Figure 6.1 Membrane properties of neurones recorded from ARC neurones, in hypothalamic slices prepared from rats fed *ad libitum* and 24-hour fasted rats

A: Bar-chart showing and comparing average resting membrane potential of neurones recorded in slices from fed (n = 41) and 24-hour fasted (n = 38) rats. A statistically significant difference in resting membrane potential between rats fed *ad libitum* and 24-hour fasted rats is indicated as * with $P < 0.05$.

B: Bar-chart comparing input resistances of ARC neurones recorded in slices from fed and 24-hour fasted rats.

C: Bar-chart comparing firing frequencies of ARC neurones recorded in slices from fed and 24-hour fasted rats.

Figure 6.2 Subtypes of ARC neurones (clusters 1 to 8; see text for details) recorded in slices prepared from fed and 24-hour fasted rats

Bar-chart showing the relative proportions of neuronal clusters (1 to 8) recorded in slices prepared from fed (n = 41; black) and 24-hour fasted (n = 38; grey) rats.
Figure 6.3 legend with figures
Figure 6.4 Effects of changes in extracellular glucose on membrane properties of glucose-excited (GE) neurones, recorded in slices from fed and fasted rats

Ai: Bar-chart comparing resting membrane potentials, in 2.0 mM glucose, of GE neurones from slices prepared from fed (black; n = 23) and 24-hour fasted rats (n = 14; grey).

Aii: Bar-chart comparing changes in resting membrane potential induced in GE neurones, in response to a change in extracellular glucose, from slices prepared from fed (black; n = 23) and 24-hour fasted rats (n = 14; grey).

Bi: Bar-chart comparing resting input resistance, in 2.0 mM glucose, of GE neurones from slices prepared from fed (black; n = 23) and 24-hour fasted rats (n = 14; grey). A statistically significant difference in input resistance of neurones recorded in slices from ad libitum fed rats between 2.0 and 0.2 mM glucose is indicated as * with $P < 0.001$.

Bii: Bar-chart comparing changes in input resistance induced in GE neurones, in response to a change in extracellular glucose, from slices prepared from fed (black; n = 23) and 24-hour fasted rats (n = 14; grey).

Ci: Bar-chart comparing spontaneous firing rate, in 2.0 mM glucose, of GE neurones from slices prepared from fed (black; n = 23) and 24-hour fasted rats (n = 14; grey). A statistically significant difference in firing frequency of neurones recorded in slices from ad libitum fed rats between 2.0 and 0.2 mM glucose is indicated as * with $P < 0.05$.

Cii: Bar-chart comparing changes in firing rate induced in GE neurones, in response to a change in extracellular glucose, from slices prepared from fed (black; n = 23) and 24-hour fasted rats (n = 14; grey).
Figure 6.5  Reducing extracellular glucose concentration induces inhibition in ARC GE neurones recorded in slices from rats fed *ad libitum* and reverses with subsequent increases in extracellular glucose

A:  Samples of a continuous whole-cell current-clamp recording from an ARC neurone with a resting membrane potential of –52.0 mV (shown to the left of the trace in this and subsequent figures). The line below the trace indicates application of the extracellular glucose concentration stated. The // indicates a break within the trace of approximately 2.0 minutes at which point current-voltage relationships were investigated. Downward deflections in this and subsequent figures are membrane responses to regular-wave negative current injections (5-20 pA, 1.0 s, 0.2 Hz), enabling the input resistance to be monitored. Reducing extracellular glucose from 2.0 to 0.2 mM, induced a membrane hyperpolarisation, reduction in firing frequency and decrease in neuronal input resistance, indicated by the decrease in amplitude of electrotonic potentials (downward deflections of the trace). This effect was progressively reversed with increasing glucose levels to 0.5, 1.0, 2.0 and 5.0 mM.

B:  I-V relationships obtained from neurone shown in A, in each extracellular glucose concentration tested. The traces show superimposed samples of a continuous whole-cell current-clamp recording showing membrane potential responses to a series of depolarising and hyperpolarising rectangular-wave current injections of constant increment.

