

Milk Replacers & Food Supplements

for Native Animals



WOMBAROO

Wombaroo Food Products
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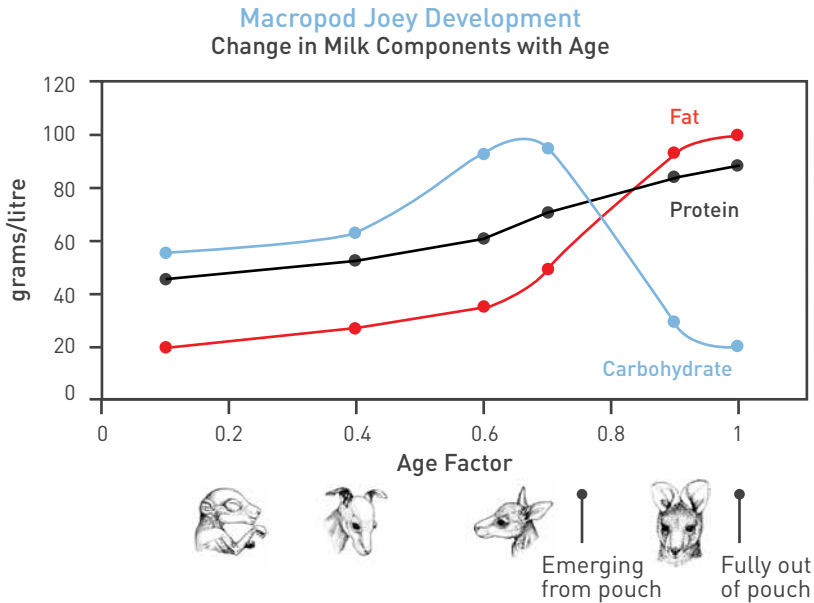
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ABOUT MARSUPIAL MILK

Milk provides the essential nutrients for the growth and development of juvenile marsupials. Information on the nutritional composition of milks from a range of different species is now available from both published data as well as private research undertaken by Wombaroo. This research shows that marsupial milk undergoes significant changes in composition (fat, protein & carbohydrate) over the period of lactation. The chart below shows the changes in milk components for a typical kangaroo joey. Different species (eg Possums, Wombats, Koalas) show different compositional changes in their milk during lactation and therefore have different developmental charts.



The above changes in milk composition cater for the widely differing nutritional requirements of the developing joey from furless "pinkie" to fully out-of-pouch. For example early lactation macropods obtain much of their energy from carbohydrate and cannot tolerate high fat levels. However later in lactation this situation is reversed, with milk becoming heavily concentrated with fat to provide additional energy. This is why a single milk formula is not ideal for hand rearing any marsupial. Different Wombaroo milks are formulated to provide the correct nutrition at different stages of joey development.

The Wombaroo milk stages are related to the Age Factor (AF) of the joey, which is the age of a joey as a proportion of its total pouch life:


$$\text{Age Factor (AF)} = \frac{\text{Age of joey}}{\text{Age when fully out of pouch}}$$

For example a Grey Kangaroo is normally fully out of the pouch at about 310 days. Therefore a Grey Kangaroo joey at 155 days has an age factor of $155 / 310 = 0.5$. A joey at fully out of pouch age has completed 100% of its pouch life so it has an age factor of 1. By definition, a joey that spends any time in the pouch has an age factor of less than 1. Pouch emergence begins for most species of macropods at an age factor of around 0.7 to 0.8.

The concept of Age Factor helps us standardise the nutritional requirements for joeys from the same family of species. Macropods develop at roughly the same rate when compared using Age Factor so that a Potoroo at 75 days, a Swamp Wallaby at 130 days, and a Grey Kangaroo at 155 days all have similar nutritional requirements (All have an Age Factor = 0.5).

The table below outlines the typical developmental “milestones” for macropods based on Age Factor (reproduced in part with permission from Helen George). This provides a useful guideline as to the expected development of a joey over time.

Age Factor	Stage of Development	Nutritional Considerations
0 (birth)	Eyes closed; front legs developed; buds for hind legs.	Low energy milk, with a low fat content. Digestive system is not well developed - milk contains easily digested carbohydrates and proteins. Immunoglobulins to boost immune system.
0.2	Eyes closed; ears folded flat on top of head; ear-canal closed; membrane joining lip; small hole at front of mouth for teat; hind legs formed.	
0.3	Membrane between lips has disappeared; whiskers growing. Runny yellow faeces.	No gut flora.
0.4	Eyes still closed; ears still flat but starting to become upright; animal fully formed.	Steadily increasing energy content of milk.
0.5	Eyes now open; dark colouring on back of hands, bridge of nose, tips of ears; fur about to come through skin; poking head out from pouch occasionally; Faeces yellow custard to toothpaste consistency.	Protein contains sufficient levels of sulphur-containing amino acids (eg cysteine & methionine) for the onset of hair & claw growth.
0.56	Fur colour visible under skin on entire body; Fur forming on bridge of nose and head.	Still no gut flora.




Age Factor	Stage of Development	Nutritional Considerations
0.6	Fur lengthening rapidly all over the body; fur appears last on belly/chest; leaning from mother's pouch and eating dirt to establish gut flora, starting to thermoregulate. Faeces darkening and forming.	Peak carbohydrate content in milk with high levels of associated digestive enzymes. Able to handle higher fat levels in milk.
0.7	Joey grazing from pouch making use of green feed; secondary coat appearing, the animal looks like a miniature adult. Faeces soft to firm green pellets.	High energy milk with a high fat content - coincides with increased activity levels of joey.
0.8	Joey starting to emerge from the pouch; spends longer and longer periods outside the pouch; feeding, urinating, defecating outside the pouch.	Sharp fall in carbohydrate content of milk with decrease in associated gut enzymes.
0.9	First incisor teeth erupting through gum; full length fur growth.	Increasing levels of "body-building" proteins (eg caseins, α -globulins) to coincide with peak growth rate.
1.00	Joey fully emerged from the pouch; still drinking milk; solid food plays a large part in the diet.	Gut flora developed for digestion of solid food.

WHAT'S IN WOMBAROO

Wombaroo contains a blend of protein, carbohydrate, fat, vitamins and minerals formulated to match as closely as possible the composition of natural mother's milk.

PROTEIN is a recombination of bovine milk protein fractions to produce the right proportion of caseins and whey proteins, with a balanced amino acid profile. Essential amino acids have been fortified with extra lysine, cysteine & methionine the latter of which are particularly important for healthy hair growth.

CARBOHYDRATE is in the form of dextrose and maltodextrin made from the enzymatic digestion of starch which is high in glucose and low in α -limit dextrin. Our research has shown this to be highly digestible form of energy, particularly for early lactation marsupials when carbohydrate accounts for up to 40% of the milk's energy. All formulae are low in lactose to minimize digestive upset. See **Appendix 5** for further discussion on carbohydrate assimilation in juvenile marsupials.



FAT is a mix of milk fat solids, vegetable oils and fatty acid esters prepared from fish oil. These ingredients are blended to produce the right mix of saturated, mono-unsaturated and polyunsaturated fats and include the essential omega-3 fatty acids α -linolenic acid (ALA), eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA).

VITAMIN and MINERAL composition data in marsupial milk is sparse. The addition of these micro-nutrients is based on best estimates obtained from those milks that have been analysed. The nutrients well quantified in marsupial milk include vitamin A, vitamin E, calcium, phosphorous, iron and copper. Where values are unknown we have added the full complement of vitamins and minerals in quantities that are acceptable by recognised animal husbandry standards. This includes vitamin D₃, vitamin C, vitamin K₁, thiamine, riboflavin, pyridoxine, nicotinic acid, pantothenic acid, folic acid, biotin, cyanocobalamin, choline, inositol, potassium, sodium, magnesium, zinc, manganese, iodine and selenium. See **Appendix 4** for further discussion about calcium levels and the incidence of bone fractures in joeys.

HOW TO USE WOMBAROO

Use Wombaroo as a complete food for rearing orphaned joeys or as supporting nutrition for debilitated or convalescing animals. Maternal milk supplies immunoglobulins throughout much of a marsupial's lactation, providing immunity to diseases and intestinal protection due to its many antimicrobial properties

Success in hand rearing joeys may be improved if **Impact Colostrum Supplement** is added to Wombaroo milk to help boost the immune system (see page 31 for further information about **Impact Colostrum Supplement**).

Using Wombaroo milk for marsupials is a three-step process

Step 1 Determine the Age Factor of the joey in care.

Step 2 Select the correct Wombaroo milk replacer for that age factor.

Step 3 Feed the correct volume of milk replacer based on the **body weight** of the animal.



Age Determination

Accurate age determination means that the correct formula for the stage of development can be fed. Joeys can be aged according to their physical characteristics (eg hair growth, body measurements, consistency of faeces). The developmental milestones outlined for macropods in the table on page 2 may be a useful guide. This booklet also provides growth charts for some of the common species of marsupials in Australia, which can be used as a guideline for feeding joeys.

▶ **Body weight should not be used to estimate age as this can be misleading especially in malnourished, dehydrated or overweight individuals.**

Using the Growth Charts

Estimate the animal's age from the body measurements for that species (eg tail and foot lengths). Often these measurements do not exactly correlate, so use the average age indicated by the measurements.

▶ **The estimated age determines the stage of Wombaroo milk to feed.**

Now look across the chart and this will give the optimum weight for a joey of that age. This is a healthy target weight for the animal. Now accurately weigh the joey to determine its actual weight. Comparing the joey's actual weight to the optimum weight from the chart will provide an indication as to the overall condition of the joey.

▶ **The actual weight determines the daily feed volume required.**

Now look up the joey's actual weight on the chart (or on the milk packet label) and this will give the correct daily feed volume (mL/day).

Gradually change joey from one milk stage to the next at the specified age in the charts (called **milk transition** see page 8). The charts are only a guide and do not take into account differences due to sex, sub-species and health condition of the joey. Individual growth rates can vary substantially from these guidelines, so don't be concerned if your joey doesn't match up with the charts.

▶ **Feed milk volumes according to joey's actual weight, even if this is substantially less than its optimum weight.**

Refer to **Appendix 2** for further information on underweight or malnourished joeys.

Making Up Milk

Wombaroo should be made up according to the directions on the pack. Different formulae are made up at different concentrations of solids per litre of milk.

For example Kangaroo Milk Replacer >0.7 formula is made up at 250g of powder per litre of prepared milk. This means that sufficient water is added to 250g of powder to make the formula up to 1 litre. Do not simply add 1 litre of water to the 250g of powder as this will produce more than 1 litre of milk and result in a somewhat diluted formula.

