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# Effect of Protecting Proteins from Degradation in the Rumen on Single Volatile Fatty Acid of Al Awassi Lambs

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## ABSTRACT

The present experiment was carried out to investigate the effect of different percentages (50 and 100%) of dried whey powder and sun flower meal treated with blood or formaldehyde on Single Volatile Fatty Acids (Acetate = C2), (Propionate = C3), (Butyrate = C4) and (C2 : C3) in lambs fattening diets. The results showed significant increase ($P < 0.05$) in (Butyrate) and insignificant effect in (Acetate), (Propionate) and (C2 : C3) for dried whey powder treated with blood or formaldehyde compared sun flower meal treated with blood or formaldehyde, While There was insignificant effect in (Acetate), (Propionate), (Butyrate) and (C2 : C3) for dried whey powder treated with blood in percentages 100% compared sun flower meal treated with blood in percentages 100%, and there was significant increase ($P < 0.05$) in (Butyrate) and insignificant effect in (Acetate), (Propionate) and (C2 : C3) for dried whey powder treated with blood in percentages 50% compared sun flower meal treated with blood in percentages 50%, and significant increase ($P < 0.05$) in (Butyrate) and insignificant effect in (Acetate), (Propionate) and (C2 : C3) for dried whey powder treated with formaldehyde in percentages 100% compared sun flower meal treated with formaldehyde in percentages 100%, and significant increase ($P < 0.05$) in (Butyrate) and insignificant effect in (Acetate), (Propionate) and (C2 : C3) for dried whey powder treated with formaldehyde in percentages 50% compared sun flower meal treated with formaldehyde in percentages 50%.

**Keywords:** Dried whey powder, sunflower meal, blood, formaldehyde, Acetate, Propionate, Butyrate.

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## INTRODUCTION

Ruminants have a unique ability to ferment fodder in the rumen before moving to the rest of the gut. The final products of fermentation include Volatile Fatty Acids VFA, Microbial Protein MP, and Ammonia Nitrogen $NH_3$ (Gleghorn, ؛ 2003 Diego *et al.,* 2018). The level of protein degradation affects the volatile fatty acid and the pH (Jasim , 2019), While other studies reported that there was no significant effect of the protein source on volatile fatty acids and the pH (Shain *et al.,* 1998). Peptides and amino acids produced from protein forage sources are converted to the inner part of microbial cells, peptides may still degrade into amino acids by enzyme action of peptidases and the amino acids are released from their composition, and finally, the amine group may be removed from the amino acids and the production of volatile fatty acids. , CO2 and ammonia, also, can be used again during microbial protein synthesis (Nolan & Dobos, 2005), The amino acid and peptide uptake pathways depend on the energy availability in the rumen, if there is enough energy available, the microbes will use it to manufacture the microbial protein, on the contrary, the priority will be in the ATP-producing catabolic pathways to meet the energy requirements of the rest of the metabolic functions of the microbes (Ørskov, 1992). The increased need for animal production prompted researchers to use oilseed grains to feed ruminants as protein sources such as Helianthus annuus, an important oil crop characterized by high protein content with high sulfuric acid content (Daghir *et al*, 1980). The third largest source of protein used for ruminants feed after soybean and canola seedling (USDA-FAS, 2017). The protein of the sunflower is characterized by its solubility and high decomposition compared to the other protein sources. Therefore, there are obstacles to meet the needs of highyielding dairy cows, calves and fast-growing sheep because the protein is rapid decomposition in the rumen, producing peptides, amino acids and ammonia, which reduces the degree of utilization and loss of amino acidsand low digestibility (Lusus, 1982).

Whey was considered a non-conventional, fastdegradable protein source, it is a byproduct of cheese making process of milk, containing 7% solid materials consisting of 4.9% lactose, 0.6% ash, low amounts of fat acid and protein (15-20%) and most whey is eliminated as a neglected product, so the challenge for nutritionists is to find the best way to benefit from it (El-shewy, 2016). In the low-protein feed, substituting the urea substitutes for improved urea performance compared with the soybean meal with urea, which resulted in less improvement in animal performance. The addition of shark also increased the production of microbial protein and improved feed utilization (Stock *et al*, 1986). Research in livestock feed in many countries has shown that straw as a byproduct of cheese production can be used to feed large ruminants without any negative effects. There are also studies on determining optimal levels of addition, taking into account the benefits that will be achieved by limiting use of concentrates and disposal as an accidental product for dairy manufacturers and environmental pollution prevention (Salem *et al*, 2007).

## OBJECTIVE OF THE STUDY

Study of the effect of replacing the dried whey powder treated with blood or formaldehyde, sun flower meal treated with blood or formaldehyde and effect of replacing different percentages (50 and 100%) of dried whey powder and sun flower meal treated with blood or formaldehyde in the fattening diets on Single Volatile Fatty Acids (Acetate = C2), (Propionate = C3), (Butyrate = C4) and (C2 : C3) , of Al Awassi Lambs.

## MATERIALS AND METHODS

This study was conducted in the animal field of the Animal Production Department, Faculty of Agricultural

Engineering Sciences, University of Baghdad. The experiment lasted for 60 days preceded by a preliminary period of 14 days for the period from 2 of December 2017 to 13 of February 2018.

**Preparation of feed materials**

All raw materials, such as barley, wheat bran, dried whey powder, sunflower and dried whey powder, were purchased from the local markets. Random samples were taken for the purpose of conducting chemical analyzes and using the green alfalfa from the fields of the Faculty of Agricultural Engineering Sciences, University of Baghdad and conducting chemical analyzes (Table 1).

