INGESTION OF FOOD is as important for life as is breathing oxygen, and it is not surprising that the neural control circuits located in the phylogenetically “old” part of the brain are functioning almost automatically. The caudal brain stem of rats and human infants contains the complete pathways necessary for ingestion, mastication, and swallowing (acceptance) of beneficial foods, as well as for rejection of potentially dangerous foods, all with accompanying autonomic responses such as saliva secretion (8, 10, 16). Both mastication and swallowing are complex behaviors that rely on an array of sensory inputs and the cooperation of many muscles (1, 3, 14, 15). Protection of the airways is of capital importance so that certain muscles cannot be activated independently. Rhythmic, temporally fixed, and sequential patterns of jaw, tongue, and facial muscle action are therefore organized and coordinated within specialized pattern generator circuits located mainly in the medullary reticular formation (11, 14).

Although neuroscientists have become very efficient in using various recording and tracing techniques to identify the sensory (9, 13) and motor limbs (6, 7) of ingestive reflexes, comparatively little is known about the neural network integrating and translating this sensory information into meaningful and coordinated skeletal and autonomic motor actions. The study presented by Chen and Travers (5) in this issue of the American Journal of Physiology-Regulatory, Integrative and Comparative Physiology greatly increases our understanding of this process. Chen and Travers systematically examine the circuits in the medullary reticular formation implicated in the control of taste-elicited oromotor ingestive responses in nonanesthetized, freely behaving rats. Nanoliter infusions of specific antagonists to glutamate, GABA$_\text{A}$, and glycine receptors were made into a region of the reticular formation that harbors premotor neurons to oromotor nuclei. Responses of jaw opener, tongue protruder, and tongue retractor muscles were electromyographically monitored during either intraoral infusion or voluntary drinking of small volumes of sucrose and quinine solutions, and the behavior was videotaped (some video clips are available for viewing).

As the authors have previously shown for the GABA agonist muscimol (4), selective blockade of either NMDA or AMPA-kainate receptors in the lateral reticular formation reversibly suppressed both licking in response to sweet and gaping in response to bitter-tasting solution. Remarkably, the animals still actively probed the sucrose bottle, indicating that appetitive behavior was normal and the functional lesion very specific. This is an important finding, because it suggests that neither of these two receptor subtypes mediates the switch from acceptance to rejection, although some differential involvement was indicated during recovery from the chemically induced depression. In contrast, infusions of the selective GABA$_\text{A}$ receptor blocker bicuculline increased the amplitude of jaw openings in response to intraoral delivery of sucrose in a way that was characteristic of the gaping response to aversive stimuli. This suggests that the switch from acceptance to rejection responses might involve removal of tonic inhibition occurring through GABA$_\text{A}$ receptors. Thus a single medullary network functioning in different chemically controlled configurations might underlie different orolingual response patterns. That a similar single medullary network can be reconfigured to serve multiple breathing patterns has been recently concluded on the basis of recording electrical rhythms in brain stem slices (12). The in vivo, awake rat model of Chen and Travers goes beyond measurement of electrical activity and allows direct analysis of behavior. This model will be very useful for analysis of medullary ingestive responses as modulated by other transmitters, including a number of feeding-related peptides, many of which are expressed in descending projections from the hypothalamus and amygdala (2).

REFERENCES