▶ **Wombaroo milk powders have different densities and should be weighed when preparing milk.**

If weighing milk powder is not possible then one level standard tablespoon dispenses about 10g.

Even if only feeding small quantities, it is preferable to make up milk in larger volumes (ie a litre at a time) as this is more accurate to measure out and mix up. Once made up, milk can be stored frozen in smaller quantities (eg in ice cube trays or freezer bags). These smaller quantities can then be thawed, remixed and used as required with minimal wastage. Do not re-freeze thawed milk. Prepared milk can be stored in a refrigerator for a day or frozen for up to 2 weeks.

When making up milk it is advisable to use pre-boiled water to reduce microbial contamination. Use warm water (about 50°C), too cold and the powder won't disperse properly and too hot can curdle the milk and destroy some nutrients. Some formulae are particularly high in fat so are best mixed with an electric whisk to prevent separation. Milk may not make up properly if there are contaminants in water (eg tank water), or if the powder has been exposed to heat, moisture, light or is out of date. Refer to **Appendix 1** about shipping and storage of milk powders.



Feeding


Milk should be warmed to about 30°C and fed using a bottle and teat. Your Wombaroo stockist can supply 120ml graduated plastic bottles and a suitable latex teat from our range of shapes (see page 36 for the range of Wombaroo teats available).

Tables of suggested feed volumes are supplied with each packet of milk replacer. Feed volumes have been carefully calculated from estimates of daily energy requirement. Energy requirement is determined using a mathematical relationship between body surface area and weight. The relationship of feed volume to body weight is not linear. Often carers are told "Feed from 10% to 30% of body weight per day." **This simple rule eventually produces feed volumes that are grossly inaccurate and can be detrimental to the health of the animal.** Depending on the species and stage of lactation, the feed volume can range from 4% to 100% of body weight. Note that feed volumes are **not** based on age, tail, foot or other body measurements, as these factors are largely unrelated to a joey's energy requirement and therefore food consumption.

Do not concentrate or dilute Wombaroo milk replacers by making them up to volumes other than that stated on the label. This will change the osmolarity of the milk solution and may lead to malabsorption of nutrients from the gut. Avoid introducing additional nutrients to the milk (other than Impact Colostrum Supplement) as this may unbalance the nutrient profile of the Wombaroo. Overfeeding may cause diarrhoea.

Young joeys suckle small volumes of milk frequently and can only cope with large, infrequent feeds as they become older. As a rule, it is preferable to feed a little often rather than a lot infrequently. Guidelines for macropods are as follows:

Age Factor	No. of feeds per day
<0.4	8
0.4	5-6
0.6	4-5
>0.7	2-3
1.0 to weaning	2* depending on other food eaten.



Feeding frequency is also dependent on the species' biology. For example, once left in the burrow, young wombats and echidnas are naturally fed larger volumes but less frequently. If unsure, consult an experienced carer about the husbandry requirements of the species in question.

Weigh joey regularly. Consistency in growth rate is a good measure of correct nutrition. Animals have an optimum, or ideal, growth rate that allows development to occur in a controlled fashion. A growth rate in excess of this optimum may lead to obesity and possible skeletal deformities. A sub-optimal growth rate may lead to poor development and a more disease prone animal. A continuing decline in growth rate could herald the onset of disease or indicate dehydration in small animals. See **Appendix 2** for more information on underweight or malnourished joeys.

Transition of Milk

Milk **transition** refers to when a joey is changed from one Wombaroo milk stage to the next. This transition is necessary to cater for the changing nutritional requirements of joeys as described on page 1. It is important to transition joeys at the correct age to ensure they are getting the proper nutrition for their stage of development. We recommend to transition from one milk stage to the next gradually over a period of about 10 to 20 days (depending on species and age). The gradual transition of milk formula reduces the likelihood of digestive upset for the joey. Total daily feed volume tends to decrease slightly at the onset of transition due to the introduction of the more energy dense, later lactation milk.

Some developmental problems can be related to joeys not being transitioned at the right age, or being left on a particular stage of milk for too long. For example the 0.6 Kangaroo stage only lasts for about 30 days for a Grey Kangaroo. Even if a joey is underweight for its age it is important to transition on to the next stage milk after after the specified amount of time. The reason for this is that the changes in digestive physiology still occur at the same time during lactation regardless of the joey being underweight.



Drinking

The level of hydration provided by Wombaroo milks is equivalent to that which the joey would receive from the mother's milk. Fully pouch-bound young with low activity levels, kept at the correct temperature **do not** generally require additional drinking water.

However young animals will drink water when thirsty. It is therefore important to give drinks of water during periods of hot weather or if the joey is showing signs of dehydration. Also provide joeys with small drinks of water between feeds once they begin to emerge from the pouch and become more active. Ensure drinking water is available when joey is fully out of pouch.

If providing drinking water, **do not** add extra water to the milk, as this significantly dilutes the milk and can lead to poor absorption of nutrients. **Give drinking water separately, between milk feeds.** See Appendix 3 for more information on Dehydration & Drinking Water.

Weaning

Once a joey leaves the pouch it begins to eat more solid food and becomes less reliant on milk. The amount of milk fed until fully weaned will depend on the amount and nutritional value of other food eaten. The length of time taken to wean a joey depends on the species. As a guide, joeys should be weaned at about 1.3 -1.5 times the joey's pouch life. For example a Grey Kangaroo should be fully weaned by about 450 days. Sick or malnourished joeys may need to be weaned later than healthier ones. Animals should be weaned on to solid foods that form part of the natural diet of the species in question. For grazers and browsers such as kangaroos, wallabies and wombats **Wombaroo Kangaroo Pellets** can be used as an ideal supplement to wean joeys as well as part of a maintenance diet for adult animals (see page 32 for further information).

PACKAGING AND STORAGE

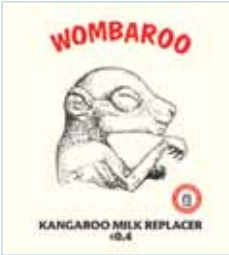

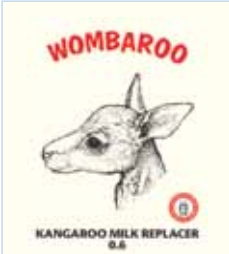
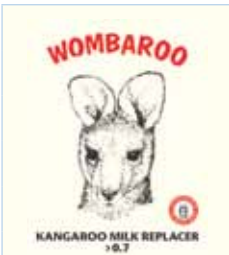
Wombaroo milk products are packaged as dry powder and are available in cartons that make up 1 and 5 litres and in sacks of 5kg, 10kg and 20kg. Wombaroo milk products should be stored in a cool, dry place, preferably under 30°C.

Once opened, store in a resealable, air tight container. When correctly stored, best before date is 18 months from manufacture.

See **Appendix 1** for more information on correct shipping & storage of Wombaroo Milk Powders.

Milk for Kangaroos

Suitable for all species of macropods including kangaroos, wallabies, pademelons, bettongs & potoroos.

 <p>WOMBAROO KANGAROO MILK REPLACER <0.4</p>	<p>Kangaroo Milk Replacer <0.4</p> <p>For joeys with less than 40% of pouch life completed. Furless. Pink skin. Eyes closed. Ears down. Faeces: Yellow custard consistency.</p> <p>Pack size: 140g, 700g.</p>	<p>Analysis</p> <table border="1"> <tbody> <tr> <td>Solids</td> <td>140g/litre</td> </tr> <tr> <td>Protein</td> <td>34%</td> </tr> <tr> <td>Fat</td> <td>14%</td> </tr> <tr> <td>Carbohydrate</td> <td>40%</td> </tr> <tr> <td>Energy</td> <td>2.5MJ/litre</td> </tr> </tbody> </table>		Solids	140g/litre	Protein	34%	Fat	14%	Carbohydrate	40%	Energy	2.5MJ/litre
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 <p>WOMBAROO KANGAROO MILK REPLACER 0.4</p>	<p>Kangaroo Milk Replacer 0.4</p> <p>For joeys with 40% of pouch life completed. Furless. Darkening skin. Eyes nearly open or just opened. Ears nearly erect. Faeces: Yellow toothpaste.</p> <p>Pack Size: 180g, 900g, 5kg.</p>	<p>Analysis</p> <table border="1"> <tbody> <tr> <td>Solids</td> <td>180g/litre</td> </tr> <tr> <td>Protein</td> <td>32%</td> </tr> <tr> <td>Fat</td> <td>22%</td> </tr> <tr> <td>Carbohydrate</td> <td>34%</td> </tr> <tr> <td>Energy</td> <td>3.7MJ/litre</td> </tr> </tbody> </table>		Solids	180g/litre	Protein	32%	Fat	22%	Carbohydrate	34%	Energy	3.7MJ/litre
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Carbohydrate	34%												
Energy	3.7MJ/litre												
 <p>WOMBAROO KANGAROO MILK REPLACER 0.6</p>	<p>Kangaroo Milk Replacer 0.6</p> <p>For joeys with 60% of pouch life completed. Fur: Fine to short. Ears erect. Faeces: Mustard toothpaste to soft green pellets.</p> <p>Pack size: 220g, 1.1kg, 5kg, 10kg.</p>	<p>Analysis</p> <table border="1"> <tbody> <tr> <td>Solids</td> <td>220g/litre</td> </tr> <tr> <td>Protein</td> <td>30%</td> </tr> <tr> <td>Fat</td> <td>26%</td> </tr> <tr> <td>Carbohydrate</td> <td>30%</td> </tr> <tr> <td>Energy</td> <td>4.7MJ/litre</td> </tr> </tbody> </table>		Solids	220g/litre	Protein	30%	Fat	26%	Carbohydrate	30%	Energy	4.7MJ/litre
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Energy	4.7MJ/litre												
 <p>WOMBAROO KANGAROO MILK REPLACER >0.7</p>	<p>Kangaroo Milk Replacer >0.7</p> <p>For joeys with greater than 70% of pouch life completed. Fur: Short to dense. Spends time out of pouch. Faeces: Soft to firm green pellets.</p> <p>Pack size: 250g, 1.25kg, 5kg, 10kg, 20kg.</p>	<p>Analysis</p> <table border="1"> <tbody> <tr> <td>Solids</td> <td>250g/litre</td> </tr> <tr> <td>Protein</td> <td>28%</td> </tr> <tr> <td>Fat</td> <td>42%</td> </tr> <tr> <td>Carbohydrate</td> <td>13%</td> </tr> <tr> <td>Energy</td> <td>6.2MJ/litre</td> </tr> </tbody> </table>		Solids	250g/litre	Protein	28%	Fat	42%	Carbohydrate	13%	Energy	6.2MJ/litre
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Growth and Feed Charts

These charts are only a guide and do not take into account differences due to sex, sub-species and health condition of the joey. Individual growth rates can vary substantially from these guidelines, so don't be concerned if your joey doesn't match up with the charts. **Always feed milk volumes according to joey's actual weight.** Charts are available on request for other species including Whiptail & Tammar Wallaby, Yellow-footed Rock Wallaby, Red-Bellied Pademelon & Tasmanian Bettong.