**Treatment of the sunflower meal with fresh blood**

Blood was collected from ruminants that were slaughtered in the Karkh massacre in containers containing citrate of sodium (6.8 g/L blood). The blood was then added to the sun flower by using an equal weight of blood and weight (1: 1) and then mixed by hand and dried in a fan oven at 60°C for 24 hours, after that, the sun flower was manually broken and packed in bags until it was used (Matsumoto *et al*, 1995).

**Treatment of sunflower meal with formaldehyde**

The sun flower was treated with 5% formaldehyde solution and 1 liter solution/10 kg dry matter from the sun flower by sprinkler after brushing the sun flower over a piece of nylon on the ground in a closed chamber with constant flipping to ensure that the solution reaches all parts of the sunflower to obtain a homogeneous level of treatment. The formaldehyde sunflower was kept in tightly sealed nylon bags and left for 72 hours for interaction between formaldehyde and sunflower meal. The bags and their contents were then emptied onto a nylon piece inside a well-ventilated hall for 48 hours to allow for the volatilization of the unformed formaldehyde solution, then the sunflower was put in bags until it was used (Hassan *et al*, 1990).

**Treatment of dried whey powder with fresh blood**

Blood was collected from the ruminants that were slaughtered in the Karkh massacre in containers containing citrate of sodium (6.8 g/L blood). The blood was then added to the dried whey powder using an equal weight of blood and dried whey powder by 1: 1 and then mix it byhand and dry it in a fan oven at 60°C for 24 hours. Then it was manually broken and packed in bags for use. (Matsumoto *et al*, 1995).

**Treatment of dried whey powder with formaldehyde**

Dried whey powder was treated with 5% formaldehyde solution and 1 liter solution/10 kg dry matter of dried whey powder by sprinkler after brushing the whey powder over a piece of nylon on the ground in a closed chamber with continuous stirring to ensure that the solution reached all parts of the whey powder to obtain a homogeneous level of treatment. The dried whey powder was stored in sealed nylon bags were left for 72 hours for interaction between formaldehyde and whey powder. The bags and their contents were then emptied onto a nylon piece inside a well-ventilated hall for 48 hours to allow the volatilization of the Non-reacting formaldehyde and then dried whey powder was packed in bags until it was used (Hassan *et al*, 1990).

**Table 1:** Chemical composition of raw materials in the installation of concentrates and fresh grit based on dry matter (%).

| Feeding materials / Chemical composition % | Barley | Wheat barn | Sunflower treated with blood | Sunflower treated with formaldehyde | Whey treated with blood | Whey treated with formaldehyde | Fresh alfalfa |
|---|---|---|---|---|---|---|---|
| Dry matter | 90.12 | 89.87 | 94.77 | 93.30 | 97.59 | 95.86 | 27.22 |
| Organic matter | 93.58 | 91.59 | 89.31 | 85.78 | 96.13 | 94.68 | 91.13 |
| Crude protein | 12.22 | 14.72 | 21.37 | 21.67 | 21.08 | 19.11 | 18.21 |
| Crude fiber | 5.72 | 10.11 | 15.35 | 15.55 | ---- | ---- | 27.15 |
| Ether Extract | 3.15 | 4.63 | 9.79 | 10.05 | 7.39 | 8.17 | 3.03 |
| Ash | 6.42 | 8.41 | 8.00 | 8.04 | 6.39 | 6.02 | 8.87 |
| Nitrogen free extract | 72.49 | 62.13 | 42.42 | 42.44 | 64.32 | 65.82 | 42.74 |
| Acid detergent fiber | 27.13 | 48.45 | 38.44 | 37.88 | ---- | ---- | 45.75 |
| Neutral detergent fiber | 6.27 | 14.24 | 26.92 | 27.50 | ---- | ---- | 33.91 |
| Lignin | 1.35 | 2.88 | 9.88 | 10.50 | ---- | ---- | 8.77 |
| Cellulose | 4.92 | 11.36 | 17.04 | 17.00 | ---- | ---- | 25.14 |
| Hemicellulose | 20.86 | 34.21 | 11.52 | 10.38 | ---- | ---- | 11.84 |
| Metabolic energy (Mica Gul/kg) | 12.7 | 12.3 | 12.7 | 12.7 | 14.1 | 14.2 | 10.2 |

**Metabolic energy (Mg / kg of material as is) = 0.012 × crude protein + 0.031 x ether extract + 0.005 × raw fiber + 0.014 × nitrogen-free extract (Maff, 1975).**

## GROWTH EXPRIMENT

**Animals and experiment design**

Two experiments were done use 16 lambs (Al Awassi strain) were purchased from the local markets. The average age of the lambs was 5-6 months and the average weight was 23.87± 0.56 kg. The lambs were randomly divided into 4 treatments and 4 lambs per treatment. The experimental treatments involved treatment T1 and T2 treated with blood (dried whey powder , sun flower meal) with substitution ratios 50 and 100% while T3 and T4 treated with formaldehyde blood (dried whey powder , sun flower meal) with substitution ratios 50 and 100% To compare the significant differences between the averages with a test (T). The lambs were distributed in single pens with an area of 2 × 2m$^2$ for each treatment and numbered according to their own treatment.

