Synthetic meat: is it a threat to our livestock industries?

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Synthetic meat: is it a threat to our livestock industries?

Erratum
Last two pages included in "Nitrogenous fertilisers for cereal production," Vol16 No 4 p103
Synthetic meat

Is it a threat to our livestock industries?

By G. A. Robertson
Rural Economics and Marketing

Australians usually reject the concept of synthetic meat. We cannot understand how anyone could prefer a plate of adulterated soy beans to a juicy steak. But unfortunately, only a small proportion of the world's population can afford the steak.

The average Australian consumer enjoys one of the highest net incomes in the world, and some of the lowest meat prices (see Table 1). Consequently, Australia's per capita consumption of meat is one of the highest in the world, averaging 113.5 kg per head per year between 1969 to 1971. For comparison, Japan averages 19.7 kg per head (Table 2). It would take very high meat prices over a considerable period before Australians would change their meat-eating habits and consume 'textured vegetable proteins' in large quantities.

However, the prosperity of our livestock industries is not based on home consumption but on exports, and it is in many of these markets that consumers are tempted to turn towards meat substitutes. Although

Synthetic "meats" are becoming accepted as an alternative protein source by many consumers in Western Europe, USA and Japan. Their relatively low cost and uniform quality make them attractive to the catering trade.

Australians are not generally aware of their increasing use although it has been suggested that "meat-like products" are a potential threat to our meat exports. This article outlines the current situation and emphasises the need to be fully informed about such products.

The author has studied this problem for some years and kept in close contact with developments while living in the United Kingdom and Australia.

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Table I—Comparative beef prices in selected capital cities, March 1975

<table>
<thead>
<tr>
<th>City</th>
<th>Sirloin steak (boneless) $/kg</th>
<th>Chuck steak (boneless) $/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perth</td>
<td>2.21*</td>
<td>1.35</td>
</tr>
<tr>
<td>Bonn (West Germany)</td>
<td>6.88</td>
<td>4.73</td>
</tr>
<tr>
<td>Brasilia (Brazil)</td>
<td>2.10</td>
<td>1.85</td>
</tr>
<tr>
<td>Brussels (Belgium)</td>
<td>5.65</td>
<td>2.92</td>
</tr>
<tr>
<td>Buenos Aires (Argentina)</td>
<td>1.16</td>
<td>0.50</td>
</tr>
<tr>
<td>Canberra (Australia)</td>
<td>2.15</td>
<td>0.89</td>
</tr>
<tr>
<td>Copenhagen (Denmark)</td>
<td>7.77</td>
<td>3.47</td>
</tr>
<tr>
<td>London (United Kingdom)</td>
<td>4.83</td>
<td>2.53</td>
</tr>
<tr>
<td>Mexico City (Mexico)</td>
<td>2.03</td>
<td>1.92</td>
</tr>
<tr>
<td>Ottawa (Canada)</td>
<td>3.10</td>
<td>1.95</td>
</tr>
<tr>
<td>Paris (France)</td>
<td>4.62</td>
<td>2.63</td>
</tr>
<tr>
<td>Rome (Italy)</td>
<td>5.21</td>
<td>3.46</td>
</tr>
<tr>
<td>Stockholm (Sweden)</td>
<td>7.82</td>
<td>3.44</td>
</tr>
<tr>
<td>The Hague (Holland)</td>
<td>6.02</td>
<td>4.14</td>
</tr>
<tr>
<td>Tokyo (Japan)</td>
<td>16.47</td>
<td>7.41</td>
</tr>
<tr>
<td>Washington (U.S.A.)</td>
<td>2.80</td>
<td>2.13</td>
</tr>
</tbody>
</table>

* estimate

meat substitutes may never be important as a food in Australia, they will undoubtedly affect our livestock industries, particularly our export of lower grade meats.

To compete with meat substitutes we need to be fully informed about them. Failure to come to grips with the dangers will not make the problem disappear.

What are 'meat-like products'
A large range of products are used as substitutes for meat. Their origins are diverse, being of both animal and vegetable nature. Their common characteristic is that they are high in protein. These high protein substances have been described as synthetic meats, meat analogues, meat substitutes or meat extenders. They are made from single cell proteins, fungal proteins and textured vegetable proteins.

1. Single cell protein (S.C.P.)
A decade ago S.C.P. was considered to have a good future. However, technical problems have delayed progress despite expensive research.

To produce S.C.P., yeasts and other single cell micro-organisms are grown on a carbohydrate source such as sugar or starch (often a by-product of food processing) or on petroleum products (crude oil, natural gas or paraffin oil).

The organisms are grown in continuous fermentation tanks, regularly harvested, cleaned, purified and then dried. The product is very high in protein and is easily handled.

Current use of single cell protein is limited to high protein feedstuffs for animals. Human consumption is limited by:

- The difficulty of removing all traces of mineral oils from the micro organisms grown in petroleum products. These may be carcinogenic and may create other health problems.
- The high ratio of nucleic acids to proteins in single cell organisms causes a build up of uric acid in the body. This may produce gout and other problems.

2. Vegetable proteins
Vegetable proteins are usually extracted from crops high in natural protein, such as soy beans, field beans, peanuts, oil seeds, peas or lupins, although it is now possible to extract protein from common grass on a commercial scale.

The protein level of the extract depends on the degree of purification and this affects the price of the product. Vegetable proteins are likely to have the biggest immediate impact in the market place.

3. Textured vegetable protein (T.V.P.)
Vegetable proteins can be further treated to impart some of the characteristics of meat.