Red Kangaroo

Milk	Age (days)	Tail (mm)	Foot (mm)	Weight (g)	Feed (ml/day)
<0.4	10	18	10	4	3
	30	28	16	10	5
	50	46	26	39	13
	70	69	40	96	25
	90	96	56	189	45
Transition from <0.4 to 0.4	91-93	30ml <0.4 + 10ml 0.4			40
	94-96	20ml <0.4 + 20ml 0.4			40
	97-99	10ml <0.4 + 30ml 0.4			40
0.4	100	111	65	251	45
	110	128	74	325	50
	120	145	85	410	55
	130	164	96	509	65
	140	184	107	621	75
Transition from 0.4 to 0.6	141-143	50ml 0.4 + 20ml 0.6			70
	144-146	35ml 0.4 + 35ml 0.6			70
	147-149	20ml 0.4 + 50ml 0.6			70
0.6	150	205	120	755	70
	160	227	133	889	75
	170	250	147	1047	90
Transition from 0.6 to >0.7	171-175	70ml 0.6 + 10ml >0.7			80
	176-180	50ml 0.6 + 30ml >0.7			80
	181-185	30ml 0.6 + 50ml >0.7			80
	186-189	10ml 0.6 + 70ml >0.7			80
Emerging from pouch	190	300	176	1412	85
	200	326	192	1621	90
>0.7	210	354	Not Valid	2030	105
	220	382		2820	135
	230	412		3610	165
	240	444		4400	200
	250	474		5190*	220**
Fully out of pouch	250	474		5190*	220**

*Growth rate is now about 80g per day.

**Feed volume now depends on other food eaten.

Grey Kangaroo (applies to Eastern & Western)

Milk	Age (days)	Tail (mm)	Foot (mm)	Weight (g)	Feed (ml/day)
<0.4	20	34	14	13	6
	40	49	23	54	17
	60	67	33	125	35
	80	88	46	228	50
	100	111	61	363	70
	120	137	78	531	85
Transition from <0.4 to 0.4	121-126	60ml <0.4 + 20ml 0.4			80
	127-133	40ml <0.4 + 40ml 0.4			80
	134-139	20ml <0.4 + 60ml 0.4			80
0.4	140	166	97	731	85
	160	198	118	965	105
	180	233	142	1233	120
Transition from 0.4 to 0.6	181-183	75ml 0.4 + 25ml 0.6			100
	184-186	50ml 0.4 + 50ml 0.6			100
	187-189	25ml 0.4 + 75ml 0.6			100
0.6	190	251	154	1380	105
	200	270	167	1535	115
	220	310	194	1872	130
Transition from 0.6 to >0.7	221-225	90ml 0.6 + 20ml >0.7			110
	226-230	70ml 0.6 + 40ml >0.7			110
	231-235	50ml 0.6 + 60ml >0.7			110
	236-239	30ml 0.6 + 80ml >0.7			110
Emerging from pouch	240	353	224	2243	115
	250	376	239	2341	120
>0.7	260	399	Not Valid	2770	135
	270	423		3340	160
	280	448		3910	180
	290	473		4480	200
	300	499		5050	220
	310	526		5620*	235**
Fully out of pouch					

*Growth rate is now about 60g per day.

**Feed volume now depends on other food eaten.

Euro or Wallaroo

Milk	Age (days)	Tail (mm)	Foot (mm)	Weight (g)	Feed (ml/day)
<0.4	10	18	10	4	3
	30	27	13	8	4
	50	45	23	22	10
	70	67	34	56	17
	90	94	48	113	35
Transition from <0.4 to 0.4	91-93	20ml <0.4 + 10ml 0.4			30
	94-96	15ml <0.4 + 15ml 0.4			30
	97-99	10ml <0.4 + 20ml 0.4			30
0.4	100	108	56	151	30
	110	124	65	197	35
	120	141	74	252	40
	130	160	84	315	45
	140	179	94	387	55
Transition from 0.4 to 0.6	141-143	40ml 0.4 + 10ml 0.6			50
	144-146	25ml 0.4 + 25ml 0.6			50
	147-149	10ml 0.4 + 40ml 0.6			50
0.6	150	199	105	469	55
	160	221	117	562	60
	170	243	129	665	65
Transition from 0.6 to >0.7	171-175	50ml 0.6 + 10ml >0.7			60
	176-180	40ml 0.6 + 20ml >0.7			60
	181-185	20ml 0.6 + 40ml >0.7			60
	186-189	10ml 0.6 + 50ml >0.7			60
Emerging from pouch	190	291	155	907	65
	200	317	169	1310	75
>0.7	210	344	Not Valid	1800	100
	220	372		2290	115
	230	401		2780	135
	240	431		3270*	160**
Fully out of pouch					

*Growth rate is now about 50g per day.

**Feed volume now depends on other food eaten.

Agile Wallaby

Milk	Age (days)	Tail (mm)	Foot (mm)	Weight (g)	Feed (ml/day)
<0.4	20	17	11	8	4
	30	25	14	12	5
	40	34	19	20	8
	50	45	24	28	10
	60	57	29	40	14
	70	71	36	62	18
	80	86	42	85	25
Transition from <0.4 to 0.4	81-83	15ml <0.4 + 5ml 0.4			20
	84-86	10ml <0.4 + 10ml 0.4			20
	87-89	5ml <0.4 + 15ml 0.4			20
0.4	90	103	50	118	20
	100	121	58	169	30
	110	141	66	235	35
	120	162	75	317	45
	130	184	85	418	50
Transition from 0.4 to 0.6	131-133	40ml 0.4 + 10ml 0.6			50
	134-136	25ml 0.4 + 25ml 0.6			50
	137-139	10ml 0.4 + 40ml 0.6			50
0.6	140	208	95	539	50
	150	234	106	684	65
	160	261	118	853	75
	170	290	130	1051	85
Transition from 0.6 to >0.7	171-175	70ml 0.6 + 10ml >0.7			80
	176-180	50ml 0.6 + 30ml >0.7			80
	181-185	30ml 0.6 + 50ml >0.7			80
	186-189	10ml 0.6 + 70ml >0.7			80
Emerging from pouch	190	351	156	1537	85
	200	384	170	1787	95
>0.7	210	418	Not Valid	2037	105
	220	Not Valid		2287	115
Fully out of pouch	230		Not Valid	2540*	125**

*Growth rate is now about 30g per day.

**Feed volume now depends on other food eaten.

Red-Necked Wallaby

Milk	Age [days]	Tail (mm)	Foot (mm)	Weight (g)	Feed (ml/day)
<0.4	10	14	8	8	4
	30	23	13	24	9
	50	38	20	48	16
	70	56	28	62	20
	90	78	38	105	30
	110	103	49	184	45
Transition from <0.4 to 0.4	111-113	30ml <0.4 + 10ml 0.4			40
	114-116	20ml <0.4 + 20ml 0.4			40
	117-119	10ml <0.4 + 30ml 0.4			40
0.4	120	117	50	210	40
	130	132	50	287	45
	140	148	58	358	50
	150	164	66	476	60
	160	182	75	590	75
Transition from 0.4 to 0.6	161-163	50ml 0.4 + 20ml 0.6			70
	164-166	35ml 0.4 + 35ml 0.6			70
	167-169	20ml 0.4 + 50ml 0.6			70
0.6	170	201	95	732	70
	180	220	95	843	75
	190	240	106	988	80
	200	262	118	1086	90
Transition from 0.6 to >0.7	201-205	70ml 0.6 + 10ml >0.7			80
	206-210	50ml 0.6 + 30ml >0.7			80
	211-215	30ml 0.6 + 50ml >0.7			80
	216-219	10ml 0.6 + 70ml >0.7			80
Emerging from pouch	220	307	138	1330	85
	230	331	149	1540	90
>0.7	240	355	159	1790	95
	250	381	Not Valid	2040	105
	260	408		2290	115
	270	435		2540	130
	Fully out of pouch	280		463	2790*

*Growth rate is now about 30g per day.

**Feed volume now depends on other food eaten.

Swamp Wallaby

Milk	Age (days)	Leg (mm)	Foot (mm)	Weight (g)	Feed (ml/day)
<0.4	10	8	6	8	4
	30	15	11	21	8
	50	27	19	35	12
	70	39	28	58	18
	90	52	38	97	25
	110	65	47	161	45
Transition from <0.4 to 0.4	111-113	30ml <0.4 + 10ml 0.4			40
	114-116	20ml <0.4 + 20ml 0.4			40
	117-119	10ml <0.4 + 30ml 0.4			40
0.4	120	72	56	207	40
	130	82	62	267	45
	140	95	69	344	50
	150	108	77	443	55
	160	115	86	553	65
Transition from 0.4 to 0.6	161-163	40ml 0.4 + 20ml 0.6			60
	164-166	30ml 0.4 + 30ml 0.6			60
	167-169	20ml 0.4 + 40ml 0.6			60
0.6	170	122	95	673	60
	180	132	106	813	70
	190	141	114	963	80
	200	152	119	1113	90
Transition from 0.6 to >0.7	201-205	70ml 0.6 + 10ml >0.7			80
	206-210	50ml 0.6 + 30ml >0.7			80
	211-215	30ml 0.6 + 50ml >0.7			80
	216-219	10ml 0.6 + 70ml >0.7			80
Emerging from pouch	220	Not Valid	Not Valid	1473	85
	230			1683	95
>0.7	240			1893	100
	250			2103	110
	Fully out of pouch			2313*	125**

*Growth rate is now about 25g per day.

**Feed volume now depends on other food eaten.

Carnivorous Marsupials, Bandicoots & Bilby

The milk of carnivorous marsupials, bandicoots and bilby undergoes similar quantitative and qualitative changes as in other marsupials. This involves a progressive increase in total solids, fat and protein from early to late lactation while carbohydrate increases to about mid lactation and then declines to low levels during late lactation.