**Experimental diets**

The animals were fed on the experimental diets and according to the treatments shown in Table (2,3). The dried whey powder treated with Whole blood 50% instead of the untreated sunflower in diet of (T1) and all the other components of the diet remain constant, The dried whey powder treated with Whole blood 100% instead of the untreated sunflower in diet of (T2) and all the other components of the diet remain constant, in diet of (T3) the dried whey powder treated with formaldehyde 50% instead of the untreated sunflower and all the other components of the diet remain constant, in diet of (T4) the dried whey powder treated with formaldehyde 100% instead of the untreated sunflower and all the other components of the diet remain constant, In the first experiment. In the second experiment The sunflower treated with Whole blood 50% instead of the untreated sunflower in diet of (T1) and all the other components of the diet remain constant, The sunflower treated with Whole blood 100% instead of the untreated sunflower in diet of (T2) and all the other components of the diet remain constant, in diet of (T3) the sunflower treated with formaldehyde 50% instead of the untreated sunflower and all the other components of the diet remain constant, in diet of (T4) the sunflower treated with formaldehyde 100% instead of the untreated sunflower and all the other components of the diet remain constant. The lambs were fed gradually for 14 days before the start of the experiment, the concentrated diet was served once daily at 8:00 am and by 3% of the body weight in addition the alfalfa was provided freely and separated from the concentrated feed while the amounts of concentrated feed based on the new body weight for each lamb were adjusted weekly. The lambs were weighed at the beginning of the experiment in a In a special scale to determine the primary weight and then the process of weighing on a weekly basis and before the morning ration to calculate the rate of daily weight increase and then the weight of lambs at the end of the experiment to determine the final weight, the remaining feed was collected from concentrated diet and alfalfa every morning and before morning ration to calculate the daily feed intake as well, clean water was provided continuously in special metal containers that are cleaned daily, the lambs were vaccinated against the internal and external parasites as the animals were vaccinated against hepatic worms and bariatric with the continued control of the confidentiality throughout the duration of the experiment

**Table 2:** Percentage of the primary components involved in the composition of concentrates of first experiment (%).

| **Type of treatment** | **Treatment with blood** | | **Treatment with formaldehyde** | |
|---|---|---|---|---|
| Replacement ratio % | 50 | 100 | 50 | 100 |
| Treatments | T1 | T2 | T3 | T4 |
| **Feeding materials** | | | | |
| Barley | 45 | 45 | 45 | 45 |
| Wheat bran | 40 | 40 | 40 | 40 |
| Sunflower meal | 6.5 | 0 | 6.5 | 0 |
| dried whey powder treated with blood | 6.5 | 13 | 0 | 0 |
| **dried whey powder treated with formaldehyde** | 0 | 0 | 6.5 | 13 |
| ***Mix minerals and vitamins** | 2 | 2 | 2 | 2 |

***Mix minerals and vitamins table 6**

**Table 3:** Percentage of the primary components involved in the composition of concentrates of second experiment (%).

| **Type of treatment** | **Treatment with blood** | | **Treatment with formaldehyde** | |
|---|---|---|---|---|
| Replacement ratio % | 50 | 100 | 50 | 100 |
| Treatments | T1 | T2 | T3 | T4 |
| **Feeding materials** | | | | |
| Barley | 45 | 45 | 45 | 45 |
| Wheat bran | 40 | 40 | 40 | 40 |
| Sunflower meal | 6.5 | 0 | 6.5 | 0 |
| Sunflower treated with blood | 6.5 | 13 | 0 | 0 |

| | | | | |
|---|---|---|---|---|
| **Sunflower treated with formaldehyde** | 0 | 0 | 6.5 | 13 |
| ***Mix minerals and vitamins** | 2 | 2 | 2 | 2 |

***Mix minerals and vitamins table 6**

**Table 4:** Chemical analysis of experimental treatments for first experiment based on dry matter.

| **Type of treatment** | **Treatment with blood** | | **Treatment with formaldehyde** | |
|---|---|---|---|---|
| **Replacement ratio %** | **50** | **100** | **50** | **100** |
| **Treatments** | T1 | T2 | T3 | T4 |
| **Chemical composition** | | | | |
| **Dry matter** | 98.41 | 98.45 | 98.14 | 97.03 |
| **Organic matter** | 92.74 | 93.52 | 93.85 | 93.66 |
| **Crude protein** | 14.53 | 15.04 | 15.28 | 15.44 |
| **Crude fiber** | 8.53 | 7.44 | 8.29 | 8.81 |
| **Ether Extract** | 5.09 | 4.52 | 5.10 | 5.56 |
| **Ash** | 7.26 | 6.48 | 6.14 | 6.34 |
| **Nitrogen free extract** | 64.69 | 66.52 | 65.18 | 63.85 |
| **Acid detergent fiber** | 36.01 | 35.25 | 35.20 | 35.61 |
| **Neutral detergent fiber** | 13.50 | 12.66 | 13.29 | 12.81 |
| **Lignin** | 2.41 | 2.12 | 2.50 | 2.18 |
| **Cellulose** | 11.09 | 10.54 | 10.79 | 10.63 |
| **Hemicellulose** | 22.51 | 22.59 | 21.91 | 22.80 |
| **Metabolic energy (Mica Gul/kg)** | 12.7 | 12.9 | 12.9 | 12.8 |

**Metabolic energy (Mg / kg of material as is) = 0.012 × crude protein + 0.031 x ether extract + 0.005 × raw fiber + 0.014 × nitrogen-free extract (Maff, 1975).**

