38.0	42.0	29.0	35.0
	35.0	14.5	28.0	27.0	17.5	25.0	27.0
	30.5	23.0	30.5	26.0	23.0	35.0	43.0
	48.0	15.75	34.0	20.0	35.5	40.5	46.5
Mean ± SD	42.00 ± 8.61	16.15 ± 4.73	24.70 ± 8.69	25.70 ± 7.95	27.60 ± 10.61	29.20 ± 9.22	38.20 ± 7.57