It is impracticable to produce a multi-stage milk replacer for these animals as most have short pouch lives and rescued animals tend to be at late lactation stage. We recommended feeding them **Kangaroo Milk Replacer >0.7**. This is a suitable high energy formula which many carers will have on hand or find readily available.

Bandicoots are known to have particularly high levels of energy in their milk and are very fast-growing. To cater for this some carers have added up to 5% additional fat in the form of **The Good Oil for Animals** (see page 36) ie 5ml per 100ml of >0.7 kangaroo milk. This could also be applied to the smaller carnivorous marsupials including **antechinus** and **phascogales**.


Depending on age, young **Tasmanian Devil** joeys may be started on either Kangaroo 0.4 or 0.6 formula and then transitioned on to the >0.7 as they get older.

Feed Table Using Kangaroo >0.7

Body Weight (g)	Feed Volume (ml/day)	Body Weight (g)	Feed Volume (ml/day)	Body Weight (g)	Feed Volume (ml/day)
5	1.3	60	8	200	20
10	2.2	70	9	250	24
15	2.9	80	10	300	27
20	3.6	90	11	350	29
25	4.3	100	12	400	32
30	4.9	110	13	450	35
35	5.5	120	14	500	38
40	6.1	130	15	550	42
45	6.7	140	16	600	44
50	7.3	150	16	650	46

Milk for Possums

Suitable for all species of possums & gliders.

	Possum Milk Replacer <0.8	Analysis	
	For joeys with less than 80% of pouch life completed. Furless. Pink skin. Eyes closed to just opened. Ears drooped. Faeces: Yellow custard to toothpaste consistency. Pack size: 160g, 800g.	Solids	160g/litre
	Protein	33%	
	Fat	15%	
	Carbohydrate	38%	
	Energy	3.1 MJ/litre	

	Possum Milk Replacer >0.8	Analysis	
	For joeys with greater than 80% of pouch life completed. Fur: Short soft to dense long. Spends time out of pouch. Faeces: Toothpaste to soft then firm green pellets. Pack Size: 250g, 1.25kg, 5kg.	Solids	250g/litre
	Protein	30%	
	Fat	35%	
	Carbohydrate	20%	
	Energy	5.7 MJ/litre	

Gradually change joey from one milk stage to the next as indicated in the charts. The growth charts are only a guide and do not take into account differences due to sex, subspecies and health condition of the joey. **Always feed milk volumes according to joey's actual weight.**

Sugar Glider

Milk	Age (days)	Head (mm)	Leg (mm)	Weight (g)	Feed (ml/day)
<0.8	20	11	6	0.8	0.7
	30	14	9	1.6	1.1
	40	17	12	3.2	1.8
	50	20	16	6.2	3
Transition from <0.8 to >0.8	51-53	2ml <0.8 + 1ml >0.8			3
	54-56	1.5ml <0.8 + 1.5ml >0.8			3
	57-59	1ml <0.8 + 2ml >0.8			3
Emerging from pouch	60	23	20	12	3
	70	26	24	24	4
>0.8	80	29	29	34	6
	90	32	35	44	7
Emerging from nest	100	35		54*	8**

*Growth rate is now about 2g per day.

**Feed volume now depends on other food eaten.

Ringtail Possum

Milk	Age (days)	Tail (mm)	Weight (g)	Feed (ml/day)
<0.8 Emerging from pouch	20	17	5	3
	30	32	10	4
	40	47	16	6
	50	62	24	8
	60	77	32	9
	70	92	42	12
	80	108	52	14
	90	123	64	16
Transition from <0.8 to >0.8	91-95	9ml <0.8 + 2ml >0.8		11
	96-100	7ml <0.8 + 4ml >0.8		11
	101-105	4ml <0.8 + 7ml >0.8		11
	106-109	2ml <0.8 + 9ml >0.8		11
>0.8 Fully out of pouch	110	153	88	11
	120	168	100	12
	130	183	114	14
	140	198	131*	15**

*Growth rate is about 3 to 6g per day.

**Feed volume now depends on other food eaten.

Ringtails should be fully weaned by about 180 days (approx. 310g body weight, depending on average daily weight gain).

Brushtail Possum

Milk	Age (days)	Tail (mm)	Foot (mm)	Weight (g)	Feed (ml/day)
<0.8 Emerging from pouch	20	13	10	6	3
	30	20	13	8	3
	40	27	16	11	5
	50	35	20	16	6
	60	44	24	22	8
	70	54	28	30	9
	80	65	33	42	12
	90	77	38	58	16
Transition from <0.8 to >0.8	100	91	44	79	19
	101-105	12ml <0.8 + 3ml >0.8			15
	106-110	9ml <0.8 + 6ml >0.8			15
	111-115	6ml <0.8 + 9ml >0.8			15
>0.8 Fully out of pouch	116-119	3ml <0.8 + 12ml >0.8			15
	120	121	56	151	17
	130	137	62	209	20
	140	155	69	282	26
	150	174	77	390*	35**

*Growth rate is about 10 to 15g per day.

**Feed volume now depends on other food eaten.

Brushtails should be fully weaned by about 195 days (approx. 840g body weight, depending on average daily weight gain).

Squirrel Glider

Milk	Age (days)	Head (mm)	Leg (mm)	Weight (g)	Feed (ml/day)
<0.8	20	12	6	1.1	0.8
	30	15	8	2.2	1.4
	40	16	11	4.2	2.2
	50	21	15	8.1	3.6
	60	24	18	16	6
Transition from <0.8 to >0.8	61-63	4ml <0.8 + 1ml >0.8			5
	64-66	2.5ml <0.8 + 2.5ml >0.8			5
	67-69	1ml <0.8 + 4ml >0.8			5
Emerging from pouch	70	27		29	5
	80	30		43	7
>0.8	90	33		57	8
	100	36		71	9
Emerging from nest	110	39		85*	11**

*Growth rate is now about 3g per day.

**Feed volume now depends on other food eaten.

Feeding Captive Possums and Gliders

In the wild omnivorous possums and gliders get protein from browse, pollen and insects. Once captive possums and gliders are weaned dietary protein can be supplemented by the addition of **Wombaroo High Protein Supplement** (see page 33) and **Wombaroo Small Carnivore Food** (see page 34). Folivorous species such as Ringtails and Greater Gliders should be maintained predominantly on native browse (eg young eucalypt leaves).

For animals fed fruit:

Disperse 2 heaped teaspoons (5-10g) of **Wombaroo High Protein Supplement** over each 100g of fruit offered.


For animals fed plain biscuit:


Suspend 25g of **Wombaroo High Protein Supplement** in 75ml of water and mix well. Pour 10ml of the prepared suspension over each 25g of broken plain biscuit offered.

For animals that eat insects:

Mix about 70g of **Wombaroo Small Carnivore Food** with about 30ml of warm water. Add the water slowly to the powder while mixing to make a moist, crumbly food. Include up to 20% in the diet of omnivorous gliders and possum species.

Milk for Wombats

	Wombat Milk Replacer <0.4	Analysis	
	<p>For joeys with less than 40% of pouch life completed. Furless. Pink skin. Eyes closed. Ears drooped to erect. Faeces: Yellow custard to toothpaste consistency. Pack size: 140g, 700g.</p>	Solids	140g/litre
		Protein	34%
		Fat	15%
		Carbohydrate	36%
		Energy	2.6 MJ/litre

	Wombat Milk Replacer 0.4	Analysis	
	<p>For joeys with 40% of pouch life completed. Furless to fine fur. Eyes just open. Ears erect. Faeces: toothpaste consistency. Pack Size: 190g, 950g, 5kg.</p>	Solids	190g/litre
		Protein	32%
		Fat	21%
		Carbohydrate	32%
		Energy	3.9 MJ/litre

	Wombat Milk Replacer >0.6	Analysis	
	<p>For joeys with greater than 60% of pouch life completed. Fur: Short to dense long fur. Spends time out of pouch. Faeces: Toothpaste to soft then firm green pellets. Pack size: 250g, 1.25kg, 5kg, 10kg, 20kg</p>	Solids	250g/litre
		Protein	30%
		Fat	39%
		Carbohydrate	11%
		Energy	6.2 MJ/litre

Gradually change joey from one milk stage to the next as indicated in the charts. The growth charts are only a guide and do not take into account differences due to sex, regional variation and health condition. **Always feed milk volumes according to joey's actual weight.**

Hairy-Nosed Wombat

Milk	Age (days)	Leg (mm)	Foot (mm)	Weight (g)	Feed (ml/day)
<0.4	20	33	22	2	2
	40	36	2	14	6
	60	39	32	42	14
	80	42	37	93	25
	90	44	40	129	30
	100	46	43	173	40
Transition from <0.4 to 0.4	101-103	30ml <0.4 + 10ml 0.4			40
	104-106	20ml <0.4 + 20ml 0.4			40
	107-109	10ml <0.4 + 30ml 0.4			40
0.4	110	48	46	225	40
	120	50	49	287	45
	130	52	53	358	50
	140	54	56	439	55
	150	56	59	532	60
	160	58	63	636	65
Transition from 0.4 to >0.6	161-163	40ml 0.4 + 20ml >0.6			60
	164-166	30ml 0.4 + 30ml >0.6			60
	167-169	20ml 0.4 + 40 ml >0.6			60
>0.6 Emerging from pouch	170	60	67	753	60
	180	62	71	882	65
	190	64	74	1024	70
	200	66	78	1181	75
	210	68	83	1352	85
	220	70	87	1592	95
	230	73	91	1882	105
	240	75	96	2212	120
	250	77	100	2562	135
	260	80	105	2912	145
Fully out of pouch	270	82	110	3262*	160**

*Growth rate is now about 35g per day.