**Table 5:** Chemical analysis of experimental treatments for Second experiment based on dry matter.

| **Type of treatment** | **Treatment with blood** | | **Treatment with formaldehyde** | |
|---|---|---|---|---|
| **Replacement ratio %** | **50** | **100** | **50** | **100** |
| **Treatments** | T1 | T2 | T3 | T4 |
| **Chemical composition** | | | | |
| **Dry matter** | 97.33 | 98.18 | 96.30 | 95.21 |
| **Organic matter** | 91.58 | 92.88 | 92.09 | 93.58 |
| **Crude protein** | 15.36 | 15.18 | 15.50 | 15.63 |
| **Crude fiber** | 9.55 | 10.04 | 8.87 | 8.32 |
| **Ether Extract** | 4.28 | 4.52 | 5.28 | 5.45 |
| **Ash** | 8.42 | 7.12 | 7.90 | 6.42 |
| **Nitrogen free extract** | 62.38 | 63.14 | 62.44 | 64.18 |
| **Acid detergent fiber** | 35.80 | 36.03 | 35.14 | 36.05 |
| **Neutral detergent fiber** | 12.94 | 13.02 | 13.22 | 12.65 |
| **Lignin** | 2.82 | 2.77 | 2.73 | 2.75 |
| **Cellulose** | 10.12 | 10.25 | 10.49 | 9.90 |
| **Hemicellulose** | 22.86 | 23.01 | 21.92 | 23.40 |
| **Metabolic energy (Mica Gul/kg)** | 12.3 | 12.5 | 12.6 | 12.8 |

**Metabolic energy (Mg / kg of material as is) = 0.012 × crude protein + 0.031 x ether extract + 0.005 × raw fiber + 0.014 × nitrogen-free extract (Maff, 1975).**

**Table 6:** Components of vitamins and minerals mix.

| **Vitamins** | **Concentration** | **Minerals** | **Concentration** |
|---|---|---|---|
| Vitamin A | 200 000 IU/kg | 200 000 IU/kg | 2000 mg/kg |
| Vitamin D3 | 100 000 IU/kg | 100 000 IU/kg | 2500 mg/kg |
| Vitamin E | 515 mg/kg | 515 mg/kg | 1000 mg/kg |
| Vitamin B1 | 125 mg/kg | 125 mg/kg | 25 mg/kg |
| Vitamin B2 | 500 mg/kg | 500 mg/kg | 30 mg/kg |
| Vitamin B3 | 1000 mg/kg | 1000 mg/kg | 1200 mg/kg |
| Vitamin B6 | 35 mg/kg | 35 mg/kg | 1000 mg/kg |
| Vitamin B12 | 10 mg/kg | 10 mg/kg | qsp mg/kg |
| | | 200 000 IU/kg | 1500 mg/kg |
| | | 100 000 IU/kg | 2000 mg/kg |

**Chemical analysis**

The chemical analyzes of the feed samples were carried out, such as the untreated sunflower, the sunflower treated with blood, the sunflower treated with formaldehyde, dried whey powder treated with blood, the dried whey powder treated with formaldehyde, and the chemical analysis of the primary components of the experimental animals Table (1,4 &5) . These analyzes were carried out at the Central Laboratory of Graduate Studies, Nutrition Laboratory, Animal Production Department at the Faculty of Agricultural Engineering Sciences, University of Baghdad.

**Study of some characteristics of the rumen**

Samples of rumen fluid were extracted from 15 animals and 3 animals from each treatment during the eighth week of the experiment. The same animals were used in the digestion experiment where the rumen fluid was collected by a rubber tube inserted through the animal's mouth, reach the most appropriate point inside the animal's rumen to extract the rumen liquid through a500 ml plastic syringe. The rumen liquid was withdrawn during three different times: the first time (zero), before the morning feeding. After this drawing, the concentrated feed was provided. The second and third withdrawn were taken after 3, 6 hours of morning feeding, respectively, and the rumen liquid was filtered was with a piece of malmal to get rid of the solid particles immediately after the extraction of rumen fluid from the animal and converted to plastic bags to be saved, where 10 ml of rumen liquid was taken from each animal in each time of the three times (0, 3 and 6) hours of morning feeding. The pH of the rumen samples was measured and the bags containing the rumen liquid were divided into two parts. The first section was added 200 microliters (HCL) with the aim of stopping the microbial activity affecting the levels of both ammonia nitrogen and volatile fatty acids and then keeping these samples frozen until the analysis, while the samples of the other part of the folders containing the liquid rumen with a cooling temperature of 40C to study the total number of anaerobic bacteria also for the times when the rumen liquid was withdrawn (zero 3 and 6) hours of morning nutrition. Where the following measurements were made:

**Molecular ratios of single volatile fatty acids (VFA) :** The examination was carried out in the laboratories of the Ministry of Science and Technology, Department of Environment and Water using the Japanese Shimadzawa 2010 gas chromatography device using the FID and using a SE-30 column with lengths of 0.25 um (30 m). The temperature of the injection area and the detector (280 and 3100C) respectively and the column temperature was gradual (40-800C).

**Dry matter DM:** The dry matter of feed samples was estimated according to A.O.A.C. (2005).

**Organic material (OM):** Organic matter was calculated by subtracting the amount of ash from dry matter.

**Crude protein CP:** Crude protein was estimated using the Kjeldahl for fodder forms and according to A.O.A.C. (2005).

**Crude fiber CF:** Raw fiber was estimated for fodder models as indicated in A.O.A.C. (2005).

**Ether Extract:** The Ether extract for fodder samples was estimated according to A.O.A.C. (2005).

**Carbohydrates dissolved in NFE:** The dissolved carbohydrates were calculated according to the following equation: NFE = OM – (CP + CF + EE).

