・招待講演・

ON THE SUPPLY OF FOOD TO FARM HOUSEHOLDS IN THE FEDERAL REPUBLIC OF GERMANY

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The following data are based on nutrition surveys of small farms in Western Germany. Almost 90% of Western German farms are smaller than 40 acre or 16 ha LN-farming area. None of the surveyed families had more. It can be assumed that the unsatisfactory economic, social, and cultural situation of these families affects their nutrition accordingly.

Among all farm types, families with small farm in areas have the greatest difficulties to obtain sufficient nutrition. This is mainly due to the manner of food consumption—larger farms have a great production of their own and also buy more foodstuffs. In many cases, we find a surplus of nutrients among them.

Our findings in small farms are not as depressing as similar reports by Medici of Italy, who speaks of malnutrition as one of the most impressive pathological signs of small farms. But with some reservations we can agree with that statement. Moreover, the Italian agricultural economist emphasizes the frequency of typical deficiency diseases, such as Beri beri, Pellagra, and Scurvy which we have not been able to find in any of our 400 families surveyed.

[Slide 1] shows the regions, there are 41 different rural countries of the Federal Republic of Germany, where nutritional status has been determined. The surveys cover periods of 30 days during the vegetation period. By that we wanted to find out how energy output caused by heavy physical activity compares with energy intake through foodstuff consumption.

In earlier experiments, we were able to get results concerning physiology of agricultural, forestry, and household work by measuring energy metabolism and pulse rate.

In order to evaluate the respective work-physiological and nutritional data, we had to arrange

the subjects systematically according to sex, age, body weight, body height, and physical activity or predominating work. Accordingly, we formed groups by age and physical activity. For the calculation of the nutrient requirements, we based ourselves on the recommendations of the German Nutrition Society as well as on basal metabolism calories. These tables neither give the minimum requirements nor optimum food supplies. They merely recommended desirable food consumption. It is general experience that healthy persons who consume the recommended amounts of food maintain a good nutritional status and do not develop deficiency signs.

The daily calorie requirement is demonstrated in [slide 2.] The factor 1,1344 is calculated of 6 % of the whole calorie consumption for the specific dynamic action and likewise 6 % for the diminished resorption; BM=Basal metabolism, FM=Freetime metabolism and WM=Work metabolism. Calculated of the food intake indicates whether the requirements for essential nutrients are correct. Our data refer to the main nutrients, such as protein (including animal protein), fat, carbohydrates, the minerals calcium, phosphorus, and iron, as well as vitamins A, B₁, B₂, niacin (PP), and C. Mean daily intakes per head shows [slide 3] calories 3420, protein 92 gm., 53 gm. of which of animal origin, fat 144gm., carbohydrates 405gm., calcium 1.1gm., phosphorus 1.9gm., iron 18mg., ascorphthol 5530 I. U., thiamin 1.9mg., riboflavine 2.1 mg., niacin 18 mg., and ascorbic acid 92 mg.

Fig. 2

DAILY CALORIE REQUIREMNT	
$= \frac{1.1344}{1} (BM + FM + WM)$	
BM =	BASAL METABOLISM
FM =	FREETIME METABOLISM
WM =	WORK METABOLISM

**FORMULA FOR CALCULATE DAILY
CALORIE REQUIREMENT**

Fig. 3

		Nährstoffgehalt nach Verbrauch	Nährstoffaufnahme nach Verzehr
Kalorien		3700	3420
Eiweiss	(g)	101	92
davon tierisch	(g)	57	53
Fett	(g)	153	144
Kohlenhydrate	(g)	445	405
Calcium	(g)	1.2	1.1
Phosphor	(g)	2.0	1.9
Eisen	(mg)	20	18
Vitamin A	(I.E.)	5930	5530
Vitamin B ₁	(mg)	2.1	1.9
Vitamin B ₂	(mg)	2.3	2.1
Vitamin Niacin	(mg)	20	18
Vitamin C	(mg)	105	92
Nährstoffaufnahme im Mittel aller Haushalte			

During the survey, every family was personally visited in order to assess individual characteristics necessary for grouping of the subjects and exact calculation of food consumption.