**Feed volume now depends on other food eaten.

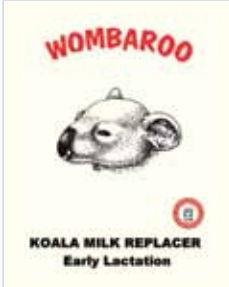
Common Wombat

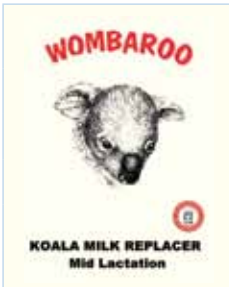
Milk	Age (days)	Body Length (mm)	Weight (g)	Feed (ml/day)
<0.4	20	65	2	2
	40	86	12	6
	60	107	45	15
	80	128	103	25
	90	149	151	30
	100	156	213	45
Transition from <0.4 to 0.4	110	162	291	50
	111-113	40ml <0.4 + 10ml 0.4		50
	114-116	25ml <0.4 + 25ml 0.4		50
0.4	117-119	10ml <0.4 + 40ml 0.4		50
	120	169	387	55
	130	175	502	65
	140	182	640	75
	150	188	802	90
	160	195	984	100
Transition from 0.4 to >0.6	170	201	1191	115
	171-173	60ml 0.4 + 25ml >0.6		85
	174-176	40ml 0.4 + 45ml >0.6		85
>0.6 Emerging from pouch	177-179	25ml 0.4 + 60ml >0.6		85
	180	208	1426	85
	190	214	1691	100
	200	221	1936	110
	210	228	2244	120
	220	234	2584	135
	230	241	2956	150
	240	247	3363	160
	250	254	3783	180
	260	260	4203	190
	270	267	4623	205
Fully out of pouch	280	270	5043	220
	290	280	5463*	230**

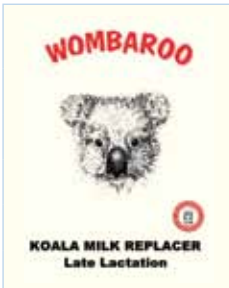
*Growth rate is now about 40g per day.

**Feed volume now depends on other food eaten.

Milk for Koalas

	Koala Milk Replacer Early Lactation	Analysis	
	For joeys less than 160 days old. Furless to fine fur. Eyes closed to just open. Pack size: 220g, 1.1kg.	Solids	220g/litre
		Protein	20%
		Fat	36%
		Carbohydrate	34%
		Energy	5.0 MJ/litre

	Koala Milk Replacer Mid Lactation	Analysis	
	For joeys between 180 and 250 days old. Short to dense long fur. Front teeth erupted and nibbling on leaves. Pack Size: 330g, 1.65kg, 5kg.	Solids	330g/litre
		Protein	25%
		Fat	47%
		Carbohydrate	15%
		Energy	8.2 MJ/litre

	Koala Milk Replacer Late Lactation	Analysis	
	For joeys greater than 270 days old until weaning. Fully emerged with adult type fur. Leaves are a large part of diet. Pack size: 300g, 1.5kg, 5kg, 10kg.	Solids	300g/litre
		Protein	35%
		Fat	46%
		Carbohydrate	7%
		Energy	7.4 MJ/litre

Age Estimation

Age estimation of koalas is based on head length, from tip of nose to nuchal crest at rear of skull. Regional differences present considerable variation in koala size and growth rate. Therefore it is not applicable to provide a standard growth chart for the species. Once the correct Wombaroo formula for age is selected, feed milk volume for body weight according to pack label.

It is important to weigh joeys regularly to confirm growth. Overfeeding can cause diarrhoea so don't exceed the suggested milk volumes in the feed chart on the milk pack.

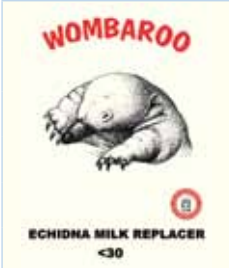
Koala - Developmental Stages

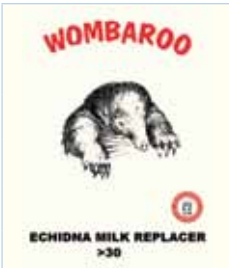
Milk	Age [days]	Stage of Development	Feed Volume
Early Lactation	90	First Fur	Feed milk volume for body weight as per label
	150	Eyes Open. Head appears out of pouch.	
	160		
Transition from Early to Mid Lactation	161-164	Feed 75% Early + 25% Mid Lactation	
	165-174	Feed 50% Early + 50% Mid Lactation	
	175-179	Feed 25% Early + 75% Mid Lactation	
Mid Lactation	180	Fully furred, front teeth erupted. Nibbling leaves.	Feed milk volume for body weight as per label
	210	Adult-type fur. Carried on mother's front.	
	250	Fully emerged. Carried on mother's back.	
Transition from Mid to Late Lactation	251-254	Feed 75% Mid + 25% Late Lactation	
	255-264	Feed 50% Mid + 50% Late Lactation	
	265-269	Feed 25% Mid + 75% Late Lactation	
Late Lactation	270	Fully weaned	Feed milk volume for body weight as per label**
	370		

**Feed volume now depends on amount of leaves eaten

Milk for Echidna

Also used for Platypus

	Echidna Milk Replacer <30	Analysis	
	<p>For young less than 30 days old. Furless. Pinkish-grey skin. Eyes closed. Pouch bound. Faeces: Custard to toothpaste consistency. Pack size: 210g</p>	Solids	210g/litre
		Protein	32%
		Fat	38%
		Carbohydrate	15%
Energy		5.0 MJ/litre	

	Echidna Milk Replacer >30	Analysis	
	<p>For young greater than 30 days old. Fur: By 60 days finely furred with spines emerging. Faeces: Toothpaste to soft then firm pellets. Pack size: 360g, 1.8kg.</p>	Solids	360g/litre
		Protein	30%
		Fat	42%
		Carbohydrate	10%
Energy		8.8 MJ/litre	

Age Estimation

Age estimation of echidnas based on body length becomes inaccurate when applied to more advanced juveniles. Echidna young leave the pouch (skin fold) at similar ages but at vastly different sizes. It is also difficult to accurately measure body length in older juveniles. Age estimation based on body weight is highly inaccurate after day 50.

Echidna young suckle vigorously and milk can be consumed up to a rate of 2ml per minute. This rapid intake of milk with high nutrient content means that young echidna feed infrequently. In the wild burrow young (>50 days) are only suckled by their mother once every 5 days. (Rismiller PD and McKelvey MW, 2009. Activity and behaviour of lactating echidnas. Aust J Zoology.)

Digestion of milk is slow so the contents of the stomach need to be fully emptied before the next feed. For captive animals <30 days we recommend to feed every 36 hours, and for those >50 days feed at least 2 days apart. This time frame may be further extended as the animal gets older. Note that the feed chart gives average **daily** feed volumes so multiply this by the number of days between each feed.

Short-Beaked Echidna

Milk	Age (days)	Body Length (mm)	Weight (g)	Feed (ml/day)
<30	10	55	10	3
	15	70	25	6
	20	85	40	8
	25	100	60	10
	30	115	90	14
Transition from <30 to >30	31-35	12ml <30 + 3ml >30		15
	36-40	9ml <30 + 6ml >30		15
	41-45	6ml <30 + 9ml >30		15
	46-49	3ml <30 + 9ml >30		15
>30 Out of pouch	50	160	230	15
	60*	Not Valid	300	18
	Not Valid		400	22
			600	30
			800	37**
			1000	44**
			1200	51**
			1400	57**
	1600		63**	
	1800	68**		

* Growth rate is now about 10 -20g per day.

**Feed volume now depends on other food eaten.

Gradually change young from one milk stage to the next as indicated in the chart. This chart is only a guide and does not take into account differences due to sex or regional variation.

Weaning

Echidnas should be fully weaned at about 7 months of age and the body weight at this time may be anywhere from 700g to over 2kg. Prior to weaning solid food may be introduced into the diet. Start by mixing small amounts of **Wombaroo Small Carnivore Food** into the milk. Over the next month, slowly increase the amount of solids while decreasing the amount of milk. During this time the mix should change in consistency from a thin porridge to a thick paste. This will prepare the young for introduction to the adult diet.

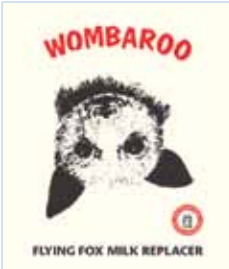
Introducing Adult Diet

Mix about 9 parts of **Wombaroo Small Carnivore Food** (see page 34) with 1 part of finely crushed termite mound, including some termites. Slowly mix with water to the desired consistency.

MILK FOR EUTHERIANS


Eutherian mammals develop their young in the womb and give birth to more highly advanced young than marsupials or monotremes. The young are initially nourished with colostrum to provide immunity, which then develops into milk within about 48 hours of birth. Milk composition does not change significantly during the course of lactation, so usually a single (species-specific) formula is suitable for hand-rearing. All of the domesticated, feral and exotic mammals found in Australia are eutherians. The most commonly encountered native eutherians are flying foxes, insectivorous bats and native rodents. Wombaroo makes a range of specifically formulated milk replacers to cater for most species of eutherian mammals.

Milk for Flying Foxes (Fruit Bats)

	Flying Fox Milk Replacer	Analysis	
	<p>A nutritionally complete substitute for pups. Use when mother's milk is limited or when pups are orphaned. Can be fed from birth to weaning. Neonates have benefited from receiving Impact Colostrum Supplement before being fed milk. Pack size: 170g, 1kg, 5kg.</p>	Solids	170g/litre
Protein		30%	
Fat		18%	
Carbohydrate		37%	
Energy		3.2 MJ/litre	

When weaning onto a fruit diet, it is important to provide a protein source. Disperse 4 heaped teaspoons of **Wombaroo High Protein Supplement** (see page 33) over 300g of fruit for each juvenile flying fox.

Milk for Insectivorous Bats (Microbats)

	Bat Milk Replacer	Analysis	
	<p>A nutritionally complete substitute for pups. Use when mother's milk is limited or when pups are orphaned. Can be fed from birth to weaning. Neonates have benefited from receiving Impact Colostrum Supplement before being fed milk. Pack size: 165g which makes 500ml</p>	Solids	330g/litre
Protein		32%	
Fat		43%	
Carbohydrate		6%	
Energy		8.1 MJ/litre	

When weaning introduce **Wombaroo Small Carnivore Food** (see page 34) to the diet. This can be used as a maintenance food while supplementing bats with moths, beetles and a few meal worms.

Milk for Native Rodents

We recommend **Wombaroo Dog Milk Replacer** (215g/litre) for these rodents. It has an approximate composition of 36% protein, 40% fat and 15% carbohydrate with an energy content of 5.1 MJ/litre. Spinifex and Mitchell's Hopping Mice, Bush Rats and Water Rats have been successfully reared using this milk replacer.

Feed Table Using Wombaroo Dog Milk Replacer For Native Rodents

Body Weight (g)	Feed Volume (ml/day)	Body Weight (g)	Feed Volume (ml/day)	Body Weight (g)	Feed Volume (ml/day)
0.1	0.15	1	0.8	10	4
0.2	0.25	2	1.3	20	8
0.3	0.35	3	1.8	30	10
0.4	0.40	4	2.2	40	12
0.5	0.45	5	2.6	50	15

Other Wombaroo Milk Replacers

Alpaca (170g/litre)

Cat (215g/litre)

Dog (215g/litre)

Deer (380g/litre)

Guinea Pig (190g/litre)

Horse (115g/litre)

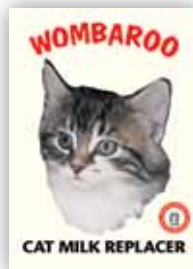
Pig (180g/litre)

Rabbit (360g/litre)

Sheep (190g/litre)


Sealion (300g/litre)

Plus a range of specialty formulas used by zoos and wildlife parks in Australia and around the world.



