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ENERGY LEVELS for milk production

N. L. Jacobson

Although dairy cows are well equipped to use large quantities of roughage, roughage is not always the cheapest source of nutrients. Nor is it possible for high-producing cows to obtain enough energy from high-roughage rations to meet their needs. This has become more apparent in recent years when high-energy feeding and high production per cow have been emphasized.

The cow's stomach capacity limits the total amount of feed she can ingest; since roughages are more bulky than concentrates the high-producing cow cannot consume enough of them to obtain the energy she requires. Furthermore, in some areas, particularly in the Midwest, roughage sometimes is a more costly source of nutrients than concentrates. For example, the cost of a therm of net energy from alfalfa hay at $20 a ton is about the same as from shelled corn at $1.10 per bushel.

Under usual circumstances cows should receive at least 1 pound of hay daily, or its dry matter equivalent in silage, for each 100 pounds of body weight. Feeding much less than this may result in a marked reduction in the fat percentage of the milk. However, after this minimum roughage level is met, concentrates can be used to supply any proportion of the cow's remaining energy requirement.

If the dairy enterprise is to be efficient and profitable the feeding and management program must be designed for high production per cow. Too often, cows do not attain their maximum potential because they don't receive enough feed.

There is evidence that feeding standards for milk production do not provide sufficient energy to permit maximum production by potentially high producers. It appears that the TDN requirement per pound of 4-percent milk increases markedly as production level rises. This does not mean that the high producer is less efficient in the gross utilization of feed; maintenance requirements are a substantial proportion of any cow's total needs, and the lower the level of production the higher the portion used for maintenance.

Some cows will eat more than the recommended amount of feed if it is offered. And adjustments in managemental procedures, such as frequent feeding and the use of a variety of feeds, can sometimes achieve substantial increases in energy intake.

Two other ways in which energy consumption can be increased are to improve forage quality and to feed more grain.

Early cut forage is higher in both digestible protein and in TDN. Moreover, cows eat considerably more of the high-quality forage, as shown in table 1. When forage quality decreases and milk production rises, the proportion of concentrate in the ration should be increased.

Table 1. Influence of forage quality on estimated concentrates needed in high-energy rations for a 1,400-pound cow producing 60 pounds of 4.0 percent milk; hay fed free-choice.

	Stage of growth of the alfalfa			
	Vegetative	Bud	Bloom	Seed
Alfalfa hay (estimated pounds consumed)	42	35	28	21
Concentrates, pounds	12	20	28	33

In recent years a system of supplying more energy in late pregnancy and early lactation has gained favor. The procedure is essentially as follows:

Before calving: The amount of concentrates to feed depends on a cow's condition. In addition to high-quality roughage a cow in good condition needs only 4 to 6 pounds of concentrate daily at the beginning of her dry period, while a thin cow needs 8 to 10 pounds.

The level of concentrate feeding should be increased gradually toward the end of the dry period so that 12 to 18 pounds is fed immediately before calving. Some recommend levels as high as 26 pounds per cow per day.

After calving: On the day of calving feed the same as the day before. Thereafter, increase concentrate feeding as rapidly as good judgment indicates, usually at the rate of 1 to 2 pounds per day. *This must be adjusted to the individual animal.* Continue this increase as long as the cow's milk production increases.

When the cow ceases to respond with additional milk, continue to feed at the current level until milk production begins to decline. Then, for cows producing milk containing 4.5 percent fat or less, reduce the daily concentrate level 1 pound for each 3-pound drop in daily milk production. For cows producing milk testing higher than 4.5 percent, decrease concentrate 1 pound for each 2- to 2½-pound drop in daily milk production.

Some cows respond to the increased energy intake by producing more milk. Others respond only by gaining weight and should be culled. In some experi-

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ments wherein concentrates have been fed to appetite, cows sometimes have consumed exceedingly high levels without showing the expected response either in milk production or in weight gain. The reason is not clear, but this emphasizes the need for more information and for exercise of good judgment in the use of high-energy rations.

The protein content of the concentrate mixture must be adjusted to balance the kind and amounts of forages being fed. A series of concentrate mixtures suitable for use with different types of forage has been proposed by Van Horn and associates of Iowa State University.