In rural families, there is furthermore the problem of how to separate foodstuffs consumed by humans and by animals. In cases where animals regularly received leftovers of human foodstuffs, this was considered in the calculation. In cases where leftover foodstuffs were fed only irregularly and also not always to the same animals, we had to rely on personal judgment. Beyond that, 10 %

of the calculated values were deducted for wastage.

The evaluation of the data showed great differences, as demonstrated in [slide 4.] The highest caloric intake was found in the district of Freiburg, that is to say 4,170 calories. Households in the district of Künzelsau are approximately 1,500 calories lower. The protein calories are between 9.8 and 12.3%, in most cases between 11 and 12%. The fat calories are between 32 and 52%.

These values do not indicate the requirements covered by individual families. The total protein

Fig. 4
Nächster und niedrigster
Nährstoffverbrauch
Kopf / Tag

Nährstoffe		Höchster Verbrauch Menge	Bezirk	Niedrigster Verbrauch Menge	Bezirk
Eiweis insges	g	109	Meppen	74	Bad Aibling
tiersch	g	60	Freiburg	41	Villingen
Eett	g	230	Freiburg	104	Künzelsau
Kohlenhydrate	g	490	Schleiden	330	Osterode
Calorien	kcal	4170	Freiburg	2710	Künzelsau
Calcium	g	1,5	Olpe	0.8	Alzey
Phosphor	g	2,3	Weissenburg	1.5	Künzelsau
Eisen	mg	21	Springe	14	Regen
Vitamin A	IE	8220	Alzey	3380	Künzelsau
Vitamin B ₁	mg	2.7	Meppen	1.4	Künzelsau
Vitamin B ₂	mg	2.6	Mindelheim	1.6	Villingen
Vitamin Niacin	mg	23	Schleiden	12	Regen
Vitamin C	mg	185	Schleiden	40	Künzelsau

Fig. 5
Höchster und niedrigster
Nahrungsmittelverbrauch
g / Kopf / Tag

Nahrungsmittel	Höchster Verbrauch Menge	Bezirk	Niedrigster Verbrauch Menge	Bezirk
Getreideerzeugnisse(1)	445	Passau	222	Tecklenburg
Kartoffeln	816	Schleiden	90	Bad Aibling
Zucker	106	Straubing	41	Aschaffenburg
Gemüse	264	Ebersberg	84	Künzelsau
Obst	379	Ebersberg	69	Marktheidenfeld
Fleisch	218	Eichstätt	60	Kötzting
Rindfleisch	59	Freiburg	5	Kötzting
Schweinefleisch	176	Amberg	32	Kötzting
Milch	1045	Olpe	294	Alzey
Käse	42	Wunsiedel	4	Ebersberg
Eier, Stück	1.3	Münsingen	0.3	Meppen
Nahrungsfette (2)	152	Freiburg	45	Künzelsau
Butter (3)	69	Olpe	11	Marktheidenfeld
Margarine (3)	41	Freiburg	1	Regen
Fisch	27	Springe	-	Marktheidenfeld Amberg

1) Mehlwert
2) Reinfett
3) Produktgewicht

Fig. 6
Von 360 bäuerlichen Haushalten
liegen unter 80 v. H. der
wünschenswerten Höhe
der Nährstoffzufuhr
bei :

	Anzahl	%
Thiamin (B ₁)	83	23
Ascorbinsäure (C)	75	21
Calcium	48	13
Eiweiß	44	12
Axerophthol (A)	38	11
Riboflavin (B ₂)	21	6
Phosphor	14	4
Niacin	11	3

supply seems inadequate in many cases, as does also in some cases the supply of animal protein.. Fat intake, on the other hand, frequently exceeds the desirable amount. Among the minerals, the majority of the deficiencies are found with calcium. More than 20% of all families do not reach the recommended 1 gram per adult, per day. This seems surprising, since self-produced foodstuffs such as milk and cheese, and in addition several plant products are rich in calcium. These products are apparently not eaten in an amount adequate for an agricultural household living on mixed food; not whereas the requirements of phosphorous and iron are covered in nearly all households.