**Neutral fiber extract:** The NDF fiber extract was estimated according to Goering and Van Soest (1970).

**Acid Fiber Extract:** The acid fiber extract was estimated according to Goering and Van Soest (1970).

**Acid fiber extract:** The ADL extract was estimated according to Goering and Van Soest (1970).

**Cellulose:** Cellulose was calculated according to the following equation: Cellulose = ADF – ADL.

**Hemicellulose:** Hemicellulose was calculated according to the following equation: Hemicellulose = NDF– ADF.

**Statistical analysis**

The Statistical Analysis System (SAS) (2012) was used in data analysis to study Comparing the two experiences in the studied traits according to (Completely Randomized Design-CRD), The differences between the averages were compared with Test (T).

**The mathematical model**

$Yij = \mu + Ei + eij$

Yij= the value of the transaction j return to the transaction i.

μ = The general mean of the studied character.

Ei= It represents two experiences i.

eij= Random error distributed by a normal distribution with an average of 0 and a variance of $\sigma^2 e$.

## RESULTS AND DISCUSSION

There were no digestive disorders in the animals during and after the experiment period. All the animals were in a good health. The objective of the experiment was achieved by providing concentrated diets containing the ratio of sunflower treated with blood or formaldehyde, dried whey powder treated with blood or formaldehyde instead untreated sunflower with levels of (50 , 100%), while the green alfalfa was provided freely and the intake of concentrated feed, green alfalfa and total feed intake were calculated during the experiment period.

The rumen is an unstable fermentation vessel and according to the type of fermentation, so there are daily fluctuations in the Rumen pH (pH), Total volatile fatty acids (TVFA), Single Volatile Fatty Acids (Acetate = C2), (Propionate = C3), (Butyrate = C4) and (C2 : C3) , Ammonia nitrogen in the rumen ($NH_3$-N) and The total count of bacteria (BC), of the rumen (Emanuele & Putnam, 2006), while the level of protein degradation in the rumen is considered An important factor in influencing rumen variables that in turn affect the nature of digestion and microbial protein synthesis in ruminants, which are basic factors in animal need.

**Effect type of protein (sunflower meal, dried whey powder) treatment with blood or formaldehyde on Single Volatile Fatty Acids.**

Table 7 showed that there were significant increase ($P < 0.05$) in (Butyrate = C4) and insignificant effect in (Acetate = C2), (Propionate = C3) and (C2 : C3) , for diets dried whey powder treated with blood or formaldehyde compared diets sun flower meal treated with blood or formaldehyde. This may be due to the effect of the protein source (dried whey powder, sunflower meal) on the level of single volatile fatty acids, as studies have confirmed the effect of replacing 6% of food starch with lactose in dried whey powder on the basis of dry matter on rumen functions, as well as on volatile fatty acid absorption and the extent of nitrogen utilization in Ruminants. The results were as follows: There was an effect found on the production rates of volatile fatty acids, as the percentage of butyrate increased while the absorption rates of both acetate and propionate increased. For Ruminants fed on dried whey powder, the level of $NH_3$-N in the rumen decreased, there was an effect of increasing the apparent digestibility factor of dry matter. And organic matter, the study concluded that replacing starch with lactose in dried whey powder led to the regulation of acetate and propionate absorption (Chibisa *et al.* 2015) these results

are in agreement with (Pinchasov *et al.* 1982 ؛ Susmel ، *et al.* 1995).

Fig. 1 shows the effect of the type of protein treatment with (blood or formaldehyde) on Single Volatile Fatty Acids (Acetate = C2), (Propionate = C3), (Butyrate = C4) and (C2: C3).

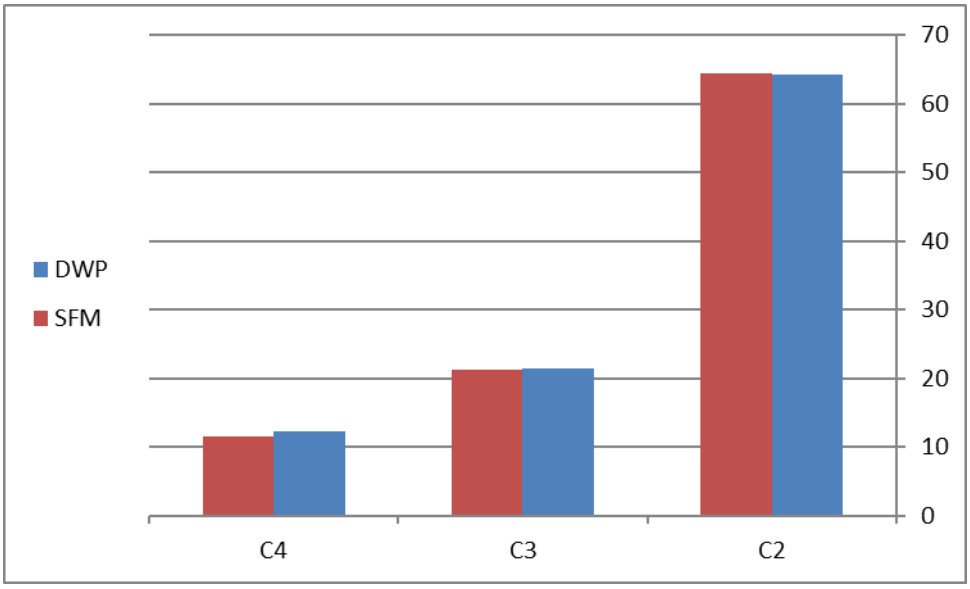


**Fig. 1:** effect of the type of protein treatment with (blood or formaldehyde) on Single Volatile Fatty Acids.

**Table 7:** Effect type of protein (sunflower meal, dried whey powder) treatment with blood or formaldehyde on Single Volatile Fatty Acids