The specific composition of the concentrate can be varied within wide limits as long as quality—especially palatability and levels of protein, energy, calcium, and phosphorus—is maintained. At present, urea is an economical ingredient of dairy feeds and should be given favorable consideration.

Availability and cost of various ingredients have a major influence on the composition of the concentrate. Moreover, the cost relationships among concentrate, roughage, and milk will influence the forage-concentrate ratio and the plane of nutrition.

Table 2. Twelve alternative concentrate mixtures to feed with different quality forages*

Ingredient	Digestible protein %	Total protein %	TDN %	Group A. Feed with high-protein forages				Group B. Feed with medium-protein forages				Group C. Feed with low-protein forages			
				1	2	3	4	5	6	7	8	9	10	11	12
Ground shelled corn	6.7	8.7	80.1	—	700	—	700	600	500	—	—	—	—	—	550
Corn and cob meal	5.4	7.4	73.2	980	—	880	—	—	—	780	730	480	630	680	—
Ground or rolled oats	9.4	12.0	70.1	—	280	—	—	280	280	—	—	—	—	—	—
Wheat bran	13.3	16.4	66.9	—	—	—	280	—	—	—	—	—	—	—	180
Soybean meal†	42.0	45.7	78.1	—	—	—	—	100	—	200	—	—	—	300	250
Cracked soybeans	33.7	37.9	87.6	—	—	100	—	—	—	—	250	—	350	—	—
32% supplement, est.	24.0	32.0	70.0	—	—	—	—	—	200	—	—	500	—	—	—
Dicalcium phosphate‡	—	—	—	10	10	10	10	10	10	10	10	10	10	10	10
Salt	—	—	—	10	10	10	10	10	10	10	10	10	10	10	10
Percent digestible protein in concentrate mixture				5.3	7.3	8.1	8.4	10.9	11.2	12.6	12.4	14.6	15.1	16.3	16.6
Percent total protein in concentrate mixture				7.3	9.5	10.3	10.7	13.2	14.1	14.9	14.9	19.6	17.9	18.7	19.2
Percent TDN in concentrate mixture				71.7	75.7	73.2	74.8	75.5	73.7	72.7	75.3	70.1	76.8	73.2	75.6

* If cows are limited to less forage than they will consume under a free-choice feeding program, follow the steps in balancing rations to determine the appropriate percentage protein to use in the concentrate mixture.

† Other high-protein supplements, such as cottonseed meal or linseed meal, can be substituted for soybean meal. Use 1.5 times as much linseed meal as soybean meal and 1.3 times as much cottonseed meal as soybean meal, substituting for corn the amount in excess of that originally used of soybean meal.

‡ Steamed bonemeal or defluorinated rock phosphate can be used in place of dicalcium phosphate.

EGG QUALITY PROBLEMS AND FEEDING

Lawrence R. Berg

Marketing of quality eggs is of prime importance to the poultry industry as it competes for its share of the consumer's food budget. Complaints about eggs are far too frequent. Many factors contribute.

Because of genetic differences, all birds do not produce eggs of the same quality. Physiological changes in hens associated with aging and with certain diseases result in declining egg quality. The environment in which both the hen and the egg is maintained also affect the quality of the egg.

Although nutrient factors which have been shown to affect egg quality and abnormalities are not numerous, knowledge of factors in feed formulation which may result in reduced egg quality is important to feed manufacturers.

Blood Spots

Genetic differences affect the incidence of blood spots in eggs. The incidence of blood spots increases as the laying year progresses. And management factors, such as cage housing, have been implicated as causes of increased blood spots.

Many attempts to associate nutrient levels and nutrient interrelationships with incidence of blood spots have been made. But the inability of various investigators to obtain similar results, or to repeat results in their own laboratories, indicates that many interacting factors influence blood spot formation.