[Slide 5] shows the highest and the lowest consumption of important foodstuffs as averaged in the different counties in Passau; for instance, twice the amount of cereals is consumed as in Tecklenburg in Westfalia. The consumption of potatoes in Bad Aibling is only 1/9 of the one in Schleiden. In Straubing, the amount of sugar consumed is 2 and a half times as high as in Aschaffenburg. In Ebersberg, the consumption of vegetables is 3 times as high as in Künzelsau, and for it consumption is 5 times as high as in Marktheidenfeld. The highest amount of meat is consumed in the district of Eichstätt, the lowest amount in the economically badly situated district of Kötzing. The households in Olpe shows the highest, the wine-growing farmers in Alzey the lowest intake of milk. The consumption of fat in Ereiburg is more than 3 times as high as in Künzelsau. In Freiburg, we find the highest intake in margarine, whereas almost no margarine is consumed in Regen. Fish consumption is highest in Springe, but almost no fish is consumed by the families in Marktheidenfeld and Amberg.

Nutrients supply is shown in [slide 6] from family to family. We found an insufficient supply of thiamin, vitamin C, calcium, protein, vitamin A, riboflavine and phosphorus. In 23% of the households, the requirements of vitamin B₁, in 21% by vitamin C, in 13% by calcium, in 12% by protein, in 11 % by vitamin A, and so on are not covered. Many families almost never drink milk. Moreover, we find 6% uncovered requirements of riboflavin, 4% of phosphorus.

Main nutritious matters:

Protein: The desired amount of protein supply equals to 93 gm. per capita and day. On an average of all households it amounts to 92.1 gm.=99%. In spite of this result, 44, or 12% of all the households show less than 80% attained. The smallest amount was attained by a household with 56% of the Nominal Consumption. But, 41½ households have been by 20% and more in excess of the nominal consumption. The desired amount of animal protein (approximately 42 gm.) is by far exceeded and amounts to 53.1 gm., or nearly 127% of the nominal consumption. From this it can be concluded that the households cover their protein required in the first line from animal products.

For 18 households, the protein supply of which was less than 80% of nominal consumption, the evaluation was extended to the contents of essential amino acids. Beside a "minimum required", a desired intake termed, due to studies of ROSE and ROSE et al., as "definitely safe intake" is indicated. With this, it is meant the double amount of "minimum required" of all essential amino acids. All of said 18 households cover an amount exceeding the desired intake of valine, leucine, isoleucine, threonine, phenylalanine, lysin, tryptophane. But none of them was able to take in, with the food, the desired amount of methionine. Methionine is always the limiting amino acid. However, the methionine requirement can be largely covered, i.e. up to 80%, by cystine. Same with phenylalanine which can be substituted up to approximately 70% by tyrosine

The lowest intake amount to 2.8 gm. for valine; 4 gm. for leucin; 2.6 gm. for isoleucin; 1.9 gm. for threonine 1.0 gm. for methionine; 2.6 gm. for phenylalanine; 2.6 gm. for lysin; and 0.7 gm. for tryptophane. All aforementioned minima are found in a household, which so can be said to be the one with the poorest supply of essential amino acids.

Fat : When following the DGE recommendations, a desired fat intake amounting to 99 gm. should be calculated as an average for all households. However, the average consumption amounts to nearly 144 gm., that means, approximately 146% are actually covered. You can also conclude from the high portion of fat calories which amounts to approximately 40% of the total amount of calories, that the nominal intake is largely exceeded.

With most of the households it is more than 100% of Nominal consumption. Less than 10% of the households indicate less than 100% of nominal fat consumption. One of them covers just 61 % of the nominal figure. Beside it, there are 5 more households which cover less than 80%. 27 households cover more than 200% of the desired fat intake.

Calcium : The overall average Ca-intake of the households amounts to 111%. Below 100% of nominal consumption are 140 households, below 80% 48 households. However, 52 households cover more than 150% of the desired intake.

Phosphorus : Phosphate intake amounts, on an average to 126 % of nominal consumption. Just for the working man, sufficient supply with phosphoric acids is of high importance. With fat reduction, with the citric acid cycle as well as with the phosphorylation of the respiratory cycle, strong phosphoric acid combinations grow, the energy of which is used for muscle contraction and various syntheses. —14 households cover less than 80% of the desired intake. The poorest supply was stated with two families; it amounted to 68%. On the other side, 70 households cover more than 150% of the desired intake. The amount of phosphate required is mostly calculated according to the Ca-intake. The DGE recommendations say, the ratio Ca : P should be equal to between 1 : 1 and 1 : 2. The average found with our panel amounts to 1 : 1.6, with a dispersion of from 1 : 1.2 up to 1 : 2.1. In 1961, the ratio in the Federal Republic of Germany was as high as 1 : 1.9 according to the "indirect food consumption".