A purified vegetable protein (usually soy protein of 90 per cent purity) is dissolved in an alkali solution. The resulting solution is then treated in a similar fashion to synthetic textile fibres, and is extruded through fine pores. The fibres produced are coagulated, layered and after addition of fat, flavouring and colouring, are sold as meat substitutes.

4. Fungal proteins
Although the idea of eating a fungus instead of a steak may be difficult to swallow, we already eat several forms of fungi such as mushrooms and truffles.

A large British firm, Rank-Hovis-McDougall, has developed a process for using low cost carbohydrates to produce protein using a microfungus.

The carbohydrate can come from a variety of sources and may be a waste product of another industry. For instance, R.H.M. use the waste starch after protein has been extracted from field bean seeds.

The process is efficient and produces a protein low in nucleic acids and safe for human consumption. Moreover, its fibrous nature allows the material to be readily incorporated into 'chunks' of meat-like products.

Uses of meat substitutes
The various types of proteins produced can be used in four ways:

- By wholly substituting for fresh meat (meat analogues)
- By replacing meat in manufactured foods (meat substitutes)
- By complementing meat in manufactured foods, improving texture, palatability appearance and volume (meat extenders)
- By replacing fish meal, meat meal or dearer protein sources as protein supplements in animal feeds (feed proteins).

Present use of meat analogues
Most Australians are aware of the so-called synthetic steak, although few have tasted one. Basically, it is a slab of textured vegetable protein (T.V.P.) that has had fats, flavouring, colouring, emulsifying agents, salts, etc., added to it. This gives it a succulent meat-like texture and it substitutes for the traditional steak.

However, its costs are too high to seriously threaten meat. Its main use is for people who do not eat meat for health or religious reasons.

One success of T.V.P. in the United States is a ‘bacon’ from one of the pioneers of T.V.P., General Foods Corporation. Consumers are not particularly discerning at breakfast time, and the synthetic bacon is cheap (80 cents per kg compared to around $1.60 per kg for real bacon), easily cooked, high in protein, low in fats, and tasty.

Meat substitutes
T.V.P. is becoming important as a meat substitute in many manufactured foods. T.V.P. ‘hamburgers’, stews, minces, pies, pasties, and luncheon ‘meats’ are similar, if not identical to the ‘real’ meat product.

The science of food flavouring and texturing has reached such sophistication that it is now possible to
in the dry powder form, only a small amount needs to be added to the meat to give a large increase in the cooked volume.

Often, food manufacturers sell the prepared extender with a flavour included. All the caterer needs to do is mix the powder with the meat, add water, cook for a while and the result may be a savoury m"nce, a Hungarian goulash or Madras curry.

The protein extenders, which may be casein (milk protein) soy proteins, bean proteins or other vegetable proteins absorb and bind fats in cooked dishes, thus reducing shrinkage as well as increasing the emulsifying and stabilising properties of the preparation. In canned foods they are able to inhibit separation of fat and jelly which improves the appearance of the product when the can is opened.

In Europe and North America the addition of meat extenders to manufactured food has become standard. Until now, their use in Australia has been limited but a recent survey into the quality of sausages carried out by "Choice" magazine in the Eastern States detected meat extenders in a large proportion of the sausages analysed.

In fact "Choice" reprinted a recipe that is freely available to butchers for a sausage using a proprietary additive made from soy beans. The resulting sausage would analyse as lean meat but in fact contains no meat at all. Some pie manufacturers in Sydney are said to be substituting meat extenders for chicken.

An example illustrates the benefits of one extender that can be purchased in the U.K. for home use: 60 grams of this extender mixed with 480 grams of mince and water produce the equivalent of 960 grams of minced beef—twice as much! As the extra 480 grams of mince costs between 60 and 70 cents and the 60 grams of extender only 30 cents, the savings are considerable.

Feed proteins

Fluctuating prices of conventional stock feed proteins such as fish and soy bean meal have discouraged meat production in many countries. The producers of synthetic feed proteins, usually single cell protein, hope to provide a uniform low-priced substitute. This could lead to increased production of meat such as pork and chicken, particularly in Europe and Japan.

What share of the market have meatlike products captured?

The proportion of the total meat market captured by the synthetic meat-like products is small but significant.

The prosperity of Australia's livestock industries depends on exports and only about 7 per cent of the world's meat production is traded internationally. Thus if synthetics captured 2 per cent of the world's meat consumption, this would be equivalent to one third of the world's trade.

Moreover, the areas where synthetics are making the largest inroads are in Australia's traditional export markets, United States of America, Western Europe and Japan.

In 1973, the year of high beef prices, United States soybean 'meat' production was over 200 000 tonnes, nearly one third of its total beef imports. In Japan about 2 per cent of total meat consumption in 1973 was synthetic meat.

It has been estimated* for Europe that by 1980 at least 5 per cent of manufactured meat products would contain meat substitutes. This is a conservative estimate and nonmeat protein is being strongly advertised. The food-manufacturing journals are full of advertisements stressing the benefits of T.V.P. or meat extenders. Large multi-national firms are developing outlets, particularly in Europe, and the stage is being set for a large market struggle.

The potential of meat substitutes

Single cell protein is unlikely to be used much as a human food in the near future. The large companies involved in producing this protein—Shell, British Petroleum, General Electrics, etc.—are concentrating on animal feed production.

In 1974, the world production of dried S.C.P. was 318 000 tonnes and this should increase to over a million tonnes by 1977. Production of S.C.P. in Europe and Japan will reduce their imports of protein feeds