C:  Plot of data shown in B.  Current-voltage (I-V) relationships are shown; (i) I-V in 2.0 mM glucose (■) and 0.2 mM (□).  Note the decrease in the slope of the I-V in the presence of 0.2 mM indicating a decrease in neuronal resistance, with a reversal potential around -57 mV, close to that for chloride channels under our recording conditions.  (ii) I-V in 1.0 mM (○) and 2.0 mM glucose (▲).  Note the parallel shift.
Figure 6.6  Reducing extracellular glucose concentration induces inhibition in ARC GE neurones recorded in slices from rats fed *ad libitum*

A:  Samples of a continuous whole-cell current-clamp recording from an ARC neuron. Reducing extracellular glucose from 2.0 to 0.2 mM induced membrane hyperpolarisation, a reduction in firing frequency and associated decrease in neuronal input resistance. This effect persisted upon subsequent, progressive increases in glucose concentration.

B:  I-V relationships obtained from the neurone shown in A in different extracellular glucose concentrations. The traces show superimposed samples of a continuous whole-cell current-clamp recording showing membrane potential responses to a series of depolarising and hyperpolarising rectangular-wave current injections of constant increment.

C:  Plot of data shown in B. The I-V relationships in the presence of 2.0 mM (■) and 0.2 mM glucose (□) are shown. Note the decrease in slope of the I-V in the presence of 0.2 mM glucose, indicating a decrease in neuronal resistance, with a reversal potential around -80 mV, close to that for potassium ions under our recording conditions.
Figure 6.7 Effects of changes in extracellular glucose on membrane properties of glucose-excited (GI) neurones, recorded in slices from fed and fasted rats

Ai: Bar-chart comparing resting membrane potentials, in 2.0 mM glucose, of GI neurones from slices prepared from fed (black; n = 4) and 24-hour fasted rats (n = 7; grey).

Aii: Bar-chart comparing changes in resting membrane potential induced in GI neurones, in response to a change in extracellular glucose, from slices prepared from fed (black; n = 4) and 24-hour fasted rats (n = 7; grey).

Bi: Bar-chart comparing resting input resistance, in 2.0 mM glucose, of GI neurones, from slices prepared from fed (black; n = 4) and 24-hour fasted rats (n = 7; grey).

Bii: Bar-chart comparing changes in input resistance induced in GI neurones, in response to a change in extracellular glucose, from slices prepared from fed (black; n = 4) and 24-hour fasted rats (n = 7; grey).

Ci: Bar-chart comparing spontaneous firing rate, in 2.0 mM glucose, of GI neurones from slices prepared from fed (black; n = 4) and 24-hour fasted rats (n = 7; grey).

Cii: Bar-chart comparing changes in firing rate induced in GI neurones, in response to a change in extracellular glucose, from slices prepared from fed (black; n = 23) and 24 hour fasted rats (n = 14; grey).
Figure 6.8 Reducing extracellular glucose induced excitation in ARC GI neurones, in slices prepared from fed rats

A: Samples of a continuous whole-cell current-clamp recording from an ARC neurone with a resting membrane potential of -44.0 mV. Reducing extracellular glucose from 2.0 to 0.2 mM, induced a membrane depolarisation, increase in firing frequency and increase in neuronal input resistance.

B: I-V relationships obtained from the same neurone as shown in A in each extracellular glucose concentration application. The traces show superimposed samples of a continuous whole-cell current-clamp recording showing membrane potential responses to a series of depolarising and hyperpolarising rectangular-wave current injections of constant increment.

C: Plot of data shown in B. The I-V relationships in the presence of 2.0 mM (■) and 0.2 mM glucose (□) were shown (top). Note the parallel shift but increase in input resistance, noted in A. Similar I-V relations were shown in the presence of 2.0 mM (▲) and 5.0 mM glucose (Δ).
Figure 6.9 Effects of changes in extracellular glucose on membrane properties of glucose-rapidly adapting (GRA) neurones, recorded in slices from fed rats

Ai: Bar-chart showing the average resting membrane potentials of GRA neurones recorded in hypothalamic slices from fed rats in 2.0 mM glucose ($n = 2$).

Aii: Bar-chart showing changes in membrane potential induced in GRA neurones, in response to a change in extracellular glucose, from slices prepared from fed rats ($n = 2$).

Bi: Bar-chart showing resting input resistance, in 2.0 mM glucose, of GRA neurones, from slices prepared from fed rats.

Bii: Bar-chart showing changes in input resistance induced in GRA neurones, in response to a change in extracellular glucose, from slices prepared from fed rats.

Ci: Bar-chart showing spontaneous firing rate, in 2.0 mM glucose, of GRA neurones in slices prepared from fed rats. A statistically significant difference in firing frequency of neurones recorded in slices from rats fed ad libitum between 0.5 and 1.0 mM glucose is indicated as * with $P < 0.05$.