Iron : Since a small portion of the iron taken in with the food, is resorbed only, —LANG—, a high daily iron intake is generally recommended. For farm households, a daily per capita nominal consumption amounting to 12 mg. is given. The evaluation showed for our panel an average amounting to no less than 150% of such nominal consumption. 16 households cover less than 100%, 2 households less than 80%. The poorest figure was shown with a household which covered 65% only. On the other hand, 25 households covered more than 200%.

Axerophthol (vitamin A) : The different resorption of pure vitamin A particularly of carotene, gives rise to recommend for this nutritious matter an extra of some importance too, to make matters sure. On an average, the nominal intake amounting to 4530 I.U. is exceeded by 1000 I.U. i.e. by 22 %. The intake is scattering, with the individual households, from 39% up to 368% of the desired amount. 38 households cover less than 80%, 20 households more than 200%.

Thiamine (vitamin B₁) : Thiamine supply is covered, with 1.9 mg. on an average, by approximately 100% (99.9). The average is satisfying. But a great deal of the households does not cover the nominal figure of 1.9 mg. This applies to 204 households. One of them covers no more than 48 %. 83 households cover less than 80 %. 18 households cover more than 150% of the nominal value. After another methods, as demonstrated in [slide 7] at first in relation to the nonfat-calorie supply, and then in mcg per nonfat-calorie supply, we find out, that every times the most families don't reach the satisfactory supply of thiamine. The insufficient supply is not a result of the method than of the consumption habits of foodstuffs.

Riboflavine (vitamin B₂) : The average riboflavine intake amounts to 123 % of the nominal supply. However, a fourth part of all the households does not cover the nominal intake. A household covers just 49% 21 households cover less than 80%. Maximum intake amounts to 229%.

Fig. 7 Aufnahme an Thiamin und Nichtfettcalorien (83 Haushalte) in γ je Nichtfettcalorie

Fig. 8

Fig. 9

ALTER UND ARBEITSUMSATZ
AGE AND WORK METABOLISM

Niacin (nicotinamide) : Up to a certain extent, the amino-cdi tryptophane is transformed, with man, into niacin, this way covering part of man's niacin requirement. This way, tryptophane can be considered as a provitamin of niacin. Therefore, when recommending any niacin intake, reference is made to the tryptophane contents of the respective food. According to the studies of GOLDSMITH et al., as well as of HORWITT et al., on an average, 55 up to

60 mg. (with a dispersion of from 33 up to 86 mg) of tryptophane are equal to 1 mg Niacin. In our evaluation, tryptophane intake was not evaluated. 41 households do not cover the nominal intake. The poorest intake, of one household, amounts to 68 %. 21 households cover 200% and more.

Ascorbic acid (vitamin C) : Previously, scurvy was one of the most wide-spread diseases due to defective nourishment. At the present time, lack of vitamin C supply results in gum inflammation,

delayed healing of wounds and fractures of bone, reduced resistance to infections, quick fatigue, as well as other symptoms difficult to be objectivated. The DGE, and the Food and Nutrition Board, National Research Council, USA, recommend a daily dose of 75 mg for the grown-up. For our panel the nominal intake amounts to 73 mg. On an average, 92 mg are attained, i. e. 126 % of the desired intake. 75 households cover less than 80%, 102 more than 150%.

Furthermore, we looked for a correlation of calorie output and sex and age of the agricultural people. In [slide 8] is demonstrated the average

calorie output by different groups of age of men and women. For both sexes, it shows the highest calorie output for the groups between 20—39 years, followed by 40—56 years. Over 60 years it shows a strong decreasing tendency. [Slide 9] demonstrates the development between age and work metabolism of the rural population in Germany. It shows, that sometimes people of 75 years and older must do hard work. Moreover, it shows, that the female sex in this age has nearly the same energy output than male. [Slide 10] shows, that elderly agricultural people with increasing body weight has much less working calories.