| Studied traits | dried whey powder | standard error | sunflower meal | standard error | Effect significance |
|---|---|---|---|---|---|
| Acetate | 64.286 | 0.280± | 64.372 | 0.271± | N. S |
| Propionate | 21.378 | 0.122± | 21.316 | 0.162± | N. S |
| Butyrate | 12.241[a] | 0.089± | 11.554[b] | 0.118± | * |
| C2:C3 | 3.011 | 0.026± | 3.028 | 0.033± | N. S |

**Different characters within the same column indicate significant differences (p <0.05); N.S Non-significant.**
**Effect type of protein (sunflower meal, dried whey powder) treatment with blood in 100 % on Single Volatile Fatty Acids.**

Table 8 showed that there were no significant effect on Single Volatile Fatty Acids (Acetate = C2), (Propionate = C3), (Butyrate = C4) and (C2 : C3), for diets dried whey powder treated with blood in 100 % compared diets sun flower meal treated with blood in 100 %, these results are in agreement with (Hadjipanayiotou & Photiou ،1995 ؛Costas *et al.* 1998).

Fig. 2 shows the effect of the type of protein treatment with blood in 100 % on Single Volatile Fatty Acids (Acetate = C2), (Propionate = C3), (Butyrate = C4) and (C2: C3).

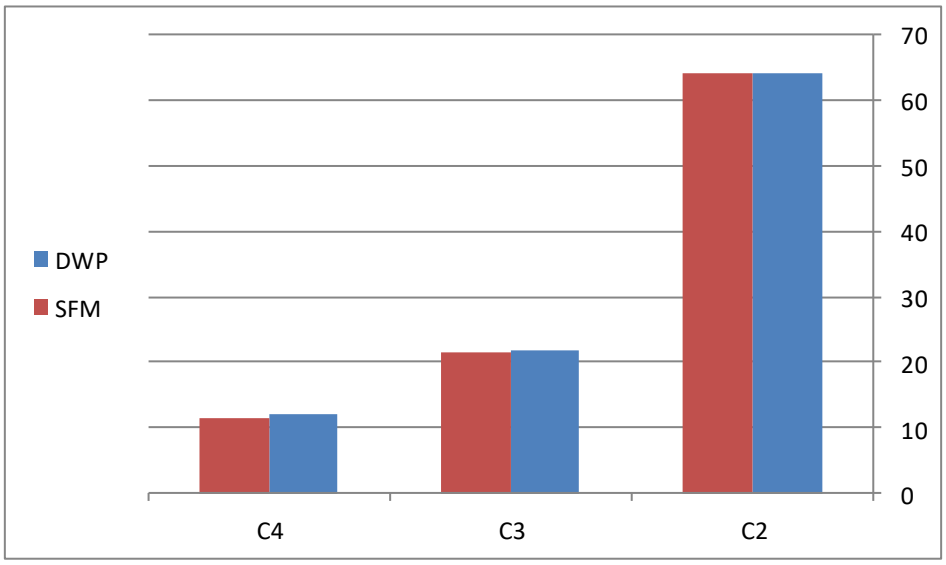


**Fig. 2:** effect of the type of protein treatment with blood in 100 % on Single Volatile Fatty Acids.

**Table 8:** Effect type of protein (sunflower meal, dried whey powder) treatment with blood in 100 % on Single Volatile Fatty Acids.

| Studied traits | dried whey powder | standard error | sunflower meal | standard error | Effect significance |
|---|---|---|---|---|---|
| Acetate | 64.019 | 0.767 ± | 64.230 | 0.669 ± | N. S |
| Propionate | 21.795 | 0.208 ± | 21.596 | 0.394 ± | N. S |
| Butyrate | 12.168 | 0.200 ± | 11.593 | 0.317 ± | N. S |
| C2:C3 | 2.940 | 0.053 ± | 2.985 | 0.082 ± | N. S |

**N.S Non-significant.**

**Effect type of protein (sunflower meal, dried whey powder) treatment with blood in 50 % on Single Volatile Fatty Acids.**

Table 9 showed that there were significant increase (P < 0.05) in (Butyrate = C4) and insignificant effect in (Acetate = C2), (Propionate = C3) and (C2 : C3) , for diets dried whey powder treated with blood in 50 % compared diets sun flower meal treated with blood in 50 % . This may be due to the effect of the protein source (dried whey powder, sunflower meal) on the level of single volatile fatty acids, Several studies confirmed the effect of whey on the level of single and total volatile fatty acids and the fermentation properties of the rumen (Pinchasov *et al.* 1982 ؛ Susmel *et al.* 1995 ؛ Chibisa *et al.* 2015 ).

Fig. 3 shows the effect of the type of protein treatment with blood in 50 % on Single Volatile Fatty Acids (Acetate = C2), (Propionate = C3), (Butyrate = C4) and (C2: C3).