Cii: Bar-chart showing changes in firing rate induced in GRA neurones, in response to a change in extracellular glucose, in slices prepared from fed rats.
Figure 6.10 Reducing extracellular glucose induced a transient rapidly adapting effect on excitability in ARC GI neurones, in slices prepared from fed rats

A: Samples of a continuous whole-cell current-clamp recording from an ARC neurone with a resting membrane potential of $-40.0$ mV. Reducing extracellular glucose from 2.0 to 0.2 mM, induced an initial membrane hyperpolarisation, reduction in firing frequency and decrease in neuronal input resistance. This initial inhibition was transient, subsequently giving rise to membrane depolarisation, an increase in firing frequency and associated increase in input resistance. This neurone subsequently remained spontaneously active following increases in glucose to 0.5, 1.0, 2.0 and 5.0 mM, respectively.

B: I-V relationships obtained from the neurone shown in A. The traces show superimposed samples of a continuous whole-cell current-clamp recording showing membrane potential responses to a series of depolarising and hyperpolarising rectangular-wave current injections of constant increment, in different glucose concentrations.

C: Plot of data shown in B. The I-V relationships in the presence of 2.0 mM (■) and 0.2 mM (□) glucose are shown. Note the small decrease in the slope of the I-V in the presence of 0.2 mM glucose, indicating a small reduction in neuronal resistance, with a reversal potential around $-64$ mV, close to that for chloride ions under our recording conditions.
Figure 6.11 Reducing extracellular glucose concentration induces inhibition in ARC GE neurones recorded in slices from 24-hour fasted rats and reverses with subsequent increases in extracellular glucose

A: Samples of a continuous whole-cell current-clamp recording from an ARC neurone with a resting membrane potential of –47.0 mV. Reducing extracellular glucose from 2.0 to 0.2 mM induced membrane hyperpolarisation, reduction in firing frequency and decrease in neuronal input resistance. This effect of reduced glucose was reversed with progressively increasing concentrations of extracellular glucose to 0.5 mM and subsequently in the presence of 1.0, 2.0 and 5.0 mM.

B: I-V relationships obtained from the neurone shown in A. Traces show superimposed samples of a continuous whole-cell current-clamp recording showing membrane potential responses to a series of depolarising and hyperpolarising rectangular-wave current injections of constant increment, in a range of extracellular glucose concentrations.

C: Plots of data shown in B. The I-V relationships in the presence of 2.0 mM ( ■) and 0.2 mM (□) glucose are shown (Ci). Note the small decrease in the slope of the I-V in the presence of 0.2 mM indicating a small reduction in neuronal resistance, with a reversal potential around -83 mV, close to that for potassium ions under our recording conditions. Similar data are shown in 0.5 mM (Cii) and in 1.0 mM where reversal potential was estimated to be -81 mV (Ciii). The final in 2.0 mM glucose revealed a parallel shift, suggesting other mechanisms may have been involved (Civ).
Figure 6.12 legend with figures
Figure 6.13  Excitation of ARC GE neurones, recorded in slices prepared from 24-hour fasted rats, induced by increased extracellular glucose concentration

A: Samples of a continuous whole-cell current-clamp recording from an ARC neurone with a resting membrane potential of –48.0 mV. Increasing extracellular glucose from 0.2 to 0.5 mM, induced membrane depolarisation associated with a small increase in neuronal input resistance. Subsequent increases in extracellular glucose further induced membrane depolarisation and increases in neuronal input resistance.

B: I-V relationships obtained from the neurone shown in A. Each record shows superimposed samples of a continuous whole-cell current-clamp recording showing membrane potential responses to a series of depolarising and hyperpolarising rectangular-wave current injections of constant increment in different extracellular glucose concentrations.

C: Plot of data shown in B. I-V relationships in the presence of 0.2 mM (□) and 0.5 mM (●) glucose are shown. Note the parallel shift in 0.5 mM extracellular glucose.
Figure 6.14  Increase in extracellular glucose concentration induced inhibition of ARC GI neurones recorded in slices from 24-hour fasted rats

A: Samples of a continuous whole-cell current-clamp recording from an ARC neurone with a resting membrane potential of –38.0 mV. Increasing extracellular glucose from 0.2 to 0.5 mM, induced a membrane hyperpolarisation, reduction in firing frequency and associated decrease in neuronal input resistance in this GI neurone.

B: I-V relationships obtained from the neurone shown in A. Records show superimposed samples of a continuous whole-cell current-clamp recording showing membrane potential responses to a series of depolarising and hyperpolarising rectangular-wave current injections of constant increment, in different concentrations of extracellular glucose.

