


**Hulless oats in organic layer diets:  
What will they cost and how will they taste?**

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1. Background and objectives
2. Trial design
3. Productivity and economics
4. Sensory and nutritional value
5. Conclusions




**Background**

- Consumer interest in organic, GM-free, local
- Problem: corn!
  - 90% US corn is GM (Fernandez-Cornejo et al., 2014).
  - Contamination of organic crops.
  - Reliance on international imports.
  - Can't be grown in WA.
- Wheat is an alternative, but supplies can be tight.

Photos: Above, Well-Fed Farms, Skagit, WA; Top, Wilcox Family Farm eggs.

**A potential solution: hulless oats**  
*Avena sativa* L. subsp. *nudisativa* (Husnot) Rod et Sold



- Western Washington's climate is well suited to oat production.
- Hulless oats lack lignified hull.
- High oil, high protein, high antioxidants (Webster, 2011).
- Previous studies showed good feed value for poultry.

**Feed value of hulless oats demonstrated in previous work**

- Hulless oats caused no adverse effects on egg yields and feed utilization when they were substituted for corn and wheat at  $\leq 40\%$  dietary intake (Maurice et al. 1985).
- Broilers performed as well or better on a hulless oat diet than on a wheat diet when hulless oats represented  $\leq 50\%$  dietary intake (MacLeod et al. 2004).
- Problems sometimes arise from beta glucan.

**Objectives**

Determine whether hulless oats grown in western Washington may be used to substitute wheat and corn in the diets of high-performance organic commercial layers.

- Effect on **layer productivity and system economics**.
- Influence of **oat variety**.
- Effect on **sensory properties of eggs**.

### Feeding Trial

April – June 2016  
Oregon State University




### Ten experimental diets

	Ingredients, g kg <sup>-1</sup>			
	Control	Oats + corn	Oats + wheat	Oats + corn + wheat
<b>Soy</b>	193	200	133	173
<b>Oats</b>	0	200	200	200
<b>Corn</b>	450	482	0	302
<b>Wheat</b>	233	0	523	200

× three varieties of hullless oat: Streaker, Paul, AC Gwen


### Oat grain higher in protein, fat and fiber

	Oat variety			Corn grain, yellow	Wheat grain, soft
	Gwen	Paul	Streaker		
<b>Protein</b>	14.8	16.5	15.5	9.1	11.6
<b>Crude Fat</b>	5.9	8.2	6.3	3.5	2.1
<b>Crude Fiber</b>	4.7	3.2	4.7	1.6	2.9
<b>Ash</b>	2.9	2.3	2.7	1.2	1.8
<b>β-Glucan</b>	4.5	5.4	4.5	NA	NA




### Experimental design

- Split-plot RCBD with treatment as main plot, oat variety as subplot
- 10 birds per subplot per replicate




- 3 replicates
- Total of 30 subplots \* 10 birds = 300 birds



#### Measurements taken from 24–32 weeks of age

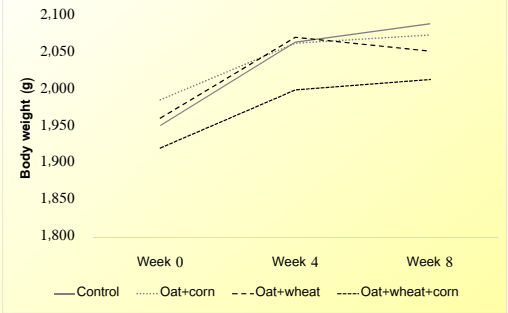
- Productivity (egg number per bird, grade and weight)
- Egg shell quality
- Yolk colour
- Albumen height
- Yolk fatty acid profile
- Egg flavor, fresh and after storage (taste panel)

### Productivity and Economics



Layer house at Oregon State University

### Decline in hen bodyweight on Oat+wheat diet



Week	Control (g)	Oat+corn (g)	Oat+wheat (g)	Oat+wheat+corn (g)
Week 0	1920	1920	1920	1920
Week 4	2060	2060	2000	2060
Week 8	2080	2080	2000	2060

- Oat+wheat diets were lower in protein
- FCE trended lower with Oat + wheat

**Generally similar performance in egg production and feed conversion across treatments**

- Egg production close to maximum for all diets.
- Egg weight:
  - Control eggs tended to be lighter
  - Oat+corn > Oat+corn+wheat > Oat+wheat

**Change in egg yolk color was caused by omission of corn**

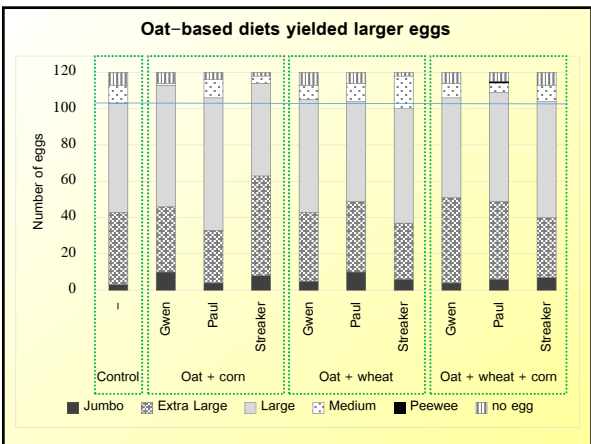
**Hulless oats more expensive than corn or wheat**

