

**Table 4. Summary of dietary nutrient requirements of North African catfish *Clarias gariepinus* (requirement expressed for dry feed except where otherwise mentioned)**

| Nutrients  | Nutrient levels                       |  |  |                             |
|--|---------------------------------------|--|--|-----------------------------|
|  | Life stage/size class                 |  |  | References                  |
|  | Larval rearing<br>12–14 d             | Nursery phase<br>0.5–10 g                    | Grow out<br>10–1 000 g   |                             |
| <b>Protein and amino acids</b>                           |                                       |  |  |                             |
| Crude protein, % min                                     | 55 <sup>1</sup>                       | 50 <sup>e,20</sup>                           | 40–42 <sup>2</sup> , 40 <sup>3,24</sup> 43 <sup>2,4,6,16,17,25,26</sup>                                | 1,2,3,4,6,16,17,20,24,25,26 |
| Least costed and or appetite feeding protein requirement |                                       |  | 35 <sup>16</sup> , 38 <sup>2</sup>   | 2,16                        |
| Amino acids, % min of dietary protein                    |                                       |  |  |                             |
| Arginine   |                                       | 4.5 <sup>6</sup> , 4.45–4.50 <sup>c,19</sup> |  | 6,19                        |
| Histidine  |                                       | 1.0–1.05 <sup>5</sup>                        | 1.39 <sup>17</sup>   | 5,17                        |
| Isoleucine   |                                       |  | 1.56 <sup>17</sup>   | 17                          |
| Leucine  |                                       |  | 4.87 <sup>17</sup>   | 17                          |
| Lysine   |                                       | 5.7 <sup>9</sup>                             | 4.49 <sup>17</sup>   | 9,17                        |
| Methionine   | 2.5 <sup>1</sup>                      |  | 3.2 <sup>8</sup>   | 1, 8                        |
| Phenylalanine  |                                       |  | 4.56 <sup>17</sup>   | 17                          |
| Threonine  |                                       |  | 2.04 <sup>17</sup>   | 17                          |
| Tryptophan   |                                       | 1.1 <sup>7</sup>                             | 2.59 <sup>17</sup>   | 7,17                        |
| Valine   |                                       |  | 2.08 <sup>17</sup>   | 17                          |
| <b>Lipid and fatty acids</b>                             |                                       |  |  |                             |
| Crude lipid, % min                                       | 9 <sup>1</sup>                        |  | 8.2 <sup>15</sup> , 10–12 <sup>2</sup> , 11.5 <sup>3</sup> , 13 <sup>16</sup> , 10–17 <sup>17</sup>    | 1,2,3,15,16,17              |
| Essential fatty acids, % min                             |                                       |  |  |                             |
| 18:2n-6  |                                       |  |  |                             |
| 20:4n-6  |                                       |  |  |                             |
| 18:3n-3  |                                       |  |  |                             |
| 20:5n-3  |                                       |  |  |                             |
| 22:6n-3  |                                       |  |  |                             |
| n-3 : n-6 ratio  | 1:1 <sup>1</sup>                      |  |  | 1                           |
| <b>Carbohydrate, % recommended</b>                       | 21 <sup>1</sup>                       |  | 15–35 <sup>2,10,11,12,15,16</sup> , 26–32 <sup>17</sup>  | 1,2,10,11,12,15,16,17       |
| <b>Energy</b>  |                                       |  |  |                             |
| Digestible energy, min kJ/g                              |                                       |  | 14–16 <sup>2</sup> , 12.7 <sup>3,21</sup>  | 2,3, 21                     |
| Metabolizable energy, min kJ/g                           |                                       |  | 13 <sup>3</sup>  | 3                           |
| Gross energy, min kJ/g                                   |                                       |  | 11–13 <sup>4</sup> , 21 <sup>3</sup> , 21.2 <sup>15</sup> , 22–24 <sup>17</sup>                        | 3,4,15,17                   |
| Protein to energy ratio, mg/kJ                           |                                       |  | 20.5 <sup>15</sup> , 26–29 <sup>2</sup> , 31 <sup>3</sup> , 31–36 <sup>4</sup> , 21.5–23 <sup>17</sup> | 2,3,4,15,17                 |
| Lipid to carbohydrate ratio (g/g)                        |                                       |  | 2.47(lipid 13%, carbohydrate 33.42%) <sup>16</sup>   | 16                          |
| <b>Minerals<sup>a</sup></b>                              |                                       |  |  |                             |
| <b>Macroelements (%)</b>                                 |                                       |  |  |                             |
| Calcium  |                                       | 0.45 <sup>18</sup>                           | 1.5 <sup>2</sup>   | 2,18                        |
| Phosphorus   |                                       | 0.45 <sup>18</sup>                           | 0.5 <sup>2</sup>   | 2,18                        |
| Magnesium  |                                       | 0.04 <sup>18</sup>                           |  | 18                          |
| Sodium   |                                       |  |  |                             |
| Potassium  |                                       | 0.26 <sup>18</sup>                           |  | 18                          |
| <b>Microelements, mg/kg dry diet</b>                     |                                       |  |  |                             |
| Iron   |                                       | 30 <sup>18</sup>                             |  | 18                          |
| Sulphur  |                                       |  |  |                             |
| Chlorine   |                                       |  |  |                             |
| Copper   |                                       | 5 <sup>18</sup>                              |  | 18                          |
| Manganese  |                                       | ≤2.40 <sup>18</sup>                          |  | 18                          |
| Zinc   |                                       | 20 <sup>18</sup>                             |  | 18                          |
| Cobalt   |                                       |  |  |                             |
| Selenium   |                                       | 0.25 <sup>18</sup>                           |  | 18                          |
| Iodine   |                                       |  |  |                             |
| Molybdenum   |                                       |  |  |                             |
| Chromium   |                                       |  |  |                             |
| Flourine   |                                       |  |  |                             |
| <b>Vitamins<sup>a</sup></b>                              |                                       |  |  |                             |
| Vitamin A IU/kg  |                                       | 1 000–2 000 <sup>18</sup>                    |  | 18                          |
| Vitamin D IU/kg  |                                       | 500–1000 <sup>18</sup>                       |  | 18                          |
| Vitamin E min mg/kg                                      |                                       | 25–50 <sup>18</sup>                          |  | 18                          |
| Thiamine min mg/kg                                       |                                       | 1 <sup>18</sup>                              |  | 18                          |
| Riboflavin min mg/kg                                     |                                       | 9 <sup>18</sup>                              |  | 18                          |
| Pyridoxine min mg/kg                                     |                                       | 3 <sup>18</sup>                              |  | 18                          |
| Pantothenic acid min mg/kg                               |                                       | 10–15 <sup>18</sup>                          |  | 18                          |
| Niacin min mg/kg   |                                       | 33.1 <sup>23</sup>                           |  | 23                          |
| Folic acid min mg/kg                                     |                                       | 1.2 <sup>18</sup>                            |  | 18                          |
| Choline min mg/kg  |                                       | 400 <sup>18</sup>                            |  | 18                          |
| Biotin <sup>b</sup> min mg/kg                            |                                       |  | 2.49 <sup>13</sup>   | 13                          |
| Ascorbic acid min mg/kg                                  | 150 <sup>14</sup> , 500 <sup>23</sup> | 11–60 <sup>18</sup> , 50 <sup>22</sup>       |  | 14,18,22,23                 |