C: Plots of data shown in B. I-V relationships in the presence of 0.2 mM (□) and 0.5 mM (●) glucose are shown. Note the small decrease in the slope of the I-V in the presence of 0.5 mM indicating a small reduction in neuronal resistance, with a reversal potential around -57 mV, close to that for chloride ions under our recording conditions.
Figure 6.1

A. Group of rats

Fed ad libitum vs. 24-hour fasted rats comparison for Membrane Potential (mV).

B. Input Resistance (MΩ) comparison for Fed ad libitum vs. 24-hour fasted rats.

C. Firing Frequency (Hz) comparison for Fed ad libitum vs. 24-hour fasted rats.

Figure 6.2

% of population distribution across clusters for Rats fed ad libitum and 24-hour fasted rats.

Clusters 1 to 8 show varying percentages of population for each condition.
Figure 6.3

Differential expression of subtypes of ARC glucose-sensing neurone, recorded in hypothalamic slices from fed and fasted rats.

A: Bar-chart comparing the relative proportions of glucose-excited (GE), glucose-inhibited (GI), glucose-rapidly adapting (GRA) and non glucose-sensing neurones, recorded in slices prepared from fed (n = 41; black) and 24-hour fasted (n = 38; grey) rats. Neurones were classified based on their responsiveness to a reduction in extracellular glucose from 2.0 to 0.2 mM. Thus, GE neurones responded with inhibition; GI with excitation and GRA with an adaptive response to the change in glucose concentration.

B: Pie chart comparing the relative proportions of GE (blue), GI (grey), GRA (purple) and non glucose-sensing neurones (black), recorded in slices prepared from fed rats.

C: Pie chart comparing the relative proportions of GE (blue), GI (grey) and non glucose-sensing neurones (black), recorded in slices prepared from 24-hour fasted rats.
Figure 6.4

Ai

Extracellular glucose concentration (mM)

Membrane Potential (mV)

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<thead>
<tr>
<th>Glucose Concentration (mM)</th>
<th>Membrane Potential (mV)</th>
</tr>
</thead>
<tbody>
<tr>
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<td>-50</td>
</tr>
<tr>
<td>0.2</td>
<td>-40</td>
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<tr>
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<td>-30</td>
</tr>
<tr>
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<td>-20</td>
</tr>
<tr>
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<td>5.0</td>
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Aii

Change in extracellular glucose concentration (mM)

<table>
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<th>Change in Extracellular Glucose Concentration (mM)</th>
<th>Change in Membrane Potential (mV)</th>
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<tr>
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<tr>
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<tr>
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Bi

Extracellular glucose concentration (mM)

Input Resistance (MΩ)

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<tr>
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<td>2.0</td>
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<tr>
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<td>0</td>
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</table>

Bii

Change in extracellular glucose concentration (mM)

<table>
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<th>Change in Input Resistance (MΩ)</th>
</tr>
</thead>
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</tr>
<tr>
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<tr>
<td>0.5-1.0</td>
<td>0</td>
</tr>
<tr>
<td>1.0-2.0</td>
<td>0</td>
</tr>
<tr>
<td>2.0-5.0</td>
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</tr>
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</table>

Ci

Extracellular glucose concentration (mM)

Firing Frequency (Hz)

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<tr>
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<td>0.1</td>
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</table>

Cii

Change in extracellular glucose concentration (mM)

<table>
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<th>Change in Extracellular Glucose Concentration (mM)</th>
<th>Change in Firing Frequency (Hz)</th>
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<tr>
<td>0.2-0.5</td>
<td>0</td>
</tr>
<tr>
<td>0.5-1.0</td>
<td>0</td>
</tr>
<tr>
<td>1.0-2.0</td>
<td>0</td>
</tr>
<tr>
<td>2.0-5.0</td>
<td>0</td>
</tr>
</tbody>
</table>

Legend:
- **Rats fed ad libitum**
- **24-hour fasted rats**
Figure 6.5

A
-52.0 mV
Glucose 0.2 mM
-50.0 mV
Glucose 0.5 mM
-42.0 mV
Glucose 1.0 mM
-42.0 mV
Glucose 2.0 mM
-50.0 mV
Glucose 5.0 mM

B
-51.0 mV
Glucose 2.0 mM
-51.0 mV
Glucose 1.0 mM
-54.0 mV
Glucose 0.2 mM
-48.0 mV
Glucose 2.0 mM
-50.0 mV
Glucose 0.5 mM
-47.0 mV
Glucose 5.0 mM