Formula One Low Lactose Milk

Low Lactose Milk formula for hand-rearing all animal species including puppies, kittens, lambs, piglets, calves, foals, cria and marsupials.

	Formula One	Analysis	
	Low Lactose Milk formula that can be used for a range of different species. Use as an emergency milk replacer. Elevated whey protein, unsaturated fats and essential nutrients than products based on cow's milk. Pack size: 65g (Shake 'n' Make), 500g, 1kg, 5kg, 10kg, 20kg.	Solids	125g/litre
	Protein	24%	
	Fat	29%	
	Carbohydrate	36%	
	Energy	2.9MJ/litre	

About Low Lactose Milks

Low lactose milk products are normally prepared from cow's milk, but with the lactose converted into its component sugars, glucose and galactose. This process does not alter the nature or composition of protein or fat in cow's milk, which can be quite inappropriate for most other mammal species.

Formula One is blended from low-lactose ingredients but is formulated to have an improved nutritional profile than products based on cow's milk.

We recommend to use Formula One as an emergency milk replacer for any animal until the correct Wombaroo milk can be administered.


Formula One is available in various pack sizes but includes a convenient **Shake 'n' Make** bottle which is pre-measured to make up 500mL of formula and is ideal for emergency care.



SPECIALISED FOODS AND SUPPLEMENTS

Along with species-specific milk formulae, Wombaroo also makes a range of specialised nutritional supplements for native and rescued animals. These products have been formulated to bridge the nutritional gaps that may arise from feeding inadequate diets.


Impact Colostrum Supplement

	Impact Colostrum Supplement	Analysis	
	For newborn animals and marsupial joeys.	Protein (min)	60%
	Contains high levels of immunoglobulins and antibacterials including lactoferrin, lysozyme and lactoperoxidase that may provide immunity and intestinal protection to young animals.	Fat (min)	6%
	Feed to newborn eutherians in the first 48 hours after birth or as an adjunct to milk replacers for marsupial joeys up until weaning.	Carbohydrate (min)	20%
	Pack size: 25g, 50g, 250g, 500g.	Immunoglobulin	75g/kg
		Lactoferrin	2g/kg
		Lactoperoxidase	100,000 iu/kg

Using Impact for Marsupials

Young marsupials receive passive immunity from immunoglobulins present in the mother's milk. In marsupials intestinal absorption occurs well into in pouch life and immunoglobulins are present in the milk throughout much of lactation. **Impact** is ideally fed about a week after coming into care, as any protection from the mother's milk has started to deplete by then (immunity from the mother's milk depletes significantly after 7 days and is completely gone by 4-6 weeks). Initially a course of **Impact** for upto 5 days is recommended. This may be repeated later as necessary (eg every 4 weeks) especially for joeys with a compromised immune system (animals failing to thrive or with diarrhoea). In particular, when joeys first start poking the head out of the pouch they become exposed to new pathogens in the environment. This is another beneficial time to use **Impact**, which corresponds to a Wombaroo Age factor of about 0.6 to 0.7.

Kangaroo Pellets

	Wombaroo Kangaroo Pellets	Analysis	
	A specialised feed for kangaroos, wallabies, wombats and other native herbivores High in fibre & antioxidants. Low in starch & oxalates. Fortified with essential amino acids, fatty acids, vitamins and minerals. Pack size: 20kg.	Protein	14%
		Fat	5%
		Fibre	22%
		Energy	9.0 MJ/kg

Australian herbivores have evolved to eat a wide range of native grasses, plants and foliage. This provides a naturally high fibre diet, rich in anti-oxidants. In captivity, these animals are often fed with pellets or muesli made from cereal grains with a high starch content. This can lead to dental problems (eg Lumpy Jaw) and poor digestive health.

Wombaroo Kangaroo Pellets have the following benefits:

High in Fibre: The abrasive fibre and large pellet size promotes chewing action which helps maintain dental condition. The inclusion of soluble fibre (mannan-oligosaccharides) promotes the growth of beneficial gut bacteria. The low starch content helps reduce the dental and digestive problems associated with excessive consumption of cereal grains.

High in Antioxidants: Animals kept in captivity are prone to stress, which can lead to disease, infections and a compromised immune system. Wombaroo Pellets are fortified with antioxidants including vitamin E, selenium and carotenoids to help eliminate the free radicals produced by oxidative stress.


Low in Oxalates: Some commercial ingredients and exotic plants contain high levels of oxalates eg lucerne, lupins and wheat bran. Oxalates can bind with dietary metals to form insoluble precipitates such as calcium oxalate crystals found in urinary tract stones. A low oxalate diet may therefore be beneficial for urinary tract health.

Directions for Feeding

Feed Wombaroo Pellets ad lib as a supplement to pasture, hay and native browse. Feed rate will depend on body weight, body condition and quality of other foods consumed. Introduce Wombaroo Pellets gradually into the diet to avoid sudden digestive upset. Water intake may increase when feeding Wombaroo Pellets so always ensure that fresh water is available.

Avoid feeding large amounts of high-sugar fruit (eg apples & pears), high starch foods (eg grains, bread, potatoes) or high-oxalate fodder (eg lucerne). These items can effectively be replaced with Wombaroo Pellets.

High Protein Supplement

 <p>WOMBAROO HIGH PROTEIN SUPPLEMENT</p>	<p>High Protein Supplement</p> <p>Use as a protein booster in the diet of fruit & nectar eating animals such as flying foxes, possums and sugar gliders. Fortified with essential amino acids, fatty acids, vitamins & minerals.</p> <p>Pack size: 250g, 1kg, 5kg.</p>	<p>Analysis</p>	
		Protein	52%
		Fat	12%
		Carbohydrate	25%
		Energy	16.3 MJ/kg

This product is used extensively by animal carers and keepers as a protein booster in the diet of many fruit and nectar eating animals. The sources of protein in this supplement are soy protein isolate and whey protein isolates of high lactalbumin content. Together these ingredients produce a protein mix with an excellent amino acid composition. The supplement is fortified with vitamins, minerals and the essential fatty acids α -linolenic acid, EPA and DHA. Product palatability and protein quality make it a useful food additive to boost the protein level in the diet of debilitated animals.

Using High Protein Supplement

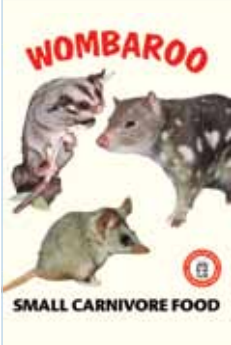
Frugivorous Animals: Fruit can represent a large proportion of the diet for some animals. To ensure that there is sufficient quality protein in their diet disperse 2 heaped teaspoons of **High Protein Supplement** over each 100g of fruit.

Possums & Gliders: For animals that eat fruit disperse 2 heaped teaspoons of **High Protein Supplement** over each 100g of fruit offered. For animals fed plain biscuit prepare a 25% weight per volume suspension of **High Protein Supplement** in water and use at the rate of 10ml per 25g of biscuit. Also include up to 20% prepared **Wombaroo Small Carnivore Food** in their diet.

Flying Foxes: Disperse 2 heaped teaspoons of **High Protein Supplement** over 300g of fresh cut apple and feed this quantity to each adult animal. Increase the amount of supplement to 4 heaped teaspoons when feeding pregnant or nursing females and juveniles.

Other Uses: **High Protein Supplement** can be substituted for the High Protein Cereal used in the many food recipes for animals and birds. You only need to use half the quantity of **High Protein Supplement** because of its superior protein quality and higher concentration.

Small Carnivore Food

	Small Carnivore Food	Analysis	
	A nutritionally balanced substitute to live foods for carnivorous marsupials, rodents and other small mammals which include insects as a part of their diet. Fortified with essential amino acids, fatty acids, vitamins & minerals. Pack size: 250g, 1kg, 5kg.	Protein	34%
		Fat	10%
		Carbohydrate	32%
		Energy	15.2 MJ/kg

Using Small Carnivore Food

Preparing Food: Mix about 70% of Small Carnivore Food with about 30% of warm water. Add the water slowly while mixing to a moist, crumbly food. Do not make into a paste. Store prepared food refrigerated for 1 day or frozen for 1 week.

Kowaris, Dunnarts, Quolls and Antechinus: Prepared food can represent up to 80% of the total diet. Supplement with crickets, moths, grasshoppers, spiders and day old mice or chicks.

Gliders, Pigmy Possums and Bandicoots: Include up to 20% of prepared food in their diet. Also feed Wombaroo High Protein Supplement dispersed over fruit.

Hopping mice, Rats & Mice: Add 10% to 20% of prepared food to the diet of these animals.

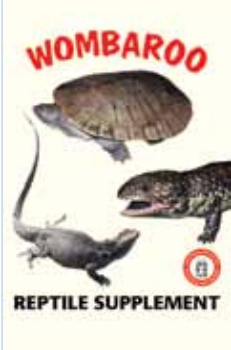
Echidna and Numbat: Mix prepared food with about 10% crushed termite mound and termites.

Insectivorous Bats: Have been successfully kept using this food as a maintenance diet while supplementing them with moths, beetles and a few fly pupae and mealworms.

Feeding Live Food

Carnivorous and omnivorous animals need to catch live food. Feeding live food is not only important nutritionally it also helps maintain a healthy attitude in captive animals. If insects are offered as live food ensure they represent the insect stage eaten by the animal in the wild. There are considerable differences in composition between mature and immature (larval stage) of insects. Animals that prey on mature insects such as moths, beetles and crickets should not be fed large numbers of larval stage insects. Captive animals are commonly fed mealworms and fly pupae which are larval stage insects. These can be poor food substitutes for many animals because of their high fat content. Fat contains twice as much energy as other nutrients and increased quantities in the diet can significantly dilute the intake of essential nutrients.

Reptile Supplement

	Reptile Supplement	Analysis	
	A versatile high protein supplement which can be added to fruits and vegetables, insects, meat or made as soft pellets. Can be fed to all reptiles including tortoises, dragons, lizards and snakes. Fortified with essential amino acids, fatty acids, vitamins & minerals. Pack size: 250g, 1kg, 5kg.	Protein	55%
	Fat	14%	
	Carbohydrate	9%	
	Energy	14.6 MJ/kg	

Using Reptile Supplement

To feed as soft pellets: Mix about 75% Reptile Supplement with about 25% warm water. Add the water slowly and mix to a consistency of putty. Roll small pieces into soft pellets and feed. Drinking water should always be available when feeding soft pellets.