Notes:

<sup>a</sup> Mineral and vitamin requirements are generally assumed to be the same as for *Ictalurus punctatus*.

<sup>b</sup> Biotin requirement determined for *Clarias batrachus*.

<sup>c</sup> For hybrids between *Clarias gariepinus* and *C. macrocephalus*.

<sup>e</sup> For hybrids between *Clarias gariepinus* and *Heterobranchus bidorsalis*.

Source:

<sup>1</sup> Uys and Hecht (1985)

<sup>2</sup> Uys (1989)

<sup>3</sup> Machiels and Henken (1985)

<sup>4</sup> Degani, Ben-Zvi and Levanon (1989)

<sup>5</sup> Khan and Abidi, (2009)

- 6 Fagbenro, Nwanna and Adebayo (1999)
- 7 Fagbenro and Nwanna (1999)
- 8 Fagbenro, Balogun and Fasakin (1998)
- 9 Fagbenro et al. (1998)
- 10 Balogun and Ologhobo (1989)
- 11 Heinsbroek, Van Thoor and Elizondo (1990)
- 12 Fagbenro et al. (1993)
- 13 Mohamed, Ravisankar and Ibrahim (2004)
- 14 Merchie et al. (1997)
- 15 Ali and Jauncey (2005a)
- 16 Ali (2001)
- 17 Pantazis (1999)
- 18 Wilson and Moreau (1996)
- 19 Singh and Khan (2007)
- 20 Adebayo and Alasoadura (2001)
- 21 Yilmaz et al. (2006)
- 22 Adewolu and Aro (2009)
- 23 Kuczynski (2002)
- 24 Machiels and Henken (1987)
- 25 Ali and Jauncey (2005b)
- 26 Ali and Jauncey (2005c)