Vitamin A

A 1960 study at Western Washington Experiment Station indicated that blood spot incidence in eggs will increase if the level of vitamin A in the ration is decreased below 1,100 U.S.P. units per pound. The effect is shown in the table (incidence refers to percent of eggs with blood spots of all sizes found in broken out eggs):

U.S.P. units vitamin A per lb. ration	1st Observation*	2nd Observation†
	%	%
553	39.6	35.5
758	22.7	30.5
816	22.4	26.8
962	19.2	23.7
1,198	20.3	22.1
1,579	16.1	15.2

* After 103 days on rations—2 days' eggs.
† After 145 days on rations—4 days' eggs.

These investigators further concluded that levels of vitamin A in the range of 1,200 to 1,600 units per pound resulted in minimum blood spot incidence. Other research generally substantiates these findings.

Vitamin K

Since vitamin K is necessary for normal blood clotting, and its absence has been associated with hemorrhaging, numerous studies have been made to determine its role in blood spotting.

As early as 1947, researchers reported that additional vitamin K in a laying ration had no effect in reducing blood spots. However, in 1961 a commercial firm reported a field trial in which the addition of 4 grams of vitamin K per ton of feed resulted in a marked drop in blood spot incidence.

Later, others reported that addition of up to 8 grams of vitamin K to a ton of vitamin K-deficient feed had no effect on blood spot incidence. Furthermore, birds producing a high incidence of blood spot eggs had normal prothrombin times.

More recent evidence from the Western Washington Experiment Station shows that even higher levels of vitamin K (20 grams per ton) will not reduce blood spot incidence:

Level of vitamin K, grams per ton	Percent blood spot eggs
0	29.1
20	38.0

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This study was conducted with a strain of birds developed for high blood spot incidence. Recent research suggests that levels of vitamin K above 4 grams per ton may actually cause an increase in blood spots.

Protein

Results of studies relative to protein levels and sources as factors in blood spot incidence have not been conclusive. Data from several experiments show increasing blood spots with increasing protein levels. However, it has not been true in every test, and no response at all has been observed in some cases.

Recent observations at Western Washington State Experiment Station showed that birds fed diets made with soybean meal produced more blood spots than birds fed diets containing herring fish meal as the main source of protein. Furthermore, increasing the protein level of the soybean diet from 15 to 19 percent resulted in increased blood spots, but no such protein level effect was observed with the fish meal diet:

Source of protein	Percent protein	Percent blood spots
Soybean meal	15	9.8
	19	12.1
Herring fish meal	15	7.4
	19	8.0

Further studies have not confirmed these results. Data from a study comparing four different sources of supplemental protein are shown below:

Source of protein	Percent blood spots	Percent change from index period
Herring fish meal	40.4	7.6
Soybean meal	36.0	1.0
Meat meal	37.3	4.3
Casein	36.0	5.2

Alfalfa or Greens

Different feeding studies have compared incidence of blood spots among laying birds fed fresh greens, fresh alfalfa, and dehydrated alfalfa. But the results of these trials offer no consistent evidence that these supplements either reduce or increase the incidence of blood spots.

Albumen Quality

Few nutritional factors have been shown to affect albumen quality. Several researchers have found sources and levels of energy and protein to have essentially no effect.

Others found no effect on albumen quality from the addition of sodium silicate, sodium chloride, magnesium oxide, or potassium carbonate to the diet. A slight depression in Haugh units has been observed when 3-nitro, 4 hydroxyphenylaaisonic acid was added to the diet.

Marked improvement in albumen quality has been observed when either ammonium chloride or hydrochloric acid was added to the diet.

Until recently, poor albumen quality has been considered to be primarily the result of (1) length of time in lay, (2) environment in which the egg was kept, (3) genetic inability of a bird to produce an egg with good albumen quality, or (4) the after effect of certain respiratory diseases. Feed has generally not been implicated in poor albumen quality.

Some of our recent studies indicate that feed may be implicated. In routine government ordering of feed grade tricalcium phosphate, a sample that caused growth depression in chicks was obtained. The causative factor was determined to be excessive vanadium in the phosphorus supplement.

Upon testing the phosphorus supplement with laying hens, a marked decrease in albumen quality resulted in a short time when rations containing this supplement were fed.

FEATHER MEAL IN POULTRY FEEDS

Edward C. Naber

When feather meal that had been processed by cooking under steam pressure was first proposed as a feed component in 1950, little interest was shown because of the long-standing knowledge that the keratin proteins are poorly soluble and highly indigestible.