To feed as Meatmix: Mix about 50% Reptile Supplement with about 50% minced meat, fish or hard-boiled egg. Water may need to be added to moisten the mixture. Roll small pieces into pellets and feed.

To feed as Vegmix: Sprinkle Reptile Supplement over equal proportions of finely chopped apple, banana, tomato and freshly washed silverbeet. Remove excess powder after mixing.


Store prepared food refrigerated for 1 day or frozen for 1 week.

Tortoises (Turtles): Freshwater tortoises are mainly carnivorous and feed underwater on slow moving aquatic animals such as yabbies, insect larvae, tadpoles and small fish. Feed captive tortoises a variety of live food and **Wombaroo Reptile Supplement** prepared as soft pellets or meatmix. Avoid contaminating the aquarium by removing any uneaten food. Do not overfeed.

Skinks, Dragons and Geckos: The larger lizards such as bluetongues, shinglebacks and bearded dragons are omnivorous and eat a variety of plants as well as snails, insects and other invertebrates. Feed these larger skinks a variety of vegetables with **Wombaroo Reptile Supplement** prepared as either pellets, meatmix or vegmix. Geckos and the small skinks and dragons are mainly insectivorous and should be fed a variety of live food and **Wombaroo Reptile Supplement** prepared as either Meatmix or Vegmix.

Goannas and Snakes: These reptiles are predators and scavengers eating insects, small lizards, snakes, birds, mammals and carrion. Feed these reptiles whole bodies stuffed with **Wombaroo Reptile Supplement** at the rate of 5g per 50g of food carcass weight.

The Good Oil for Animals

	The Good Oil for Animals	Analysis	
	Polyunsaturated fatty acid supplement used for:	Fat	100%
	<ul style="list-style-type: none"> • Boosting the energy content in the milk of fast-growing marsupials (eg bandicoots, small carnivorous marsupials). 	Oleic Acid	410mg/mL
		Linoleic Acid	290mg/mL
		α-linolenic Acid	110mg/mL
	<ul style="list-style-type: none"> • Animals with essential fatty acid deficiency to help promote a healthy skin, coat and cell membranes. 	EPA (omega 3)	25mg/mL
		DHA (omega 3)	12mg/mL
	<ul style="list-style-type: none"> • Malnourished late lactation marsupials to help increase weight gain prior to weaning. 	Vitamin A	30µg/mL
		Vitamin D ₃	2µg/mL
		Vitamin E	3mg/mL
Pack size: 250mL, 1L, 5L.			

Dosage for Marsupials: Use at the rate of 5mL added per 100mL of milk formula and mix in thoroughly. Introduce gradually to avoid digestive upset. Do not over-supplement, as this will dilute the concentration of other nutrients in the milk and lead to nutritional imbalance.

Note that all **Wombaroo** Milk formulas already contain sufficient fatty acid content for their target species. Supplementation with additional **Good Oil for Animals** is only recommended in the specific cases outlined above.

HAND-REARING ACCESSORIES

Bottle and Teats

Teat Selection: Teats should resemble mother's in shape and length for mouth comfort, fit and correct tooth eruption. Marsupial teats get longer as the joey grows, so progression to longer teats is important.











Hole Size: There is no hole in the teats, so the carer can make a hole to suit the age of the animal. Pierce the tip of the teat with a hot needle to make a hole about 1mm in diameter, or for large animals, cut a hole with scissors. If the hole is too small, excessive sucking will quickly weaken the tip and the end will blow out. If this is happening then the hole is probably too small for the animal. Make a larger hole. The hole should be large enough for milk to drip out slowly, when the bottle is inverted.

Bottle and Teats


Feeding Technique: Small animals can be fed using a syringe with a teat pulled over the end to give greater control of milk flow with the plunger. Guidance should be obtained from experienced carers on correct feeding technique for different animals.

Care & Storage: Latex is a natural product. Deterioration can be slowed by storing teats in an opaque, airtight container. Teats should be washed in warm soapy water immediately after use, dried and stored as above. Some carers sterilise by boiling or with infant sterilising solutions.

A range of latex teats are available with a sleeve to fit bottles with a neck diameter of 18-24mm. The 120 mL plastic bottle fit these teats and has graduations in mL and fluid oz.

STM Teat	MTM Teat	TM Teat	FM Teat	Bottle	
					
Small in-pouch kangaroos, wallabies, possums.	In-pouch kangaroos, wallabies, koalas.	Out of pouch kangaroos and wallabies.	Out of pouch kangaroos, wombats, koalas.	120 ml Graduated Bottle.	
SD Teat	LD Teat	C Teat	F Teat	P Teat	D Teat
					
Small dogs, possums, gliders.	Large dogs, possums, wombats, koalas.	Cats, rabbits, carnivorous marsupials.	Flying fox, some breeds of dog.	Small mammals, cats, rabbits.	Deer, 26mm sleeve to fit larger bottles.

Cosy Heat Pad

	Cosy Heat Pad	Specifications	
	<p>Useful for artificial pouches for orphaned marsupials: Place pad at back of pouch. Put insulation between pad and animal.</p> <p>Veterinarians: use on operating tables and in recovery rooms.</p> <p>Reptiles: Place at one end of the enclosure so reptile can move on or off the heated area. Cover with layer of sand or flat rock.</p> <p>Birds & Animals: Boxes and hospital cages. Place pad underneath or inside box or cage.</p>	Size	260mm x 360mm
		Material	Soft PVC Cover
		Voltage	240 volts
		Power	10 watts

Using the Pad

The Cosy Heat Pad is designed to provide warmth for sick, young or debilitated animals and birds. The pad works by gradually heating up the area under where the animal sits.

The heater produces a temperature on the pad surface of about 15-20°C above room temperature.

When room temperature is less than 10°C.

Animals should be as close as practicable to the pad surface.

When room temperature exceeds 10°C.

Animals should be insulated from the pad surface with layers of woollen fabric. The thickness of insulation required will depend on the room temperature and should be adjusted so that the animal is comfortable.

Monitor the temperature where the animal rests with a thermometer. It should be between 25°C and 35°C, depending on the age and type of animal. Seek professional advice if unsure of your animal's needs.

Heat stress can occur if the temperature is too high.

This device is fitted with a cut-off switch which limits the surface temperature of the pad, preventing excessively high temperatures.



APPENDIX 1

Shipping & Storage of Milk Powders

Careful shipping and storage of Wombaroo milk replacers is necessary to prevent microbial contamination and spoilage of milk products.

Wombaroo Milk Replacers should be stored in a cool, dry place, preferably below 30 degrees Celcius.

Moisture

Exposure to moisture is the most likely cause of microbial contamination. Once opened, we recommend storing milk powder in an air tight container. This is especially necessary in the more humid, tropical climates.

We **do not** advise storing milk powder in the refrigerator, due to condensation of moisture from the air. Every time the fridge door is opened, moisture-laden air can enter. When this is cooled, droplets of liquid water condense which can provide a suitable environment for microbial growth. While it's true that refrigeration will slow the rate of microbial growth, it does not prevent it altogether.

We **do not** advise storing milk powder in the freezer, due to the formation of ice crystals within the milk powder. These can disrupt the emulsion of fat in the milk and cause problems when trying to reconstitute the milk powder.

Temperature

High temperatures can accelerate oxidation of the fat in the milk, causing it to go rancid. This can create a noticeable change in texture, odour, colour, and taste.

However, in the absence of moisture, short-term exposure to higher temperatures is not likely to cause significant microbial problems. Hence, we generally don't see a lot of problems caused by hotter shipping conditions, unless there has been a prolonged exposure to heat or excessive moisture.

Storage of Reconstituted Milk

Made up (reconstituted) milk should be stored in the fridge for a day, or frozen for up to 2 weeks. When small quantities of milk are required, it is more convenient to make up larger batches (ie 500mL-1000mL) and store frozen in ice-cube trays. Then thaw out smaller quantities as required. Do not refreeze thawed milk.



APPENDIX 2

Underweight or Malnourished Joeys

Many joeys that come into care are malnourished or have a compromised immune system. Along with proper nutrition, these animals may require veterinary care such as fluid therapy and ongoing disease treatment. It is very difficult to achieve healthy weight gain in a joey with an untreated illness.

▶ **If a joey is severely underweight when it first comes into care, ensure that rehydration has been carried out before feeding milk.**

Underweight or malnourished animals may benefit from a course of **Impact Colostrum Supplement** (see page 31). Colostrum contains high levels of immunoglobulins and antibacterials, which may aid immunity and intestinal protection.

Underweight joeys should still be aged accurately to ensure the correct stage of Wombaroo Milk is being administered. The growth of bones is not usually retarded unless nutrition is extremely restricted for a long period, so foot and tail measurements are not often affected by short term malnutrition (hence these are still useful measurements for age determination). However, body weight will be quickly affected by poor nutrition, so should not be used for age estimation. Developmental milestones (leg eyes open, fur growth etc.) outlined on page 2 may also be useful in age determination “by eye”.

▶ **Once the correct Wombaroo milk stage is selected the feed volume should be based on the actual body weight.**

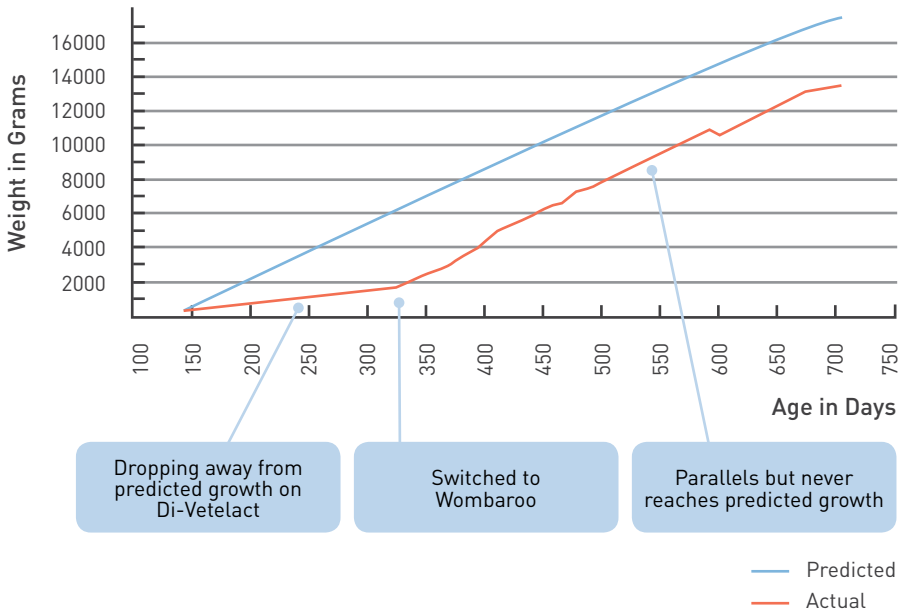
Once the joey is established on a sound feeding regime, the volume consumed may be increased gradually so that the gap between actual weight and the optimum weight is closed. Take care not to increase the volume too fast or the animal may start to scour. If the animal has control of its bowels, even though the faeces are a little looser than normal, all is well. If it starts to scour uncontrollably, then the increase in volume has been too rapid.