C
(i) Current (pA)

(ii) Current (pA)
Figure 6.6

A

Glucose 0.2 mM

-45.0 mV

3 mins

B

Glucose 0.5 mM

Glucose 1.0 mM

Glucose 2.0 mM

Glucose 5.0 mM

-54.0 mV

-55.0 mV

-56.0 mV

600 ms

C

Current (mV)

-50 -40 -30 -20 -10 0

Membrane Potential (mV)

-110 -100 -90 -80 -70 -60 -50 -40

-2.0 mM

-0.2 mM
**Figure 6.7**

**Ai**
Extracellular glucose concentration (mM)

**Aii**
Change in extracellular glucose concentration (mM)

**Bi**
Input Resistance (MΩ)

**Bii**
Change in input resistance (MΩ)

**Ci**
Firing Frequency (Hz)

**Cii**
Differences in firing frequency (Hz)

Rats fed ad libitum
24-hour fasted rats
Figure 6.8

A

-47.0 mV
Glucose 0.2 mM
-46.0 mV
Glucose 0.5 mM
-45.0 mV
Glucose 1.0 mM
-45.0 mV
Glucose 2.0 mM
-45.0 mV
Glucose 5.0 mM

B

-45.0 mV
Glucose 2.0 mM
-46.0 mV
Glucose 0.2 mM
-45.0 mV
Glucose 0.5 mM
-49.0 mV
Glucose 1.0 mM
-48.0 mV
Glucose 0.5 mM

C

Current (pA)
-25 -20 -15 -10 -5 0
-25 -20 -15 -10 -5 0
-25 -20 -15 -10 -5 0

Membrane Potential (mV)
-110 -100 -90 -80 -70 -60 -50 -40
-110 -100 -90 -80 -70 -60 -50 -40
-110 -100 -90 -80 -70 -60 -50 -40

-40 mV
40 mV
2 mins
600 ms

-25 -20 -15 -10 -5 0
-25 -20 -15 -10 -5 0
-25 -20 -15 -10 -5 0

-50 -40 -30 -20 -10 0
-50 -40 -30 -20 -10 0
-50 -40 -30 -20 -10 0
Figure 6.9

**Ai** Extracellular glucose concentration (mM)

- Membrane Potential (mV)
  - Rats fed ad libitum

**Aii**

- Differences in membrane potential (mV)
  - Change in extracellular glucose concentration (mM)

**Bi**

- Input Resistance (MΩ)

**Bii**

- Differences in input resistance (MΩ)
  - Change in extracellular glucose concentration (mM)

**Ci**

- Firing Frequency (Hz)

**Cii**

- Differences in firing frequency (Hz)
  - Change in extracellular glucose concentration (mM)
Figure 6.10

A

-40.0 mV

Glucose 0.2 mM

-41.0 mV

Glucose 0.5 mM

-41.0 mV

Glucose 1.0 mM

-40.0 mV

Glucose 2.0 mM

B

-39.0 mV

Glucose 2.0 mM

-40 mV

3 mins

600 ms

-44.0 mV

Glucose 1.0 mM

-44.0 mV

Glucose 2.0 mM

-43.0 mV

Glucose 0.5 mM

-42.0 mV

Glucose 0.2 mM

C

Current (pA)

-80 -70 -60 -50 -40 -30 -20 -10 0

Membrane Potential (mV)

-100

-90

-80

-70

-60

-50

-40
Figure 6.11

A

-47.0 mV
Glucose 2.0 mM

-68.0 mV
Glucose 0.5 mM

-53.0 mV
Glucose 2.0 mM

Glucose 0.2 mM

Glucose 1.0 mM

Glucose 5.0 mM
Figure 6.11

B

-68.0 mV  Glucose 0.2 mM
-66.0 mV  Glucose 0.5 mM
-54.0 mV  Glucose 1.0 mM
-53.0 mV  Glucose 2.0 mM
-53.0 mV  Glucose 2.0 mM
-53.0 mV  Glucose 5.0 mM

Ci

Current (pA)

-100 -80 -60 -40 -20 0 20

Membrane Potential (mV)

-120 -110 -100 -90 -80 -70 -60 -50

Ci

Current (pA)

-120 -110 -100 -90 -80 -70 -60 -50

Membrane Potential (mV)

-130 -120 -110 -100 -90 -80 -70 -60

Cii

Current (pA)

-100 -80 -60 -40 -20 0 20

Membrane Potential (mV)