But since 1955 several researchers have shown that feather protein processed by wet cooking under steam pressure can be utilized to some degree for chick growth. Their studies indicate that feathers can serve as a source of dietary protein, certain vitamins, and unidentified growth factors. However, the degree to which feather meal protein can be utilized by the chick has remained somewhat in doubt.

The true nutritive potential of feather meal has been difficult to determine because feathers from poultry slaughter plants often undergo fermentation prior to processing and are contaminated with blood and offal. There also is a problem of amino acid supplementation, because feather protein is deficient in histidine, lysine, tryptophan, and methionine.

A summary of research findings to date indicates that:

Feather meal that has been properly processed to yield 70 to 80 percent pepsin digestible protein can be used to supply one-fourth of the total protein content in chick feeding rations when corn and soybean meal supply the remaining protein. Under these conditions researchers have noted excellent chick growth, and dietary nitrogen utilization was not impaired.

When feather meal has been used to supply one-third or more of the total dietary protein, amino acid deficiency problems have been encountered. Where corn, soybean meal, and feather meal each contributed one-third of the total protein, lysine and methionine supplementation was required for maximum growth rate.

When one-half or more of the protein was contributed by feather meal, amino acid problems extended to tryptophan, histidine, and perhaps other amino acids.

Small amounts of feather meal are commonly used in feed formulation. At the levels commonly used—1 to 4 percent of the complete ration—good feather meal does not adversely affect performance. At the same time, the use of small amounts of feather meal in commercial formulas permits the nutritionist flexibility in adjusting protein levels when other formula changes are to be made.

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A test was then conducted to determine if adding vanadium (through ammonium meta vanadate) to a practical low vanadium ration would affect albumen quality:

P.p.m. vanadium added	Haugh units on Dec. 3*	Haugh units on Dec. 27
0	80.5	80.0
20	79.5	73.5
40	73.0	68.0
60	72.5	65.0

* Five days on vanadium at this observation.

Vanadium caused a marked depression in albumen quality as expressed by Haugh units. Thus it is important that the feed manufacturer be concerned about the vanadium content of the feed ingredients he uses.

Yolk Color

Egg yolk color is controlled by diet. Until a few years ago feed formulation was directed to the production of light- or medium-colored egg yolks because dark yolks caused dark yolk shadows when eggs were candled, with the resulting downgrading of eggs. Today many flocks are fed to produce yolks of a specific color for a specific use, such as dark-colored yolks for the salad dressing industry.

Undesirable yolk color can result from certain feed formulations. Research has shown that high levels of vitamin A will cause decreased yolk pigmentation, with some evidence that continued feeding of over 100,000 I. U. per pound of feed for an extended period may result in some yolks that may be classified as so-called "platinum yolks."

Cottonseed meal has long been implicated as causing olive-green yolks in fresh and stored eggs, and in salmon pink whites in stored eggs.

Gossypol is the factor in cottonseed responsible for olive-green to nearly black discoloration. The fact that a stored egg yolk tends to become more alkaline accounts for the increase in olive-green yolks after periods of storage.

Another component in cottonseed causes an abnormal enlargement of the yolk and a reddish brown color of the yolk and albumen when eggs are stored. Pink discoloration resulting from feeding cottonseed meals is caused by the oil remaining in the meal.

Yolk Mottling

Most cases of yolk mottling can be traced to improper handling of eggs with respect to temperature and humidity. However, when nicarbazin was made available as a coccidiostat for growing chicks, a certain amount found its way into the feed for layers. Among this drug's undesirable effects on laying hens was the resulting increase in numbers of eggs with mottled yolks.

Other chemicals known to cause yolk mottling are the antioxidants gallic acid and n-propyl gallate, and also tannic acid.

WHAT WE'VE LEARNED ABOUT DAIRY BEEF

Edward C. Frederick

Dairy steers are gaining popularity as beef animals. Factors behind this trend include the increase in artificial insemination, resulting in more male animals available for feeding, and the trend to larger dairy herds with more male calves per dairy unit available for meat production.