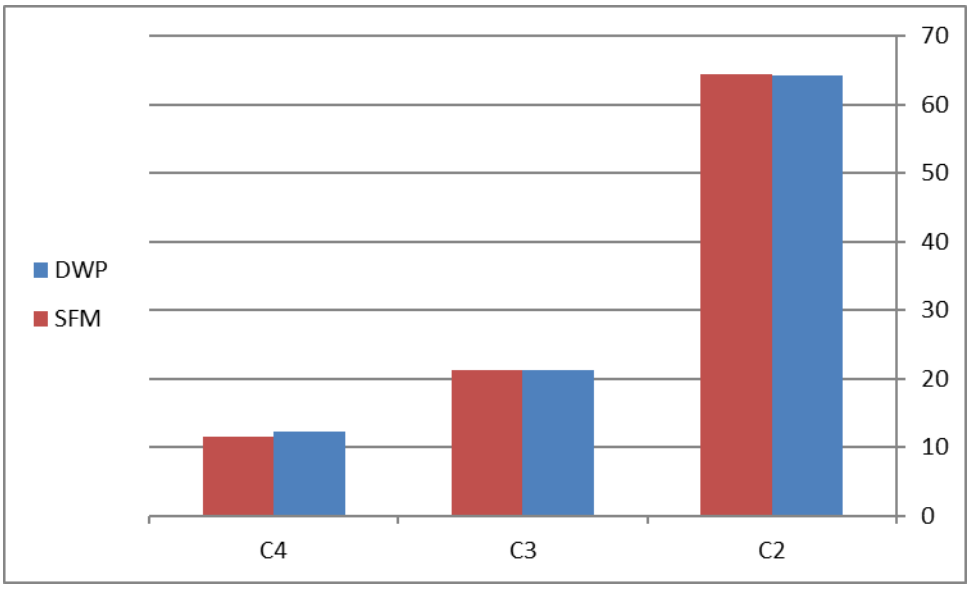

**Fig. 3:** effect of the type of protein treatment with blood in 50 % on Single Volatile Fatty Acids.

**Table 9:** Effect type of protein (sunflower meal, dried whey powder) treatment with blood in 50 % on Single Volatile Fatty Acids.

| Studied traits | dried whey powder | standard error | sunflower meal | standard error | Effect significance |
|---|---|---|---|---|---|
| Acetate | 64.282 | 0.495 ± | 64.385 | 0.502 ± | N. S |
| Propionate | 21.203 | 0.223 ± | 21.198 | 0.248 ± | N. S |
| Butyrate | 12.306[a] | 0.161 ± | 11.587[b] | 0.243 ± | * |
| C2:C3 | 3.035 | 0.047 ± | 3.0422 | 0.056 ± | N. S |

**Different characters within the same column indicate significant differences (p <0.05); N.S Non-significant.**

**Effect type of protein (sunflower meal, dried whey powder) treatment with formaldehyde in 100 % on Single Volatile Fatty Acids.**

Table 10 showed that there were significant increase (P < 0.05) in (Butyrate = C4) and insignificant effect in (Acetate = C2), (Propionate = C3) and (C2 : C3) , for diets dried whey powder treated with formaldehyde in 100 % compared diets sun flower meal treated with formaldehyde in 100 % ,also This may be due to the effect of the protein source (dried whey powder, sunflower meal) on the level of single volatile fatty acids (Pinchasov *et al.* 1982 ؛ Susmel *et al.* 1995 ؛ Chibisa *et al.* 2015 ).

Fig. 4 shows the effect of the type of protein treatment with formaldehyde in 100 % on Single Volatile Fatty Acids (Acetate = C2), (Propionate = C3), (Butyrate = C4) and (C2: C3).

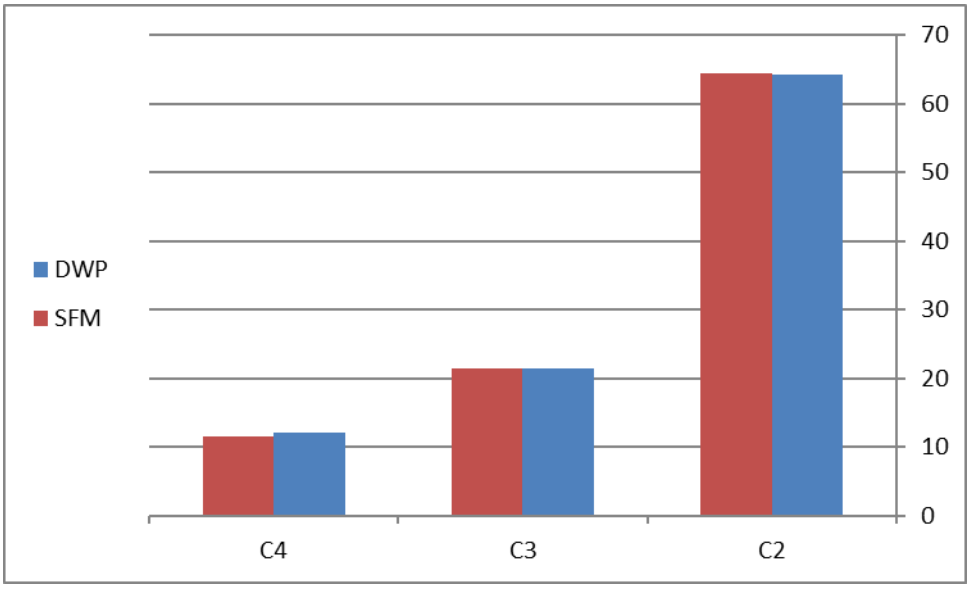


**Fig. 4:** effect of the type of protein treatment with formaldehyde in 100 % on Single Volatile Fatty Acids.

**Table 10:** Effect type of protein (sunflower meal, dried whey powder) treatment with formaldehyde in 100 % on Single Volatile Fatty Acids.