-120 -110 -100 -90 -80 -70 -60 -50

Ciii

Current (pA)

-100 -80 -60 -40 -20 0 20

Membrane Potential (mV)

-120 -110 -100 -90 -80 -70 -60 -50

Civ

Current (pA)

-100 -80 -60 -40 -20 0 20

Membrane Potential (mV)

-110 -100 -90 -80 -70 -60 -50
Figure 6.12

**A**

Response of ARC neurones to a change in extracellular glucose concentration (0.2 to 0.5 mM)

- **Excitation (GE)**
- **Inhibition (GI)**
- **Rapidly adapting**
- **No response**

**B**

Pie chart comparing the relative proportions of GE (dark pink), GI (grey) and non glucose-sensing neurones (black), recorded in slices prepared from 24-hour fasted rats.

---

**Figure 6.12** Differential expression of subtypes of ARC glucose-sensing neurone, recorded in hypothalamic slices from fasted rats in response to an increase in extracellular glucose.

**A:** Bar-chart showing percentages of neurone populations classified into 4 groups of ARC neurones according to the differences in responses to physiological changes in extracellular glucose concentrations (from 0.2 to 0.5 mM), recorded from 24 hours fasted rats. These responses of neurones to higher glucose concentrations were excitation (GE neurones), inhibition (GI neurones), rapidly adapting (GRA neurones) and no response (non glucose-sensing neurones). A total of 16 ARC neurones were recorded from 24-hour fasted rats. Note that there is no bar represented for GRA neurones due to the zero number of this group of neurones.

**B:** Pie chart comparing the relative proportions of GE (dark pink), GI (grey) and non glucose-sensing neurones (black), recorded in slices prepared from 24-hour fasted rats.
Figure 6.13

A

-48.0 mV

Glucose 0.5 mM

-43.0 mV

Glucose 2.0 mM

-44.0 mV

Glucose 5.0 mM

-47.0 mV

1 min

40 mV

B

-45.0 mV

Glucose 2.0 mM

-44.0 mV

Glucose 5.0 mM

-48.0 mV

Glucose 0.5 mM

-43.0 mV

Glucose 1.0 mM

C

Membrane Potential (mV)

Current (pA)

-35 -30 -25 -20 -15 -10 -5 0 5

-100 -90 -80 -70 -60 -50 -40

-0.2 mM

-0.5 mM
Figure 6.14

A

[Graph showing voltage changes with different glucose concentrations.
- Glucose 0.2 mM: -38.0 mV
- Glucose 0.5 mM: -49.0 mV
- Glucose 1.0 mM: -49.0 mV
- Glucose 2.0 mM: -49.0 mV

B

[Graph showing current changes with different glucose concentrations.
- Glucose 0.2 mM: -41.0 mV
- Glucose 0.5 mM: -50.0 mV
- Glucose 1.0 mM: -51.0 mV
- Glucose 2.0 mM: -49.0 mV

C

[Graph showing current vs. membrane potential.
- 0.2 mM
- 0.5 mM

Current (pA) vs. Membrane Potential (mV)
Table 6.1 The effects of extracellular glucose on membrane properties of ARC neurones, recorded in *in vitro*, in slices prepared from rats fed *ad libitum*.

<table>
<thead>
<tr>
<th>All neurones</th>
<th>Fed rats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Membrane properties</td>
<td>Concentration of extracellular glucose (mM)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.0</td>
</tr>
<tr>
<td>Membrane potential (mV)</td>
<td>-46 ± 1 (n = 41)</td>
</tr>
<tr>
<td>Input resistance (MΩ)</td>
<td>1336 ± 93 (n = 41)</td>
</tr>
<tr>
<td>Firing Frequency (Hz)</td>
<td>0.67 ± 0.17 (n = 41)</td>
</tr>
</tbody>
</table>
Table 6.2 Membrane properties of ARC GE neurones, recorded in slices prepared from rats fed *ad libitum*, in different concentrations of extracellular glucose (2.0 – 0.2 – 0.5 – 1.0 – 2.0 – 5.0 mM)