Holstein steers have outgained beef steers in feeding trials conducted so far. In one trial, Holstein steers gained 2.45 pounds per day, whereas Hereford and Shorthorn steers gained 2.22 and 2.05 pounds per day, respectively.

A summary of research at Minnesota and at other states indicates that:

1. Holstein bulls gain faster than Holstein steers and Holstein steers gain faster than beef steers.
2. Steers with stilbestrol gain as fast as bulls and significantly faster than steers without stilbestrol.
3. Holstein steers can be fed a ration with a concentrate to roughage ratio of 1:1 without lowering gains.
4. There is no advantage in using cobalt bullets on yearling Holstein steers grazing grass-legume pastures with access to trace mineralized salt.
5. Holstein steers grazing productive pastures can average 2.92 pounds daily gain and produce 456 pounds of beef per acre.
6. Holstein bulls are more efficient than Holstein steers in converting feed into body gains while Holstein steers are slightly less efficient than steers of some beef breeds.
7. Holstein bulls can be handled together in feedlots and small animals can be introduced into a lot with larger ones without any serious problems.
8. Holstein bulls show a greater lean meat yield, however, less marbling, fat cover, and a lower USDA grade than Holstein steers while Holstein steers show similar carcass advantages and disadvantages as compared to beef steers.
9. Holstein steers and bulls can be profitably fed for meat production with no advantage of one over the other in net profit.
10. Information concerning the feeding of dairy steers and bulls for meat production is limited. Further research will help determine the type of feeding program that will yield maximum profits and at the same time result in an end product highly acceptable to the consumer.

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Calendar of Institute of Agriculture Short Courses

November 17-19 Minnesota Institute for Town and Country Churches

November 23-24 Soils and Fertilizer Short Course, Leamington Hotel, Minneapolis

November 14-19 DHIA Supervisors' Training School

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Dollars and Sense in Swine Automation

Kenneth H. Thomas

Many swine growers are expanding their hog operation as one possibility of coping with the cost-price squeeze. But it takes careful planning to expand without working longer hours or becoming deeply in debt.

From 80 to 90 percent of Minnesota's hog producers still raise less than 200 hogs per year. Labor used by swine producers during the past 20 years declined only 27 percent per 100 pounds of pork whereas labor required to produce 100 bushels of corn decreased 84 percent.

But should all hog operations be expanded? And mechanized? Before he expands his operation, a hog producer should be able to answer three questions:

1. Am I ready for an intensive, automated swine production system?
2. Which system will make the best use of my limited resources?
3. What volume should I produce and how fast should I attempt to develop it?

In some cases, volume can be expanded with the present system. Fuller utilization of existing facilities and improved work routines may produce adequate incomes within the limits of the existing operation. Other farm buildings may be adapted to hog raising with minimum remodeling, too. And one certainly wouldn't expand the hog enterprise if he had a better chance for profit in some other area.

Once he decides to expand, a hog producer should look over several systems. He must then decide which production system will make the best use of his limited resource—labor or capital. For each system, he might ask:

1. How much labor will be saved by the investment?

2. How much will the system increase production rates or improve production efficiencies?

3. Will the investment add to the comfort of the operator and ease the labor and managing tasks?

4. How flexible is the system? Can it be modified and used in other systems of farming?

5. How much will the new investment add to the value of the farm if it is sold?

Cost of the production system must be examined in at least three ways—total investment, yearly repayment required, and annual use cost. When capital is limiting, return on investment and repayment requirements are of prime concern.

A producer must determine, as accurately as possible, the expected annual earnings from the investment, and the effect of the projected size of investment on the financial soundness of the total business.

To determine the expected annual earnings, he figures the expected gross income and the expected operating expenses, including the value of family labor. Subtracting the expenses gives the residual return. The percent return on investment is found by dividing the original investment into the residual return. Comparison of percent return on investment figures will show which system is most profitable.

The effect on net worth-liability ratio must be considered. Traditionally, a maximum debt of $1 for each $1 of net worth is considered safe.

Next, the amount available for debt retirement is determined. To the residual return determined above, value of family labor used is added. Then the average annual interest payment is subtracted from this amount. The remainder is the amount available for debt retirement. Dividing this amount into the total loan shows the number of years needed to repay this loan. Next move is to check the repayment schedule outlined by the lender to see if it can be met.