Ingredient	Price, USD/mt <sup>1</sup>
Feed corn, grain	396.39
Feed wheat, grain	437.80
Hulless oats	533.00
Soybean seed meal	1,165.49
Soybean Oil	781.00
Vitamin–mineral mix	3,014.00
Limestone	220.00

- Hulless oat grain cost estimate based on enterprise budget for spring wheat in the Willamette Valley by Eleveld et al., 2010.

**Higher earnings from oat–fed diets offset higher costs**


Diet	Oat variety	Feed cost, USD/100kg	Feed conversion efficiency, g per g egg	Gross revenue, ten hens/day, USD	Net revenue, ten hens/day, USD
Control	–	62.59	2.21	2.16	1.34
Oat+corn	Gwen	64.63	2.11	2.31	1.46
	Paul	63.09	2.21	2.20	1.38
	Streaker	63.46	2.19	2.37	1.51
Oat + wheat	Gwen	65.98	2.31	2.18	1.29
	Paul	63.79	2.23	2.17	1.32
	Streaker	64.14	2.30	2.18	1.31
Oat + wheat + corn	Gwen	66.18	2.14	2.21	1.38
	Paul	64.00	2.19	2.26	1.43
	Streaker	64.55	2.20	2.17	1.35



**Sensory Evaluations**

*Sensory lab at Oregon State University*

**Discrimination test: Triangle method**



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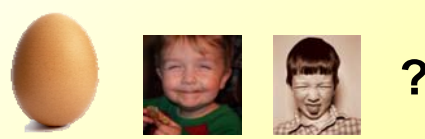
- Oat+corn vs Control
- Oat+wheat vs Control

Treatment group	n	Correct responses	% "sure", correct responses	% "sure", incorrect responses
Oat+corn	45	22*	55	43
Oat+wheat	45	23**	48	41

- Panelists sensed a difference oat-fed eggs and the control, but not with much certainty

**Acceptance Test**

‘Liking’ and ‘Just About Right’ scales




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Left photo: Lynzeangel on flickr; Right photo: country1067.com

Question	Response scale <sup>1</sup>	Diet			p
		Control	Oat+corn	Oat+wheat	
1. Overall, how much do you like or dislike this sample?	Liking	6.19	6.11	5.86	NS
2. How much do you like or dislike the overall flavor of this sample?	Liking	6.42	6.16	5.96	NS
3. Flavor strength	Just about right	2.43	2.55	2.39	NS
4. How much do you like or dislike the overall texture of this sample?	Liking	5.85 <sub>a</sub>	5.41 <sub>ab</sub>	5.16 <sub>b</sub>	**
5. Intensity of cooking	Just about right	3.42 <sub>a</sub>	3.57 <sub>ab</sub>	3.68 <sub>b</sub>	*
6. How much do you like or dislike the appearance of this sample?	Liking	5.01 <sub>a</sub>	4.51 <sub>a</sub>	3.30 <sub>b</sub>	***
7. Sample color	Just about right	3.04 <sub>a</sub>	3.18 <sub>a</sub>	1.92 <sub>b</sub>	***

**Egg samples as prepared for sensory tests**



**Yolk characteristics differed across treatments**

	Control	Oat+corn	Oat+wheat	SE <sup>2</sup>
Yolk weight (g)	34.1 <sub>a</sub>	31.6 <sub>b</sub>	31.2 <sub>b</sub>	0.5
<b>Fatty acids (% of total)</b>				
C18:2	15.26 <sub>b</sub>	16.21 <sub>ab</sub>	17.15 <sub>a</sub>	0.33
Total n-3	2.37	2.25	2.35	0.07
Total n-6	17.26 <sub>b</sub>	18.31 <sub>ab</sub>	19.19 <sub>a</sub>	0.34
Total PUFA	19.63	20.55	21.54	0.36

- This may explain smaller yolk proportion

## Conclusions

- Where sensory differences existed, they were small.
- Economically viable at 200g kg<sup>-1</sup> of the diet thanks to effect on egg size.
  - Cost of hullless oat grain will go down with improved efficiency of production.
- Hullless oats: a useful tool for organic poultry producers in the coastal Pacific Northwest.
- Future work on feeding oats with peas or rapeseed to redress yolk proportion?



## Next Steps

- Publications
- Cascadia Grains conference
- Focus group with farmers in Northwest Washington
- Working with feed companies e.g. Scratch'n'Peck
- Organic stock seed



## Thank You!

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All photographs by Louisa Winkler unless otherwise stated.