Carers are sometimes reluctant to transition their joey to the next stage of Wombaroo because it is underweight. However joeys should be transitioned based on age as their digestive physiology develops regardless of their body weight. In fact by holding it back on a lower age formula it may be missing out on vital nutrients critical for its development. An example of this is a kangaroo joey going from 0.6 formula to >0.7, which is a critical stage for increased growth and energy demands.



In practice an underweight joey may not catch-up to its “theoretical” growth curve, especially if has been maintained on an unsuitable diet for a long period of time. Below is a chart (see reference) showing the actual growth against the predicted growth for an Eastern Grey Kangaroo initially fed on Di-Vetelact then switched to Wombaroo. The change to Wombaroo arrests the decline in growth and then the animal parallels the expected growth line but doesn’t catch up. In this circumstance an earlier switch to Wombaroo along with a controlled increase in feed volume may have been enough to close the gap.

Online Animal Record System
Animal Growth History



Reference

Chart reproduced with permission from Peter Richards (Long Grass Nature Refuge) from “Animal Husbandry Software for Australian Wildlife Carers.” National Wildlife Rehabilitation Conference 2006.



APPENDIX 3

Dehydration & Drinking Water

Dehydration can be a serious problem in hand raised marsupials. Some carers are concerned that Wombaroo Milk replacers are “too concentrated” and don’t supply sufficient hydration to the joey. Some people even routinely dilute the milk in an attempt to provide more water, to the detriment of the nutritional value of the product.

The concentration of solids in most marsupial milk increases as the joey ages. We reflect these changes such that the “level of hydration” in the Wombaroo is similar to that produced by the maternal milk. Mother-reared joeys do not usually get additional water intake until they start emerging from the pouch (or burrow for wombats & echidnas). Blanket statements like “animals need 10% of their body weight in water per day” are simply not applicable to most marsupial joeys. Conditions in the pouch are high in humidity and at optimum temperature such that water losses are minimised. Many marsupials have evolved the ability to concentrate their urine in order to conserve water, a process which is fully developed by pouch emergence.

However, significant water loss can occur through respiration which is directly linked to energy expenditure. The activity level of pouch bound young is usually low, resulting in low metabolic rates and low water turnover. Husbandry conditions in captivity should closely as possible mimic those in mother-raised joeys in order to avoid dehydration. Unfortunately, often animals are kept at excessively high temperatures, low humidity and with much more activity and stress (over handling) than they would have in the wild. These factors can also lead to dehydration, and the need to provide additional water.

- ▶ **Carers need to be able to monitor joeys and determine if they have become dehydrated, especially during hot weather.**
- ▶ **We recommend to provide separate drinks of water in hot weather, if the joey is dehydrated and when a joey begins to emerge from the pouch and becomes more active.**

Young animals will readily drink water when thirsty. When providing drinking water, do not add extra water to the milk, as this significantly dilutes the milk and can lead to poor absorption of nutrients. Give drinking water separately, between feeds.

Some carers have erroneously linked cases of crystalluria and cystitis to a lack of water provided in the milk. Our research suggests that these conditions are largely un-related to milk formulae and more likely to be linked to untreated infections associated with diarrhoea and renal disease (B.G. Rich, 1997. Do milk formulae play a major role in crystalluria in hand-reared macropod joeys?)



APPENDIX 4

Calcium & Bone Fractures

Calcium is an essential nutrient in milk for the healthy growth and development of bones. Mineralisation of marsupial joey bones relies on available calcium levels, balanced with other nutrients such as phosphorus and vitamin D₃ intake. The following calcium concentrations have been measured in macropod milk:

Species	Calcium (mg/MJ)*	Reference
Red Kangaroo	500-700	Lemon & Barker 1967, Poole et al 1982
Grey Kangaroo	400-800	Poole et al 1982
Tammar Wallaby	375-550	Green et al 1980, Green & Renfree 1982, Green 1984
Red-necked Wallaby	400-700	Green 1984, Merchant et al 1987

*Calcium expressed as weight (milligrams) per unit of milk energy (in megajoules)

In all cases the measured quantity of calcium is greater than 375 mg/MJ. In addition, Walker & Vickery (see reference) boosted their calcium levels to 486 mg/MJ after experiencing fractures at 307 mg/MJ. At all stages Wombaroo Kangaroo Milk Formulae contain greater than 500 mg/MJ calcium, balanced with available phosphorus and Vitamin D₃ levels. Interestingly some other commonly used milk replacers may have marginally deficient levels of calcium (Di-Vetelact: 357 mg/MJ and Biolac M200: 310 mg/MJ).

Incidence of bone fractures

Bone mineralisation progresses when the joey leaves the pouch and load bearing occurs. Joeys need to gradually increase the level of load bearing to strengthen bones. Pouch bound joeys are prone to fractures, irrespective of calcium levels, due to their low level of bone mineralisation. Problems are exacerbated if husbandry practices induce premature load bearing eg over-activity of young, excess movement in the artificial pouch or falls from an unsecured pouch opening. In the wild the mother tightly controls movement and level of activity in the pouch-bound young and captive husbandry needs to mimic this as closely as possible to minimise the incidence of fractures.

Reference

Walker, D.M. and Vickery, K. 1988. Tolerance of pouch young kangaroos (Macropodidae) for cow's milk and milk replacers containing different amounts of glucose and lactose. Aust. Mammal. 11: 125-133.



APPENDIX 5

Carbohydrate Assimilation in Marsupials

Lactose

Lactose is the predominant carbohydrate found in non-marsupial milk (eg cow's milk). It is composed of equal parts of the simple sugars **glucose** and **galactose**. In marsupial milk some lactose is present, but for it to be digested it must first be converted into its component sugars by the enzyme **lactase**. In marsupial young, lactase is an intracellular enzyme and the carbohydrate molecules in the milk must first enter the intestinal cells (enterocytes) before the lactose can be digested. This limits the rate at which these molecules are digested and places a threshold on the amount of lactose that can be tolerated. Marsupials suffer diarrhoea when that threshold for lactose is exceeded.

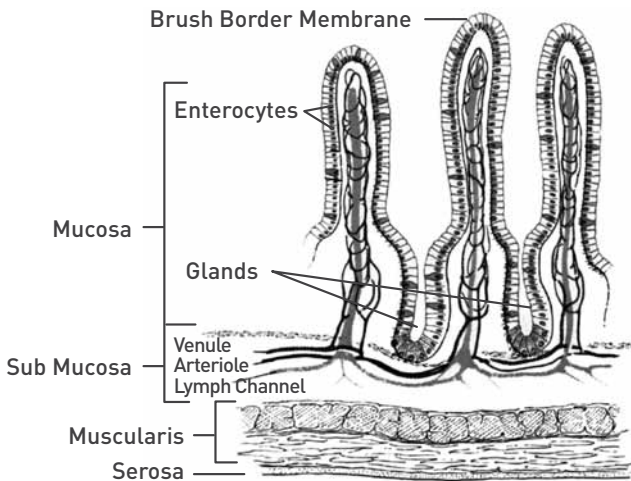
Galacto-oligosaccharides (GOS)

In marsupial milk the lactose present is usually combined with additional galactose units to form galacto-oligosaccharides of varying molecular size (Messer & Mossop 1977, Messer & Green 1979). These are prevalent in the early and mid stages of marsupial lactation.

The physiological function of producing these large carbohydrate molecules is to load the milk with more carbohydrate, up to 68% of solids, for little additional osmotic cost. Other mammals (eg cow's milk) have lactose as the main milk carbohydrate which is osmotically limited to about 35% of solids.

Marsupials have a unique digestive physiology to deal with the larger carbohydrate molecules. The oligosaccharides enter the enterocytes lining the intestinal mucosa (See diagram overleaf) and are broken down by intracellular enzymes to their simple sugar components. None of the commercially available gluco-oligosaccharides (maltodextrins) or galacto-oligosaccharides (GOS) that are added to marsupial milk replacers accurately represent the native carbohydrate. However, our research indicates that either gluco-oligosaccharides (maltodextrins) or galacto-oligosaccharides can be digested within these enterocytes (B. G. Rich, 1993. Activities of Intestinal Disaccharidases in Hand-reared Macropods. Wildlife Diseases Association of Australasia. Mallacoota.)

The problem of colonic fermentation and the diarrhoea that can be associated with it stems, more often than not, from a compromised intestinal mucosa or brush border membrane. Many juvenile animals brought into care probably have their digestive system affected in some form from infection, dehydration, drugs or poor husbandry, and the addition of any carbohydrate to the system at this time would only exacerbate the problem.



Galactose and galactose intolerance

Galactose is a normal product of carbohydrate metabolism in juvenile marsupials. Galactose is converted to glucose utilising the enzymes galactokinase, uridytransferase and UDP-glucose epimerase. The activity of these digestive enzymes sharply decreases just before pouch emergence in macropods. This results in a reduced ability to tolerate milk carbohydrates from this time on.

Galactose intolerance (galactosemia) occurs when there is a genetic deficiency of any of the enzymes that convert galactose to glucose. This is a rare occurrence in people and there is no published evidence of galactosemia in marsupials.

Cataracts

Cataracts are a clouding of the lens in the eye. There are many causes of cataracts and include ageing, eye trauma, UV and other radiation, viral infections, galactosemia and intolerance to other simple sugars. There is anecdotal evidence that free radicals associated with stress may cause cataracts in juvenile marsupials. It has been suggested that using moderate doses of antioxidants such as vitamin E may reverse the onset of cataracts.

It is erroneously considered by some that lactose intolerance causes cataracts. Although there may well be animals with cataracts that are also lactose intolerant, there is no link to suggest that lactose intolerance is the cause of their cataracts.



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