<table>
<thead>
<tr>
<th>GE neurones</th>
<th>Fed rats</th>
<th>Significance (P-Value)</th>
<th>T-Test</th>
<th>ANOVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Membrane properties</td>
<td>Concentration of extracellular glucose (mM)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.0</td>
<td>0.2</td>
<td>0.5</td>
<td>1.0</td>
</tr>
<tr>
<td>Membrane potential (mV)</td>
<td>-46 ± 1 (n = 23)</td>
<td>-49 ± 1 (n = 23)</td>
<td>-49 ± 1 (n = 23)</td>
<td>-48 ± 1 (n = 23)</td>
</tr>
<tr>
<td>Input resistance (MΩ)</td>
<td>1305 ± 90 (n = 23)</td>
<td>782 ± 61 (n = 23)</td>
<td>806 ± 74 (n = 23)</td>
<td>882 ± 84 (n = 22)</td>
</tr>
<tr>
<td>Firing Frequency (Hz)</td>
<td>0.75 ± 0.22 (n = 23)</td>
<td>0.20 ± 0.07 (n = 23)</td>
<td>0.13 ± 0.06 (n = 23)</td>
<td>0.26 ± 0.13 (n = 23)</td>
</tr>
</tbody>
</table>
Table 6.3 Membrane properties of ARC GI neurones, recorded in slices prepared from rats fed *ad libitum*, in different concentrations of extracellular glucose (2.0 – 0.2 – 0.5 – 1.0 – 2.0 – 5.0 mM)

<table>
<thead>
<tr>
<th>GI neurones</th>
<th>Fed rats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Membrane properties</td>
<td>Concentration of extracellular glucose (mM)</td>
</tr>
<tr>
<td></td>
<td>2.0</td>
</tr>
<tr>
<td>Membrane potential (mV)</td>
<td>-46 ± 4 (n = 4)</td>
</tr>
<tr>
<td>Input resistance (MΩ)</td>
<td>1603 ± 381 (n = 4)</td>
</tr>
<tr>
<td>Firing Frequency (Hz)</td>
<td>0.13 ± 0.10 (n = 4)</td>
</tr>
</tbody>
</table>
Table 6.4   Membrane properties of ARC GRA neurones, recorded in slices prepared from rats fed *ad libitum*, in different concentrations of extracellular glucose (2.0 – 0.2 – 0.5 – 1.0 – 2.0 – 5.0 mM)

<table>
<thead>
<tr>
<th>GRA neurones</th>
<th>Concentration of extracellular glucose (mM)</th>
<th>Fed rats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Membrane properties</td>
<td></td>
<td>Significance (<em>P</em>-Value)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T-Test</td>
</tr>
<tr>
<td></td>
<td>2.0</td>
<td>2.0-0.2</td>
</tr>
<tr>
<td>Membrane potential (mV)</td>
<td>-40 ± 1 ( (n = 2) )</td>
<td>-44 ± 2 ( (n = 2) )</td>
</tr>
<tr>
<td>Input resistance (MΩ)</td>
<td>876 ± 101 ( (n = 2) )</td>
<td>713 ± 93 ( (n = 2) )</td>
</tr>
<tr>
<td>Firing Frequency (Hz)</td>
<td>0.46 ± 0.26 ( (n = 2) )</td>
<td>0.02 ± 0.02 ( (n = 2) )</td>
</tr>
</tbody>
</table>
Table 6.5 The effects of extracellular glucose on membrane properties of ARC neurones, recorded in *in vitro*, in slices prepared from 24-hour fasted rats

<table>
<thead>
<tr>
<th>Membrane properties</th>
<th>Concentration of extracellular glucose (mM)</th>
<th>Significance (P-Value)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.0</td>
<td>0.2</td>
</tr>
<tr>
<td>Membrane potential (mV)</td>
<td>-43 ± 1 (n = 38)</td>
<td>-43 ± 1 (n = 38)</td>
</tr>
<tr>
<td>Input resistance (MΩ)</td>
<td>1231 ± 85 (n = 38)</td>
<td>1078 ± 81 (n = 38)</td>
</tr>
<tr>
<td>Firing Frequency (Hz)</td>
<td>1.11 ± 0.23 (n = 38)</td>
<td>1.12 ± 0.28 (n = 38)</td>
</tr>
</tbody>
</table>
Table 6.6 Membrane properties of ARC GE neurones, recorded in slices prepared from 24-hour fasted rats, in different concentrations of extracellular glucose (2.0 – 0.2 – 0.5 – 1.0 – 2.0 – 5.0 mM)