Fig 10

The monotony in the consumption of foodstuffs seems to be the most striking characteristic of the nutrition of the surveyed families. This fact should perhaps be considered more appalling than that of the insufficiently covered recommended allowances.

I hope that the data presented will give an adequate picture of the situation and may contribute to a better knowledge of the economical and sociological situation of small farm households in Western Germany

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(抄訳は次頁に)

<抄 訳>

西独農家の食物摂取について

西独農家の耕地面積は、その90%までが40エーカー以下である。これら小農における労働と食物摂取とのエネルギー収納の関係を知るために、41地区 400 世帯を対象として、農繁期の30日間にわたる栄養調査を施行した。

一般に、耕地面積の少い農家は、栄養摂取には苦勞しているが、西独農家では、イタリアに多発しているという脚気、ペラグラ、壊血病などの栄養欠乏性疾患は、全くみあたらなかった。

調査成績を正確に評価するために、対象を農業の種類、性、年齢、体重、身長によって分類し、さらに必要栄養量をドイツ栄養協会の勧告と基礎代謝率を考慮して計算し検討することにした。

その結果、1人1日当りの平均栄養摂取量は表3のごとくであるが、摂取食品の種類とともに地域的にひじょうに大きな差がみとめられた(表4)。これらの数値を検討してみると、なお一部の農家では、蛋白質総量および動物性蛋白質の摂取が不足していること、ほとんどの農家で脂肪摂取量が過剰の傾向があること、ミネラルのうちカルシウムが不足がち、ビタミンのうちB₁、B₂、C、Aが十分でない農家がかかなりあること等が指蔽された。さらに個々の主要な栄養素について、検討してみると次のごとくであった。

蛋白質：全農家の平均摂取量は1人1日92.1gで、基準量(93g)の99%にあたり、44世帯の農家が基準量の80%に達しないことがわかった。動物性蛋白質は平均53.1gで基準量(42g)をかなり上まわった。そこで、蛋白質摂取量が基準量の80%にみたない農家18戸について、必須アミノ酸量を分析した結果、Valine, leucine, isoleucine, threonine, phenylalanine, lysine, tryptophaneは基準量を超えていたが、methionineの摂取が不十分であった。

脂肪：基準量が99gであるのに対して、実さいの摂取量は、平均144g(146%)で、全熱量の40%を占め、大

幅な超過であった。

カルシウム：摂取量の平均が基準量の110%であったが、基準量以下の農家が340世帯中140世帯もあった。

リン：労働者においては、筋代謝上からみてもその十分な摂取が必要があるが、摂取量の平均は基準量の126%で、基準量の80%以下は14戸であった。

鉄：食物中の鉄分のうち吸収されるのは、ごく一部であるから、かなり多量に摂取する必要があるといわれる。摂取量の平均は基準量の150%で、不足は16世帯(80%以下2世帯)であった。

ビタミン：基準量は4,530 I. U. であるが摂取量の平均は122%であった。しかし80%に達しない世帯が38世帯もあった。

ビタミンB₁：摂取量の平均値は1.9mgで、ほぼ基準量(99.9%)であったが、204世帯が基準量に達しなかった。非脂肪性熱量摂取の問題を考えると、まだ大多数の世帯では摂取不十分で(表7)、その是正には食習慣の改善が必要と考えられた。

ビタミンB₂：摂取量の平均は基準量の123%を占めたが、基準に達しない世帯が1/4あった。

Niacin : Tryptophane がその Provitamine と考えられるので、その摂取量も同時に考慮すべきである。考慮しない成績では、41世帯が不足した。

ビタミンC：その基準量は75mgであるが、摂取量の平均は126%で、75世帯が不足であった。

さらに、年齢とカロリー量、労作代謝との関係を調査した結果、(表8、5)、男女ともに75才以上でもなお重労働に従事しなければならないものがあることは大きな問題であった。

以上の調査を通じて、もっとも著明な特色は、食品消費の単調さにあり、この点は、摂取量が基準量に達しないことよりも重要な問題であると考えられた。以上の資料が、西独小農の経済的および社会的地位についての理解を深める一助となれば幸である。(野田)