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**18/SCI05/010**

**MEDICAL LABORATORY SCIENCES.**

**BCH 204**

1. **What do you understand by the term” BIOLOGICAL VALUE OF PROTEINS”.**
2. **List and explain the various methods of assessment of protein quality.**

1.Biological value (BV) is a measure of the proportion of absorbed protein from a food which becomes incorporated into the proteins of the organism's body. It captures how readily the digested protein can be used in protein synthesis in the cells of the organism. Proteins are the major source of nitrogen in food. BV assumes protein is the only source of nitrogen and measures the proportion of this nitrogen absorbed by the body which is then excreted. The remainder must have been incorporated into the proteins of the organisms body. A ratio of nitrogen incorporated into the body over nitrogen absorbed gives a measure of protein "usability" – the BV.

Unlike some measures of protein usability, biological value does not take into account how readily the protein can be digested and absorbed (largely by the small intestine). This is reflected in the experimental methods used to determine BV.

BV uses two similar scales:

* The true percentage utilization (usually shown with a percent symbol).
* The percentage utilization relative to a readily utilizable protein source, often egg (usually shown as unitless).

These two values will be similar but not identical.

* The BV of a food varies greatly, and depends on a wide variety of factors. In particular the BV value of a food varies depending on its preparation and the recent diet of the organism. This makes reliable determination of BV difficult and of limited use — fasting prior to testing is universally required in order to ascertain reliable figures.

BV is commonly used in nutrition science in many mammalian organisms, and is a relevant measure in humans. It is a popular guideline in bodybuilding in protein choice.

For accurate determination of BV:

* The test organism must only consume the protein or mixture of proteins of interest (the test diet).
* The test diet must contain no non-protein sources of nitrogen.
* The test diet must be of suitable content and quantity to avoid use of the protein primarily as an energy source.
* These conditions mean the tests are typically carried out over the course of over one week with strict diet control. Fasting prior to testing helps produce consistency between subjects (it removes recent diet as a variable).

There are two scales on which BV is measured; percentage utilization and relative utilization. By convention percentage BV has a percent sign (%) suffix and relative BV has no unit.

**Percentage utilization.**

Biological value is determined based on this formula.

BV = ( Nr / Na ) \* 100

Where:

Na = nitrogen absorbed in proteins on the test diet

Nr = nitrogen incorporated into the body on the test diet

However direct measurement of Nr is essentially impossible. It will typically be measured indirectly from nitrogen excretion in urine. Faecal excretion of nitrogen must also be taken into account - this part of the ingested protein is not absorbed by the body and so not included in the calculation of BV. An estimate is used of the amount of the urinary and faecal nitrogen excretion not coming from ingested nitrogen. This may be done by substituting a protein-free diet and observing nitrogen excretion in urine or faeces, but the accuracy of this method of estimation of the amount of nitrogen excretion not coming from ingested nitrogen on a protein-containing diet has been questioned.

BV = ( ( Ni - Ne(f) - Ne(u) ) / (Ni - Ne(f)) ) \* 100

Where:

Ni = nitrogen intake in proteins on the test diet

Ne(f) = (nitrogen excreted in faeces whilst on the test diet) - (nitrogen excreted in faeces not from ingested nitrogen)

Ne(u) = (nitrogen excreted in urine whilst on the test diet) - (nitrogen excreted in urine not from ingested nitrogen)

Note:

Nr = Ni - Ne(f) - Ne(u)

Na = Ni - Ne(f)

This can take any value from 0 to 100, though reported BV could be out of this range if the estimates of nitrogen excretion from non-ingested sources are inaccurate, such as could happen if the endogenous secretion changes with protein intake. A BV of 100% indicates complete utilization of a dietary protein, i.e. 100% of the protein ingested and absorbed is incorporated into proteins into the body. The value of 100% is an absolute maximum, no more than 100% of the protein ingested can be utilized (in the equation above Ne(u) and Ne(f) cannot go negative, setting 100% as the maximum BV).

...Providing it is known which protein measurements were made relative to it is simple to convert from relative BV to percentage BV:

BV(relative) = ( BV(percentage) / BV(reference) ) \* 100

BV(percentage) = ( BV(relative) / 100 ) \* BV(reference)

Where:

BV(relative) = relative BV of the test protein

BV(reference) = percentage BV of reference protein (typically egg: 93.7%).

BV(percentage) = percentage BV of the test protein

While this conversion is simple it is not strictly valid due to the differences between the experimental methods. It is, however, suitable for use as a guideline.

The determination of BV is carefully designed to accurately measure some aspects of protein usage whilst eliminating variation from other aspects. When using the test (or considering BV values) care must be taken to ensure the variable of interest is quantified by BV.

**Factors which affect BV can be grouped into properties of the protein source and properties of the species or individual consuming the protein.**

The principal effect on BV in everyday life is the organism's current diet, although many other factors such as age, health, weight, sex, etc. all have an effect. In short any condition which can affect the organism's metabolism will vary the BV of a protein source.

In particular, whilst on a high protein diet the BV of all foods consumed is reduced — the limiting rate at which the amino acids may be incorporated into the body is not the availability of amino acids but the rate of protein synthesis possible in cells. This is a major point of criticism of BV as a test; the test diet is artificially protein rich and may have unusual effects.

2.Currently accepted methods for measuring protein quality do not consider the diverse roles of indispensable amino acids beyond the first limiting amino acid for growth or nitrogen balance, glucose homeostasis and healthcare quality assessment.

**How do you know the quality of the protein in the foods you consume?**

The protein quality of most foods has been determined by one of the methods below.

**Biological Value (BV**) - (grams of nitrogen retained / grams of nitrogen absorbed) x 100

**Protein Efficiency Ratio (PER**) - (grams of weight gained / grams of protein consumed)

This method is commonly performed in growing rats.

a.**Chemical or Amino Acid Score (AAS)** - (Test food limiting essential amino acid (mg/g protein) / needs of same essential amino acid (mg/g protein))

b.**Protein Digestibility Corrected Amino Acid Score (PDCAAS)** - (Amino Acid Score x Digestibility)

This is the most widely used method and was preferred by the Food and Agriculture Organization and World Health Organization (WHO). The following table shows the protein quality measures for some common foods.

***Measures of protein Quality.***

|  |  |  |  |
| --- | --- | --- | --- |
| Egg 3.8 | 98 | 121 | 100 |
| Milk 3.1 | 95 | 127 | 100 |
| Beef 2.9 | 98 | 94 | 92 |
| Soy 2.1 | 95 | 96 | 91 |
| Wheat 1.5 | 91 | 47 | 42 |