| Studied traits | dried whey powder | standard error | sunflower meal | standard error | Effect significance |
|---|---|---|---|---|---|
| Acetate | 64.300 | 0.535 ± | 64.374 | 0.425 ± | N. S |
| Propionate | 21.358 | 0.238 ± | 21.408 | 0.289 ± | N. S |
| Butyrate | 12.196[a] | 0.166 ± | 11.462[b] | 0.209 ± | * |
| C2:C3 | 3.014 | 0.052 ± | 3.012 | 0.054 ± | N. S |

**Different characters within the same column indicate significant differences (p <0.05); N.S Non-significant.**

**Effect type of protein (sunflower meal, dried whey powder) treatment with formaldehyde in 50 % on Single Volatile Fatty Acids.**

Table 11 showed that there were significant increase (P < 0.05) in (Butyrate = C4) and insignificant effect in (Acetate = C2), (Propionate = C3) and (C2 : C3) , for diets dried whey powder treated with formaldehyde in 50 % compared diets sun flower meal treated with formaldehyde in 50 %, These results are in agreement with ( Pinchasov *et al.* 1982 ؛ Susmel *et al.* 1995 ؛ Chibisa *et al.* 2015 ), While these results were not consistent (Hadjipanayiotou & Photiou ،1995 ؛ Costas *et al.*،1998 Devant *et al.*2000 ).The results of protecting protein from degradation in ruminant rumen may be conflicting due to the low level of protection in some cases and in other cases due to excessive protection as the protein becomes indigestible (Mir *et al,*1984). Many studies have shown that a diet containing higher amounts of The non-dissolving proteins in the rumen or the amino

acids protected from degradation in the rumen led to significant effects, while other studies showed little or no response, and the lack of response to the undegradable protein in the rumen is often due to one of the following reasons: 1- The undegradable proteins may be The rumen is bypassed the rumen at the expense of the rumen microbial protein synthesis. 2- The proteins that are undegradable in the rumen may be poorly digested after the rumen. 3- undegradable proteins in the rumen may be deficient in the amino acid content that limits production (Schingoethe, 1996).

Fig. 5 shows the effect of the type of protein treatment with formaldehyde in 50 % on Single Volatile Fatty Acids (Acetate = C2), (Propionate = C3), (Butyrate = C4) and (C2: C3).

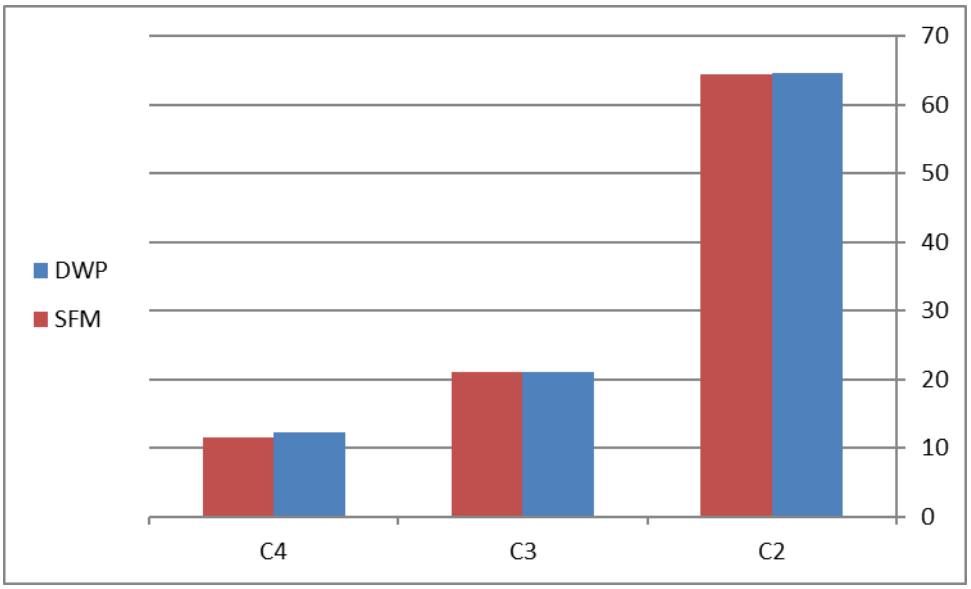


**Fig. 5:** effect of the type of protein treatment with formaldehyde in 50 % on Single Volatile Fatty Acids.

**Table 11:** Effect type of protein (sunflower meal, dried whey powder) treatment with formaldehyde in 50 % on Single Volatile Fatty Acids.

| Studied traits | dried whey powder | standard error | sunflower meal | standard error | Effect significance |
|---|---|---|---|---|---|
| Acetate | 64.545 | 0.486 ± | 64.501 | 0.637 ± | N. S |
| Propionate | 21.156 | 0.285 ± | 21.061 | 0.377 ± | N. S |
| Butyrate | 12.294[a] | 0.210 ± | 11.574[b] | 0.204 ± | * |
| C2:C3 | 3.056 | 0.056 ± | 3.074 | 0.082 ± | N. S |

**Different characters within the same column indicate significant differences (p <0.05); N.S Non-significant.**

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