<table>
<thead>
<tr>
<th>GE neurones</th>
<th>24-hour fasted rats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Membrane properties</td>
<td>Concentration of extracellular glucose (mM)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.0</td>
</tr>
<tr>
<td>Membrane potential (mV)</td>
<td>-45 ± 1 (n = 14)</td>
</tr>
<tr>
<td>Input resistance (MΩ)</td>
<td>1267 ± 117 (n = 14)</td>
</tr>
<tr>
<td>Firing Frequency (Hz)</td>
<td>0.56 ± 0.23 (n = 14)</td>
</tr>
</tbody>
</table>
Table 6.7 Membrane properties of ARC GI neurones, recorded in slices prepared from 24-hour fasted rats, in different concentrations of extracellular glucose (2.0 – 0.2 – 0.5 – 1.0 – 2.0 – 5.0 mM)

<table>
<thead>
<tr>
<th>GI neurones</th>
<th>24-hour fasted rats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Membrane properties</td>
<td>Concentration of extracellular glucose (mM)</td>
</tr>
<tr>
<td></td>
<td>2.0</td>
</tr>
<tr>
<td>Membrane potential (mV)</td>
<td>-43 ± 2 (n = 7)</td>
</tr>
<tr>
<td>Input resistance (MΩ)</td>
<td>1297 ± 173 (n = 7)</td>
</tr>
<tr>
<td>Firing Frequency (Hz)</td>
<td>0.92 ± 0.48 (n = 7)</td>
</tr>
</tbody>
</table>
Table 6.8  Membrane properties of ARC neurones, recorded in hypothalamic slices prepared from 24-hour fasted rats, in increasing concentrations of extracellular glucose (0.2 – 0.5 – 1.0 – 2.0 – 5.0 mM)

<table>
<thead>
<tr>
<th>Membrane properties</th>
<th>Concentration of extracellular glucose (mM)</th>
<th>24-hour fasted rats</th>
<th>Significance (P-Value)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.2</td>
<td>0.5</td>
<td>1.0</td>
</tr>
<tr>
<td>Membrane potential (mV)</td>
<td>-48 ± 2 (n = 16)</td>
<td>-50 ± 2 (n = 16)</td>
<td>-49 ± 2 (n = 16)</td>
</tr>
<tr>
<td>Input resistance (MΩ)</td>
<td>1135 ± 117 (n = 16)</td>
<td>1177 ± 122 (n = 16)</td>
<td>1030 ± 109 (n = 15)</td>
</tr>
<tr>
<td>Firing Frequency (Hz)</td>
<td>0.05 ± 0.02 (n = 16)</td>
<td>0.02 ± 0.01 (n = 16)</td>
<td>0.06 ± 0.05 (n = 16)</td>
</tr>
</tbody>
</table>
Table 6.9  Effects of increasing concentrations of extracellular glucose (0.2 – 0.5 – 1.0 – 2.0 – 5.0 mM) on membrane properties of ARC GE neurones recorded in hypothalamic slices prepared from 24-hour fasted rats

<table>
<thead>
<tr>
<th>GE neurones</th>
<th>24-hour fasted rats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Membrane properties</td>
<td>Concentration of extracellular glucose (mM)</td>
</tr>
<tr>
<td></td>
<td>0.2</td>
</tr>
<tr>
<td>Membrane potential (mV)</td>
<td>-48 ± 3 (n = 4)</td>
</tr>
<tr>
<td>Input resistance (MΩ)</td>
<td>867 ± 194 (n = 4)</td>
</tr>
<tr>
<td>Firing Frequency (Hz)</td>
<td>0.00 ± 0.00 (n = 4)</td>
</tr>
</tbody>
</table>
Table 6.10  Effects of increasing concentrations of extracellular glucose (0.2 – 0.5 – 1.0 – 2.0 – 5.0 mM) on membrane properties of ARC GI neurones recorded in hypothalamic slices prepared from 24-hour fasted rats

<table>
<thead>
<tr>
<th>GI neurones</th>
<th>Membrane properties</th>
<th>Concentration of extracellular glucose (mM)</th>
<th>24-hour fasted rats</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0.2</td>
<td>0.5</td>
</tr>
<tr>
<td>Membrane potential (mV)</td>
<td>-42 ± 1 (n = 4)</td>
<td>-46 ± 2 (n = 4)</td>
<td>-46 ± 2 (n = 4)</td>
</tr>
<tr>
<td>Input resistance (MΩ)</td>
<td>1492 ± 142 (n = 4)</td>
<td>1362 ± 387 (n = 4)</td>
<td>1052 ± 315 (n = 4)</td>
</tr>
<tr>
<td>Firing Frequency (Hz)</td>
<td>0.14 ± 0.07 (n = 4)</td>
<td>0.03 ± 0.03 (n = 4)</td>
<td>0.01 ± 0.01 (n = 4)</td>
</tr>
</tbody>
</table>