Finally, annual use cost is of major concern to the farmer interested in saving labor. This cost includes de-

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FEEDING SYSTEMS: Their impact on swine production

H. B. Geurin

The development of hog feeding systems has been affected by three main factors: the mechanization trend, the question of pasture versus confinement, and the question of limit versus full feeding.

The following statements summarize much of the research data that have been gathered:

1. Scooping ear corn out on the ground for hogs, as a feeding system, limits the profit potential as compared to feeding a complete well-balanced ration.

2. Feeding high-moisture corn to hogs has a basic disadvantage in that it requires more feed on a dry matter basis per hundred pounds of gain as compared to regular dry corn.

3. Feeding hogs a complete ground and mixed ration enables them to gain about 11 percent faster on 4½ percent less feed per pound of gain than hogs fed free choice when the supplement is well balanced and the ration is ground and mixed properly.

4. Hogs fed present day rations in confinement will gain faster in drylot, and pasture saves so little feed that good farm managers turn to other avenues of utilizing pasture on the farms.

5. Based on cost accounting evaluations, limit feeding of hogs, requiring hogs to stand on their hind legs to eat, or adding high-fiber components in the ration of finishing hogs usually reduces profits.

6. Liquid or slop feeding of hogs has little effect other than to generally result in hogs being limit fed, and results are changed accordingly.

Present evidence indicates that the greatest profitability from hogs comes from full feeding a well-balanced, complete mixed ration to hogs during the growing-finishing period.

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preciation, interest, repairs, taxes, and insurance. On buildings, this usually amounts to 10 percent of the new investment cost, on equipment 15 to 20 percent.

By dividing the per hour value of labor into the annual use cost, you get the number of hours of labor the new investment will have to save each year in order to justify it. If expected labor savings are more than the hours of labor that are needed to cover the annual use cost, the system will more than pay its way.

How large should the system be? Look at three factors—managerial ability, financial position, and relative profitability of other enterprises. Size is most often limited by managerial ability.

Under present day technology, successfully managed herds with more than 100 sows are quite rare. Most economies of scale are realized with herds of 30 to 60 sows.

Debt carrying capacity and the competitive relationships of other enterprises will also determine the size of a hog operation. Certainly, no hog operation should be expanded beyond the point where it cannot compete with other enterprises.

Finally, the transition from the present hog system to the new is often the key to success or failure. Production plans should be made showing the annual balance between crop and livestock programs, the rates at which shifts will be made, and the change in purchased inputs. Financial plans should show expected annual change in production expenses, income, debt repayment, and the balance that will likely exist between income and expenditures.

HOUSING SYSTEMS: Their impact on swine production

J. A. Hoefer

Great changes in swine housing are having a terrific impact on the swine industry. These changes are a part of the evolution from one- and two-litter production systems using a maximum amount of pasture, to the multiple-farrowing year-round production systems—many using total confinement.

These technological changes in housing are possible as a result of advances in swine nutrition that eliminated the need for pasture in swine rations. I see these general effects on the industry, qualified by some give and take, as individuals retreat from initial overly enthusiastic efforts unsupported by enough know-how and managerial ability, to systems they can handle:

1. Size of operation will increase; this will be accompanied by multiple farrowing and increased specialization.

2. Production cycles will tend to level out as a result of loss of flexibility and need to use facilities at capacity to protect heavy investments.

3. Production costs will not be lowered significantly, but one man will be able to care for many more hogs.

4. Managerial requirements will increase greatly as hog farms become larger and fewer in number.

5. Controlled and individual feeding will increase, particularly with the breeding herd. There will be more restricted feeding—to some level of limitation—with finishing hogs, not always because of improved performance, but because controlled feeding will be possible.

6. Consumers may benefit from a more uniform supply of pork of possibly higher quality.

7. The 25- to 50-sow operator on the diversified farm, because of certain inherent advantages in his operation, will still be very competitive. He will not be put out of business by the large specialized operations.

8. Heavy capital investments in housing and equipment will substitute for labor, will make labor's job easier and more pleasant, and will free the operator for management but will not replace or substitute for management.

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